Directory of infectious diseases of grapevines and viroses and virus-like diseases of the grapevine: bibliographic report 1998-2004

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CIHEAM
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Editors:
G.P. Martelli, E. Boudon-Padieu

2006

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and

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PREFACE

Virus, virus-like and phytoplasma diseases of grapevines constitute a major limiting factor to the development and well-being of the world viticultural industry, and to the quality and quantity of the crop. As a whole, these diseases cause loss of vigour and often a decline of affected stocks, which reflect on the commercial value and productive life of the vineyards. Furthemore, they reduce graft compatibility of scions and rootstocks, or induce subtle debilitating effects which are difficult to percieve, except when virus-free vines are grown for comparison alongside with non-sanitized sister vines.

Improving the sanitary conditions of the industry, is therefore a goal of utmost importance to which the Mediterranean Agronomic Institute of Bari (IAM-B), taking also into account the future role of the Mediterranean as a free-trade area, is contributing with direct involvement in international research projects and through the activity the Mediterranean Network on Certification of Grapevines, that fosters coperative studies in grapevine virology.

Notwithstanding these efforts and the promoting activity of the International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG), it is most unfortunate that dissemination of infectious diseases continues, although the technology is now available for detection and elimination of most of the pathogens occurring in propagation material.

Scientific knowledge is nevertheless advancing rapidly and one consequence of this is the increased number of publications in specialized journals and of papers delivered during technical Meetings and Congresses. This raises the question of how to offer to those interested in a particular field the means for following with the least difficulty the research work being done in so many laboratories throughout the world and the information stemming from it.

One way of achieving this goal is to produce and make available updated accounts of the state-of-the-art of grapevine virology and comprehensive bibliographic reports. ICVG has a long-lasting tradition in these endeavours, to which IAM-B was happy to contribute, promoting the publication of the Bibliografic Report 1985-1997 on virus and virus-like diseases of the grapevine.

The present issue of Options Méditerrnéennes, hosts a new edition of the “Directory of Infectious Diseases of Grapevines” by G.P. Martelli and E. Boudon-Padieu and the latest Bibliographic Report (1998-2004) on “The Viroses and Virus-like Diseases of the Grapevine” by R. Bovey

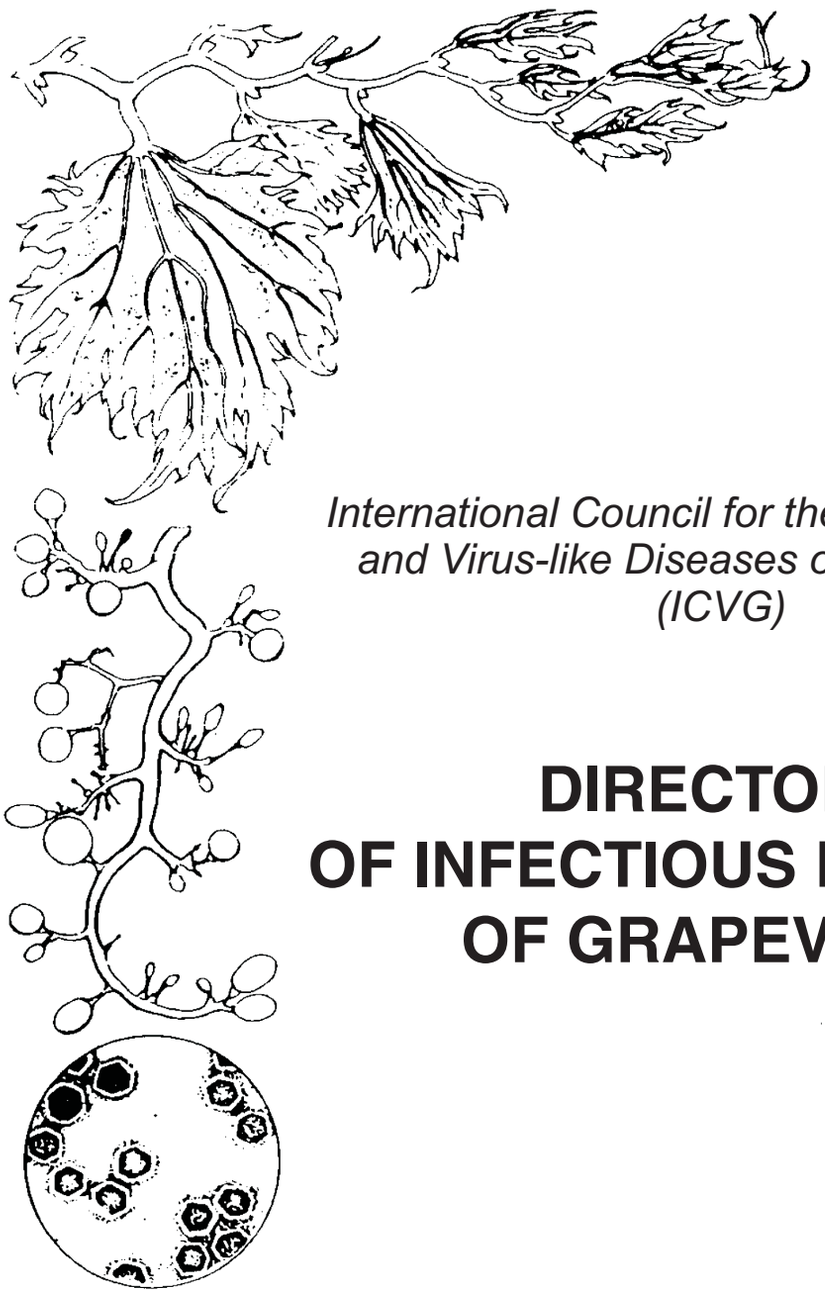
The “Directory” is a work of great thoroughness and accuracy, up to date as to the time of publication. Special care was taken in the organization of the subject matter, grouping diseases and setting them in a well thought out order, so as to produce a document which can readily be used by scientits, technicians, students, and practitioners.

As to the authors, G.P. Martelli is the President of ICVG and a widely known virologist who has much contributed to the advancement of the knowledge on grapevine viruses for the last forty years or so, whereas E. Boudon-Padieu has a long lasting experience in the study of phytoplasmas, being a recognized authority in this field.

The “Bibliographic Report” is another most precious achievement by R. Bovey, a distinguished virologist of worldwide reputation and one of the father founders of ICVG, whose Secretatiat he has admirably conducted since its very establishment in 1962.

Sincere thanks are espressed to the authors of these contributions, produced under the auspices of ICVG, whose publication IAM-B is happy to support, in the belief of rendering a good service to the scientific community and, by and large, to all those interested in viticultural matters.

Cosimo Lacirignola
Director of IAM Bari, Italy



International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG)

DIRECTORY OF INFECTIOUS DISEASES OF GRAPEVINES

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2006

INTRODUCTION

The grapevine (*Vitis* spp.) undoubtedly represents one of the horticultural crops most widely grown in temperate climates, and a highly valuable agricultural commodity.

As most of the vegetatively propagated crops, grapevines are exposed to the attacks of a variety of pests and pathogens among which infectious intracellular agents (viruses, viroids, phloem-and xylem-limited prokaryotes) play a major role, causing heavy losses, shortening the productive life of vineyards, and endangering the survival of affected vines. The importance of the grapevine industry and the magnitude of the problems caused by these pathogens has generated wide interest which, in turn, has fostered intensive research, that has been especially active at the international scale from the late 1950's onwards.

The increased attention paid to grapevine virological problems and the like, has produced an impressive series of papers which now number about 5,400. The papers up to 2004 are listed and commented upon in six bibliographic reports:

Caudwell A., 1965. Bibliographie des viroses de la vigne des origines à 1965. Office International de la Vigne et du Vin, Paris, 76 pp.,

Caudwell A., W.B. Hewitt and R. Bovey, 1972. Les virus de la vigne. Bibliographie de 1965-1970. *Vitis* **11**, 303-324,

Hewitt W.B. and R. Bovey, 1979. The viroses and virus-like diseases of the grapevine. A bibliographic report 1971-1978. *Vitis* **18**, 316-376,

Bovey R. and G.P. Martelli, 1986. The viroses and virus-like diseases of the grapevine. A bibliographic report 1979-1984. *Vitis* **25**, 227-275,

Bovey R., 1999. The viroses and virus-like diseases of the grapevine. A bibliographic report 1985-1997. *Options Méditerranéenes,* **29** (Series B, 3rd part), 10-172.

Bovey R., 2006. The viroses and virus-like diseases of the grapevine. A bibliographic report 1998-2004. *Options Méditerranéenes,* **xx** (Series B, 3rd part), 205-279.

which were compiled under the auspices of the International Council for the Study of Viruses and Virus Diseases of the Grapevine (ICVG).

ICVG was established in 1962 by a group of American and European plant pathologists who realized the importance of creating an organization for promoting research on grapevine virology and favouring the exchange of information among students. Since its foundation, ICVG has met regularly every 3 to 4 years, its 14th Conference having taken place in Italy in 2003 (Bovey and Gugerli, 2003).

Bovey R. and P. Gugerli, 2003. A short history of ICVG. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 1-2.

From the very beginning, ICVG has been instrumental in fostering basic and applied research in grapevine virology, attracting the attention of scientists, growers, nurserymen, and administrators on the detrimental effects of infectious diseases on the well-being of the industry, and supporting initiatives for the establishment and implementation of clean stock and certification programmes.

To this effect, among other things, ICVG has issued the recommendations that follow:

The International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG), recognizes that a number of the 60 or so infectious agents (viruses, viroids, and phytoplasmas) recorded from the grapevine can be highly detrimental to this crop, having a negative impact on the plant vigour and longevity, as well as on the quality and quantity of the yield.

Infected propagating material is largely responsible for the spread of diseases among and within viticultural countries. Thus, all efforts should be made to improve its sanitary conditions.

The presence of diseases such as infectious degeneration, leafroll, rugose wood, and fleck, is regarded as incompatible with an accepted sanitary status. Their elimination from mother vines intended for propagation should therefore be pursued.

Improvement of the sanitary level can be achieved through selection and sanitation, which are best performed in the framework of certification programmes encompassing also clonal selection.

(issued and approved in 1997 at the 12th ICVG Meeting, Lisbon, Portugal)

The International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG), recognises over 70 infectious agents affecting grapevine (viruses, viroids and phytoplasmas), many of which can be highly detrimental to this crop, having a negative impact on plant vigour and longevity, as well as on the quality and quantity of the yield.

Certification of grapevine nursery stock is a powerful and effective tool to control these agents, that enables vineyards to economically and sustainably maintain quality and productivity.

Certified grapevines are derived from pathogen tested, clonally selected primary sources. The certification process should specify conditions to prevent and detect subsequent infection of nursery plants by regulated pests, ensure clonal integrity, and permit tracing the certified grapevines to the originally selected and tested plants.

Inadequate certification standards have repeatedly resulted in disease problems for growers and nurserymen.

Infected propagation material is largely responsible for the spread of diseases among and within viticultural countries. Thus, all efforts should be made to improve its sanitary conditions.

However, valuable grape genetic resources exist which are infected with virus but are essential to the preservation of world viticultural heritage.

In order to preserve valuable grape clones and varieties, we propose two sanitary classes. Certified selections should be tested for specific pathogens. Class 1 should include only grape nursery stock which tests negative for the most damaging diseases/pathogens. It would move freely between regulatory boundaries. Class 2 would be a specific pathogen-tested certification system for stock which remains within regulatory regions and is only distributed with disclosure of health status. No other stock should move outside regulatory regions.

The agents that should be controlled by the Class 1 certification program are those associated with infectious degeneration and grapevine decline (nepoviruses); leafroll disease and associated closteroviruses (grapevine leafroll associated viruses 1, 2, and 3); rugose wood (GVA, GVB and GVD); and phytoplasmas (flavescence dorée, bois noir, and other grapevine yellows).

In the future, technology should make it possible to exclude additional disease-causing viruses from the certified stock, including the causal agents of fleck and rupestris stem pitting. Until that time, a moratorium will be established for these viruses.

The regional certification standards for Class 2 stock should be created at a local level based on the rate of endemic infection, regional viticultural conditions, and the need for preservation of heritage germplasm. As efforts are made to harmonize grapevine certification protocols, high standards are essential to ensure that no viticultural area is compromised by the introduction and spread of diseases.

(issued and approved in 2003 at the 14th ICVG Meeting, Locorotondo, Italy)

The Proceedings of all the international ICVG Conferences have been published *in extenso* or, lately, as Extended Abstracts. They represent a most valuable source of information. In addition, the virological problems of grapevines have been extensively treated and illustrated in a number of books and major review articles:

Uyemoto J.K, G.P. Martelli, R.C. Woodham, A.C. Goheen and H.F. Dias, 1978. Grapevine (*Vitis*) virus and virus-like diseases. Plant Virus Slide Series, Set 1 (O.W. Barnett and S.A. Tolin, eds) Clemson University, Clemson, 100 slides, 29 pp. (a revised edition by J.K. Uyemoto, G.P. Martelli and A. Rowhani will be published in 2005 in the series APS Plant Virus Image CD-ROM, Grape Section, under the name of Grapevine Viruses, Virus-like Diseases and Other Disorders).

Bovey R., W. Gärtel, W.B. Hewitt, G.P. Martelli and A. Vuittenez, 1980. Virus and Virus-like Diseases of Grapevines. Editions Payot, Lausanne, 181 pp.

Pearson R.G. and A.C. Goheen, 1988. Compendium of Grape Diseases. The American Phytopathological Society Press, St. Paul, Minnesota, USA, 93 pp. (a 2nd revised edition edited by W.F. Wilcox, W.D. Gubler and J.K. Uyemoto will be published in 2005).

Frison E.A. and R. Ikin, 1991. FAO/IBPGR Technical Guidelines for the Safe Movement of Grapevine Germplasm. Food and Agriculture Organization of the United Nations, Rome /International Board for Plant Genetic Resources, Rome, 54 pp.

Martelli G.P. (ed.), 1993. Detection and Diagnosis of Graft-transmissible Diseases of Grapevines. FAO Publication Division, Rome, 263 pp.

Walter B. and G.P. Martelli, 1996. Sélection sanitaire de la vigne: sélection sanitaire et sélection pomologique. Influence des viroses et qualité. 1ere partie: Effets des viroses sur la culture de la vigne et ses produits. *Bulletin de l'OIV* **69**, 945-971.

Walter B. and G.P. Martelli, 1997. Sélection sanitaire de la vigne: sélection sanitaire et sélection pomologique. Influence des viroses et qualité. 2ere partie: Sélection sanitaire, sélection pomologique. *Bulletin de l'OIV* **70**, 5-23.

Walter B. (ed), 1997. Sanitary selection of the grapevine. Protocols for detection of viruses and virus-like diseases: Les Colloques, n° 86, INRA Editions, Paris, 225 pp.

Martelli G.P. and B. Walter, 1998. Virus certification of grapevines. In: Plant Virus Disease Control (A. Hadidi, R.K. Khetarpal, H. Koganezawa, eds.), 261-276. American Phytopathological Society Press, St. Paul.

Krake L.R., N.S. Scott, M.A. Rezaian and R.H. Taylor, 1999. Graft-transmissible Diseases of Grapevines. CSIRO Publishing, Collingwood,137 pp.

Walter B., E. Boudon-Padieu and M. Ridé, 2000. Maladies à Virus, bactéries et phytoplasmes de la Vigne. Editions Féret, Bordeaux, 192 pp.

Notwithstanding this wealth of published information a "*Directory of Major Virus and Virus-like Diseases of Grapevines"* was compiled in 1992 by R. Bovey and G.P. Martelli and published under the auspices of the Mediterranean Fruit Crop Improvement Council (MFCIC), a body now estinguished, which was established in the framework of the International Project RAB/88 sponsored by the United States Development Programme and the Food and Agriculture Organization of the United Nations.

At the 14th ICVG Meeting, the Steering Committee of ICGV decided to update the Directory and to entrust this task to G.P. Martelli and E. Boudon-Padieu.

The authors hope that this endeavour may serve as a useful guideline and working tool for both experienced researchers and those who are now approaching the intriguing but intricate field of grapevine virology.

They express their deep gratitude to Prof. M. Hamze and Mr. B. Hervieu, Chairman of the Board of Directors and Secretary General, respectively, of the Centre International des Hautes Etudes Agronomiques Méditerranéennes, Paris, and to Dr. C. Lacirignola, Director of the Mediterrenean Agronomic Institute of Bari for supporting the publication of this work.

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INFECTIOUS AGENTS OF GRAPEVINES

More than 70 infectious agents among viruses (58), viroids (5), phytoplasmas (8), and insect-transmitted xylematic bacteria (1) have been recorded form grapevines. This represents the highest number of intracelluar pathogens ever found in a single crop.

The viral scenario of *Vitis*: viruses and their taxonomic affiliation[(a)]

FAMILY	GENUS	SPECIES
A. Viruses belonging to genera included into families		
BROMOVIRIDAE	*Alfamovirus*	*Alfalfa mosaic virus* (AMV)
	Cucumovirus	*Cucumber mosaic virus* (CMV)
	Ilarvirus	Grapevine line pattern virus (GLPV)
		Grapevine angular mosaic virus (GAMoV)
BUNYAVIRIDAE	*Tospovirus*	*Tomato spotted wilt virus* (TSWV)
CLOSTEROVIRIDAE	*Closterovirus*	*Grapevine leafroll-associated virus 2* (GLRaV-2)
	Ampelovirus	*Grapevine leafroll-associated virus 1* (GLRaV-1) *Grapevine leafroll-associated virus 3* (GLRaV-3) Grapevine leafroll-associated virus 4 (GLRaV-4) *Grapevine leafroll-associated virus 5* (GLRaV-5) Grapevine leafroll-associated virus 6 (GLRaV-6) Grapevine leafroll-associated virus 7 (GLRaV-7) Grapevine leafroll-associated virus 8 (GLRaV-8) Grapevine leafroll-associated virus 9 (GLRaV-9)
Two new putative ampeloviruses are being characterized in France and the USA		
COMOVIRIDAE	*Fabavirus*	*Broadbean wilt virus* (BBWV)
	Nepovirus	*Artichoke italian latent virus* (AILV) *Arabis mosaic virus* (ArMV) *Blueberry leaf mottle virus* (BBLMV) *Cherry leafroll virus* (CLRV) *Grapevine Bulgarian latent virus* (GBLV) Grapevine Anatolian ringspot virus (GARSV) Grapevine deformation virus (GDefV) *Grapevine chrome mosaic virus* (GCMV) *Grapevine fanleaf virus* (GFLV) *Grapevine Tunisian ringspot virus* (GTRV) *Peach rosette mosaic virus* (PRMV) *Raspberry ringspot virus* (RpRV) *Tobacco ringspot virus* (TRSV) *Tomato ringspot virus* (ToRSV) *Tomato blackring virus* (TBRV)
FLEXIVIRIDAE	*Foveavirus*	*Grapevine rupestris stem pitting-associated virus* (GRSPaV)

Potexvirus	*Potato virus X* (PVX)	
	Trichovirus	*Grapevine berry inner necrosis virus* (GINV)
	Vitivirus	*Grapevine virus A* (GVA) *Grapevine virus* B (GVB) Grapevine virus C (GVC) *Grapevine virus D* (GVD)
TOMBUSVIRIDAE	*Carmovirus*	*Carnation mottle virus* (CarMV)
	Necrovirus	*Tobacco necrosis virus D* (TNV-D)
	Tombusvirus	*Grapevine Algerian latent virus* (GALV) *Petunia asteroid mosaic virus* (PAMV)
TYMOVIRIDAE	*Marafivirus*	*Grapevine asteroid mosaic-associated virus* (GAMaV) Grapevine redglobe virus (GRGV)
	Maculavirus	*Grapevine fleck virus* (GFkV) *Grapevine rupestris vein feathering virrus* (GRVFV)

A new putative marafivirus is being characterized in the USA

POTYVIRIDAE	*Potyvirus(?)*	Unidentified potyvirus-like virus isolated in Japan from a Russian cultivar

B. Viruses belonging to unassigned genera

	Idaeovirus	*Raspberry bushy dwarf virus* (RBDV)
	Sadwavirus	*Strawberry latent ringspot virus* (SLRSV)
Sobemovirus		*Sowbane mosaic virus* (SoMV)
	Tobamovirus	*Tobacco mosaic virus* (TMV) *Tomato mosaic virus* (ToMV)

C. Taxonomically unassigned viruses

		Unnamed filamentous Grapevine Ajinashika virus (GAgV) Grapevine stunt virus (GSV) Grapevine labile rod-shaped virus (GLRSV)

[(a)]Scientific names of definitive virus species are written in italics. The names of tentative species are written in Roman characters. The updated taxonomy of all classified grapevine viruses can be found in: Fauquet, C.M., Mayo, M.A., Maniloff, J., Desselberger, U. and Ball, L.A. (eds), 2005. Virus Taxonomy, 8Ith Report of the International Committee on Taxonomy of Viruses. Elsevier/Academic Press, London, pp. 1258.

INFECTIOUS DEGENERATION

INFECTIOUS DEGENERATION
(GRAPEVINE FANLEAF VIRUS)

Several nepoviruses infect grapevines in Europe and the Mediterranean area, causing degenerative diseases whose symptoms are similar to, or indistinguishable from those of fanleaf, a disorder induced by *Grapevine fanleaf virus* (GFLV). The name of this virus comes from the peculiar malformation of infected leaves, which exhibit widely open petiolar sinuses and abnormally gathered primary veins, that give the leaf the appearance of an open fan. GFLV and several of the other grapevine-infecting European nepoviruses have distorting and chromogenic strains and may occur in mixed infections. Their economic impact varies with the tolerance of the cultivar to the viruses. Tolerant cultivars produce fairly good crops whereas sensitive cultivars are severely affected, showing progressive decline, low yields and low fruit quality, shortened productive life, low proportion of graft take, reduced rooting ability of propagation material, and decreased resistance to adverse climatic factors.

FANLEAF

1. Description

Fanleaf is the oldest known and one of the most important and widespread virus disease of the grapevine. In the European literature, records of this disease date back some 150 years, and grapevine leaves with typical symptoms were found in herbaria established before the introduction of American rootstock hybrids. The consensus is that fanleaf degeneration may have existed in the Mediterranean Basin and the Near East since the earliest time of grape cultivation. Now the disease is known to occur worldwide.

Main synonyms: court-noué, panachure, dégénérescence infectieuse (Fr.), roncet, arricciamento, mosaico giallo, degenerazione infettiva (Ital.), urticado (Port.), Reisigkrankheit (partly), Gelbmosaik (Germ.).

Main symptoms: Two distinct syndromes caused by different strains of the causal agent characterize this disease.

Infectious malformations are induced by virus strains causing distortions. Leaves are variously and severely malformed, asymmetrical, puckered, may show open petiolar sinuses, deep lobes, and acute denticulations. Occasionally, chlorotic mottling may accompany foliar deformations. Shoots are also malformed, showing abnormal branching, double nodes, short internodes, fasciations,and zigzag growth. Bunches are smaller and fewer in number, and berries ripen irregularly, are small-sized and set poorly. Foliar symptoms develop early in the spring and persist throughout the vegetative season becoming less distinct in summer.

Yellow mosaic is induced by chromogenic virus strains. The foliage develops bright chrome yellow discolorations early in the spring that may affect all vegetative parts (leaves, shoots, tendrils, and inflorescences). Chromatic alterations of the leaves vary from a few scattered yellow spots, sometimes appearing as rings or lines to extensive mottling of the veins and/or interveinal areas to total yellowing . Often infected grapevines occur in patches. The foliage and shoots show little if any malformation, but bunches are small and few. With increased ambient temperatures during summer, the yellowing fades rapidly and the canopy develops a normal green color.

The characterizing symptoms of "*Vein banding",* another disease sometimes occurring in vineyards affected by infectious degeneration, consist of chrome yellow flecks first localized along the main veins of mature leaves and progressing into the interveinal areas which appear in mid to late summer in a limited number of leaves. Symptomatic leaves show little malformation. Fruit set is poor, bunches are straggly, and the yield may be much reduced. This disorder was first reported from California as a syndrome elicited by a specific strain of GFLV. More recently, however, vein banding symptoms were shown to be caused by a co-infection by *Grapevine yellow speckle viroid* and GFLV.

Trabeculae, or endocellular cordons, i.e. radial bars crossing the lumen of epidermal, parenchyma, phloem, and xylem cells, are diagnostic of grapevines infected by GFLV. These structures are readily visible by light microscopy in lignified shoots, especially in the basal internodes.

Agent: *Grapevine fanleaf virus* (GFLV) is a nepovirus with polyhedral particles of about 30 nm in diameter, serologically rather uniform and occurring as a family of minor molecular variants. Positive sense single-stranded RNA genome, consisting of two functional molecules 7342 nt (RNA-1) and 3774 nt (RNA-2) in size, encapsidated in different particles, both required for infectivity. GFLV was the first grapevine virus to be recovered by mechanical inoculation and to be thoroughly characterized physico-chemically and molecularly. A satellite RNA 1114 nt in size is associated with some virus isolates.

Cytopathology: GFLV elicits the formation of intracellular cytopathic structures known as vesiculate-vacuolate inclusion bodies which are often apposed to the nucleus. These inclusions derive from membrane proliferation, reorganization, and redistribution and are thought to be sites of viral polyprotein processing and RNA replication. Virus particles are often within tubular structures that accumulate in bundles in the cytoplasm or nucleus. Endocelluar cordons or “trabeculae” are abnormal straight cylindrical spool-like o ribbon-like structures of pectocellulosic nature that cross the cell lumen in different tissues and are especially oustanding in vascular bundles, where they occur in a radial orientation.

Transmission: At a site, in a persistent manner by the longidorid nematode *Xiphinema index* feeding on the roots of grapevines and retaining the virus for several months. Nematode populations transmit local virus isolates with a higher efficiency than those from other geographical areas. Specific transmission by *X. index* is determined by the viral coat protein. Transmission by *Xiphinema italiae* has not been consistently documented, and transmission by *X. vuittenezi* has been suspected but not proven. Dissemination over medium and long distances is through infected vegetatively propagated scionwood and rootstocks. In the laboratory, GFLV can be transmitted by mechanical inoculation from infected grapevine tissues to various herbaceous hosts (e.g. *Chenopodium quinoa*, *C. amaranticolor*, *Gomphrena globosa*). The virus occurs in the pollen of infected grapevines and herbaceous hosts, the endosperm of grapevine seeds, and is transmitted through seeds of *C. amaranticolor*, *C. quinoa*, and soybean. There are conflicting reports on seed transmission in grapevines. Natural GFLV infections have been detected in weeds in Hungary and Iran.

Varietal susceptibility: Almost all known *Vitis vinifera* L. varieties are susceptible, with variable levels of sensitivity. However, tolerance to infection is widespread in European grapes and a high resistance level of the "host plant resistance" type was found in two accessions from Afghanistan and Iran. This resistance is controlled by two unlinked recessive genes. American rootstocks are also susceptible and are generally very sensitive, although some like *Vitis labrusca* can be infected, but show few symptoms. *Muscadinia (Vitis) rotundifolia* and *Vitis munsoniana* are highly resistant to *X. index* feeding. *M. rotundifolia* can be infected by GFLV when graft inoculated, but resists infection when the virus is transmitted by the nematode. Resistance to *X. index* in *V. rupestris* x *M. rotundifolia* hybrids is thought to be controlled by a single dominant gene. Some *V. vinifera* x *M. rotundifolia* hybrid rootstocks (e.g. O36-16) show interesting levels of field resistance to GFLV.

Detection: ELISA using polyclonal antisera and monoclonal antibodies is a quick, cheap, and very sensitive method. The best antigen sources for serological diagnosis are leaves collected in spring or cortical shavings from mature dormant canes. Molecular assays using radioactive or digoxigenin-labelled probes, RT-PCR and immunocapture RT-PCR are becoming increasingly popular. RT-PCR is estimated to be four to sixfold more sensitive than ELISA. Indexing on *Vitis* indicators by grafting takes a lot of time and field or greenhouse space, but it is still regarded as necessary for confirming freedom from virus infection. Indexing on herbaceous hosts by mechanical inoculation requires climatized greenhouses and is less reliable than ELISA. Observation of symptoms in the field is useful as a first step in selection, but is not reliable. Detection of trabeculae can give information on the health of American rootstocks, but is not a specific test. GFLV has been detected in small groups of viruliferous *X. index* (10 individuals) by ELISA and in single nematodes by RT-PCR and immunosorbent electron microscopy.

Control: Use of virus-tested scionwood and rootstock material in the framework of clean stock or certification programmes. Virus elimination is readily achieved from vegetating shoot tips by heat treatment (38-40 °C for as little as four weeks), by *in vitro* meristem tip culture, or by somatic embryogenesis. In contaminated soils, the use of fumigants against nematode vectors gives only a temporary but economically valuable control of the disease. However, use of fumigants is more and more questioned for environmental reasons and is being progressively banned. Work is under way in different laboratories to create GFLV-resistant rootstocks or cultivar through traditional breeding methods or genetic transformation technology. For transformation, a number of selectable marker genes toxic to non engineered vines are used. However, mannose and xylose, which are desirable as they cause no harm to human health, are toxic to many plants but not to *V. vinifera.*

2. Historical review

From the late 1800 to 1997, the ICVG Bibliographic Reports (a) have recorded more than 1000 papers dealing with fanleaf. For a comprehensive review on early observations, research and hypotheses on fanleaf, as well as on controversies about transmission by phylloxera, see the book by Galet, 1977(b)

1865 **Cazalis-Allut**. Description of grapevine degeneration in Frontignan (France)

1882 **Rathay**: Description of fanleaf disease from Austria (Zwiewipflereben)

1895 **Ruggeri** : Description of fanleaf disease from Italy (Roncet)

1896 **Cholin**: Description of fanleaf disease from Germany (Reisigkrankheit)

1902 **Baccarini**: First suggestion that fanleaf may be due to a virus.

1906 **Schiff-Giorgini**: Graft-transmission of fanleaf disease

1910 **Pantanelli**: Fanleaf disease can be trasmitted through the soil

1912 **Pantanelli** : Fanleaf disease has a patchy distribution in the field

1912 **Petri**: Association of trabeculae with fanleaf.

1917 **Pantanelli**: Fanleaf caused by contamination through the roots possibly due to heat-labile toxic substances

1918 **Petri**: Disinfection of contaminated soil at 120 °C or filtration of liquid leached from contaminated soil through porcelain filter prevents infection through the roots of grapevine. Hypothesis that fanleaf is a fungal disease.

1929 **Petri:** Grapevine "arricciamento" (fanleaf) has a viral origin

1931 **Arnaud and Arnaud**: Hypothesis of a viral origin for grapevine court-noué (fanleaf).

1937 **Arnaud**: Court-noué is considered as a soil-borne virus disease. Hypothesis about a possible role of phylloxera as a vector.

1937 **Branas** *et al*.: Hypothesis that court-noué (fanleaf) is caused by a virus transmitted by phylloxera. No direct proof of transmission by this aphid, but only circumstantial evidence.

1946 **Branas** *et al*.: Experiments on the capacity of phylloxera to transmit fanleaf. Healthy rooted cuttings or seedling of Rupestris du Lot were contaminated:
1. With roots of fanleaf-infected grapevines with phylloxera feeding on them;
2. With individual phylloxera (radicicolous or gallicolous) fed on infected vines;
3. With soil containing phylloxera.
No conclusive results were obtained.

1950a,b **Hewitt**: Fanleaf and yellow mosaic recorded from California.

1954 **Hewitt**: Review on grapevine virus and virus-like diseases found in California.

1958 **Bovey**: Review on grapevine virus and virus-like diseases. Report on first experiments on heat treatment of grapevine in order to eliminate fanleaf. Heating whole plants in a thermostatic chamber at 37 °C for several weeks provides a temporary elimination of symptoms on the new growth but no lasting cure.

(a) See references in the Introduction. (b) Galet P., 1977. Les maladies et les parasites de la vigne. Tome 1: Les maladies dues à des végétaux (champignons, bactéries, viroses et phanérogames). Imprimerie du "Paysan du Midi", Montpellier, France, 871 pp.

1958 **Vuittenez**: Fumigation of fanleaf-contaminated soil with nematicides prevents infection of healthy grapevines replanted immediately, whereas insecticide treatment has no effect.

1958 **Hewitt** *et al*.: Fanleaf virus is transmitted by the nematode *Xiphinema index*

1960 **Cadman** *et al*.: Transmission of fanleaf virus from grapevine to herbaceous hosts by mechanical inoculation and preliminary characterization of the virus. Serological relationship with ArMV reported.

1960a **Vuittenez**: New observations on the effects of soil fumigants on fanleaf in contaminated soils.

1960b **Vuittenez**: Mechanical transmission of fanleaf virus to *Chenopodium quinoa* and *C. amaranticolor* is confirmed.

1961 **Brückbauer and Rüdel**: The virus (or viruses) of Reisigkrankheit (GFLV and/or other nepoviruses) are seed transmitted in some herbaceous indicator plants. Discussion on the possible role of weeds in the epidemiology of the disease.

1961 **Gifford and Hewitt**: Use of heat therapy and *in vitro* shoot tip culture to eliminate fanleaf virus from infected grapevines.

1962 **Hewitt** *et al*.: Investigations on grapevine virus diseases in California. Description of the chip-budding method for indexing. Transmission of fanleaf virus by *X. index*. Control of the vector by soil fumigation.

1962 **Goheen and Hewitt**: Description of vein banding as a GFLV-induced disease

1963 **Dias**: Host range and properties of fanleaf and yellow mosaic viruses.

1963 **Dias and Harrison**: Relationships between the viruses causing fanleaf, yellow mosaic and ArMV

1963a,b **Martelli and Hewitt:** Comparative studies showed that Californian and Italian GFLV isolates are the same. Reproduction of fanleaf symptoms in mechanically inoculated grapevine seedlings

1964 **Taylor and Hewitt**: Description and characterization of Australian isolates of GFLV. Reproduction of fanleaf symptoms in mechanically inoculated grapevine seedlings is confirmed

1964 **Galzy**: Heat treatment of grapevine plantlets grown aseptically *in vitro*.

1965 **Goheen** *et al*.: Description of the Davis method of heat therapy of grapevines. Potted plants to be cured are grown at 38°C for several weeks and shoot extremities are cut and rooted under mist in a greenhouse.

1965 **Graniti and Russo**: A light microscope and cytochemical study of endocellular cordons.

1967 **Bercks**: Research on the use of three serological methods for detecting plant viruses, including fanleaf virus: bentonite flocculation test, latex test and barium sulfate test.

1968 **Das and Raski**: Studies on the relationships of GFLV with its vector *X. index*.

1968 **Boubals and Dalmasso**: Experiments on soil disinfection against *X. index* in France. Dichloropropane-dichloropropene (DD) at 1000 l/ha gave satisfactory results, and no reinfestation by *X. index* occurred during the 6 year period of observation. Yield was increased by 400 % in comparison with that of untreated controls.

1969 **Bercks and Querfurth**: Use of latex-test for detecting GFLV and other nepoviruses in grapevine tissue extracts in Germany.

1969 **Gerola** *et al*.: Detection of GFLV particles in thin-sectioned grapevine root tissues.

1970 **Cohn** *et al.*: Transmission of GFLV by *Xiphinema italiae* in Israel.

1970 **Hewitt** *et al*.: Description of GFLV in the CMI/AAB Descriptions of Plant Viruses

1970 **Taylor and Robertson**: GFLV and ArMV are retained as a monolayer of particles adsorbed onto the cuticle lining the lumina of odontophore, anterior oesophagus and oesophageal bulb of their nematode vectors. During the moult of the nematode, this lining is shed and ingested in the intestine.

1970 **Vuittenez**: Review paper on grapevine fanleaf.

1970 **Dias**: Review paper on grapevine yellow mosaic.

1970 **Taylor**: Review paper on grapevine vein banding.

1971 **Bercks**: Serological detection of grapevine viruses in West Germany.

1971 **Raski** *et al*.: Control of fanleaf by soil fumigation with 1,3 dichloropropene or methyl bromide.

1972 **Raski and Schmitt**: Progress in the control of the fanleaf-nematode complex by soil disinfection with 1,3-dichloropropene or methyl bromide. Vineyards replanted in contaminated but treated soils remained healthy for at least 5 years.

1972 **Mur** *et al*.: Heat therapy of grape plantlets grown *in vitro* causes changes in some characteristics of the variety.

1973 **Raski** *et al*.: GFLV particles observed in the lumen of the oesophagus of *X. index*.

1973 **Goheen and Luhn**: New method of heat therapy. A dormant bud of the variety to be cured is grafted onto a healthy potted rootstock. After bud take, the plant is placed in a heat cabinet for treatment

1973a **Hévin** *et al*.: Use of green grafting as a quick and secure method for graft-indexing.

1973b **Hévin** *et al*.: GFLV and marbrure (fleck) are not transmitted through the seeds of grapevine.

1974 **Van Velsen and Niejalke**: Green budding for indexing grapevine with the indicator cvs. St. George, Mission or LN 33.

1974 **Alfaro and Goheen**: The different strains of fanleaf virus (fanleaf *sensu stricto*, yellow mosaic and vein banding) are transmitted in the same way by *X. index*. The acquisition time threshold is less than 5 minutes. Indexing by budding on *V. rupestris* is more accurate than mechanical transmission to *C. quinoa*.

1975 **Martelli and Piro**: Evidence from a herbarium of dried specimens collected between 1880 and 1886 that fanleaf and yellow mosaic occurred in field-grown grapevine in Sicily in the second half of the 19th century

1976 **Quacquarelli** *et al*.: Detailed physico-chemical characterization of GFLV.

1976 **Uyemoto** *et al*.: Comparison of indexing by mechanical inoculation to *Chenopodium quinoa* and by graft-transmission to *V. rupestris* St. George for detecting GFLV. Both methods give satisfactory and similar results.

1977 **Bass and Vuittenez**: Thermotherapy was improved by growing shoot apices of heat treated vines aseptically on nutritive media or by grafting them on aseptic grape seedlings *in vitro*.

1979 **Querfurth and Paul**: Protein A-coated latex-linked antiserum (PALLAS) method for detecting GFLV and other viruses. The sensitivity of the latex test is increased, especially with low titre antisera.

1979 **Walter** *et al*.: Comparison between PALLAS latex test and ELISA for detecting GFLV in France. Both tests are more sensitive than mechanical inoculation to *C. quinoa*. PALLAS is quicker and cheaper than ELISA, but ELISA is more sensitive.

1979 **Kalasian** *et al.*: GFLV particles are arrayed in long parallel rows in thin-sectioned mesophyll cells of infected grapevines.

1980 **Vuittenez**: Review on serological methods of detection and identification of grapevine viruses.

1980 **Rüdel**: Discussion on the possible role of *X. vuittenezi*, a very common species in vineyards of Rheinhessen and Palatinate, as vector of GFLV. Transmission trials gave a few positive results. Even in the cases where the virus was transmitted, the possibility that a few *X. index* larvae were present in the *X. vuittenezi* population used for the experiments could not be entirely ruled out. That *X. vuittenezi* might be a vector of GFLV is therefore uncertain.

1980 **Brown and Roberts**: Detection of fanleaf virus in its vector *X. index* by ISEM

1980 **Bovey** *et al*.: Detection of fanleaf virus in grapevine tissues by ELISA and ISEM in different periods of the year. Efficiency of both methods is compared.

1980 **Russo** *et al*.: Detection of fanleaf virus and other sap-transmissible viruses in grapevine tissues by ISEM.

1981 **Raski** *et al*.: Experiments with systemic nematicides for controlling *X. index.*

1981 **Hafez** *et al*.: Use of systemic nematicides for the control of *X. index*.

1981 **Lear** *et al*.: Study on the effectiveness of soil fumigation for the control of *X. index* and fanleaf in grapevines. Methyl bromide and 1,3-dichloropropene failed to eradicate either nematodes or fanleaf virus from the soil but reduced the incidence of the disease to acceptable levels. Carbon disulfide gave less satisfactory results.

1981 **Bouquet**: *Muscadinia rotundifolia* becomes infected by GFLV when the virus is transmitted by grafting but resists infection when transmission is by *X. index* feeding.

1983a **Bouquet**: *M. rotundifolia* is resistant to fanleaf virus transmission by *X. index*, although it is not resistant to the virus itself.

1983b **Bouquet**: Serological detection of GFLV in its vector *X. index* by ELISA.

1983 **Raski** *et al*.: Soil fumigation with 1,3-dichloropropene (1,3-D) or methyl bromide applied 75-90 cm deep with 90 cm spacing for 1,3-D (1400 l/ha) and 50-75 cm deep with 165 cm spacing for methyl bromide (448 kg/ha) gave a good control of *X. index*, in California. The use of methyl bromide requires a continuous cover with polyethylene sheeting for some time after the treatment.

1983 **Krake and Woodham**: Possibility that the agent of yellow speckle is involved together with GFLV in the etiology of vein banding.

1983 **Morris-Krsinich** *et al*.: *In vitro* translation of genomic RNAs of GFLV yields two large polyproteins (220 Kd and 125 Kd) which are subsequently processed by proteolytic cleavage to form mature structural and non structural proteins. RNA-2 contains the cistron coding for the viral coat protein.

1985 **Walker** *et al*.: Identification of several *Vitis* species and interspecific hybrids resistant to fanleaf virus. These are promising sources of germplasm for obtaining resistant rootstocks. A Middle Eastern *V. vinifera* accession represent an excellent example of host plant resistance to GFLV.

1985 **Savino** *et al*.: Identification of a natural serological variant of GFLV from Tunisia

1986 **Huss** *et al*.: Comparison of polyclonal and monoclonal antibodies for detecting fanleaf virus with ELISA in various grapevine tissues, especially in wood shavings of dormant canes during winter.

1986 **Monette**: Heat therapy of GFLV and ArMV--infected grapevines with alternating temperatures. Forty days of treatment, with temperatures of 39 °C for 6 h followed by 22 °C for 18 h made it possible to eliminate both viruses from the developing shoot tips (2 mm) of *in vitro* cultured plantlets.

1987 **Huss** *et al*.: Production and use of monoclonal antibodies to GFLV.

1987 **Walter and Etienne**: Detection of GFLV in wood shavings of dormant canes**.**

1987 **Rüdel**: Review on the most important virus diseases of grapevines in West Germany. GFLV, RpRSV and ArMV are common, the latter being especially damaging on the variety Kerner. Effect on yield and economic importance. Treatments with soil fumigants are no longer permitted in Germany.

1988 **Raski and Goheen**: Comparison of 1,3-dichloropropene and methyl bromide for controlling *X. index* and GFLV. No eradication was obtained. Treated vines yielded more for over 4 years. Previous experience showed that 1,3-dichloropropene or methyl bromide fumigation following one year fallow period can give a satisfactory control of the disease for at least 12-15 years.

1988 **Rüdel**: Severe restrictions set on the use of soil fumigants in West Germany for environmental reasons make control of "Reisigkrankheit" very difficult. Long term fallow (about 5 years), cultivation of non-host plants and organic soil amendments are recommended. The selection of resistant cultivars and rootstocks is considered of primary importance.

1988 **Pinck** *et al.*: Identification of a satellite RNA of GFLV*.*

1989 **Catalano** *et al*.: Evidence of a differential efficiency of GFLV transmission by *Xiphinema index* populations from different geographical origins.

1989 **Walker** *et al*.: Two rootstock selections derived from crossings *V. vinifera* x *V. rotundifolia* showed good resistance to GFLV in California.

1989 **Fuchs** *et al*.: Determination of the nucleotide sequence of the satellite RNA (RNA-3) of GFLV. RNA-3 encodes a non structural protein, and has strong homologies with the satellite RNA associated with ArMV.

1989 **Altmayer**: Elimination of GFLV, ArMV, RpRV, SLRV, TBRV and leafroll from infected grapevines by *in vitro* meristem tip culture.

1989 **Walter** *et al*.: Improvement in the serological detection of GFLV and ArMV viruses using monoclonal antibodies.

1990 **Walter** *et al.:* Use of green grafting technique for sensitive and quick GFLV detection under greenhouse conditions.

1990 **Lázár** *et al*.: Detection of GFLV in grapevine seeds and seedlings by ELISA.

1990 **Serghini** *et al*.: Determination of the complete sequence of GFLV RNA-2.

1990 **Martelli and Taylor**: Review article on nematode-transmitted viruses.

1990 **Walker and Meredith**: Identification of two accessions of *Vitis vinifera* resistant to GFLV. Resistance is controlled by two unliked recessive genes

1991 **Walter** *et al*.: Study of interactions between GFLV and ArMV isolates grown in *C. quinoa* and transmitted by heterografting to Vialla and Kober 5BB rootstocks. Mild and severe strains were discriminated on the basis of field performance of infected *Vitis*. Mild strains were shown to confer protection towards severe challenging strains in *Chenopodium* and grapevine.

1991 **Etienne** *et al*.: Possibility of detecting several nepoviruses or serotypes of nepoviruses in grapevine leaves or wood shavings in a single DAS-ELISA test using a mixture of different polyclonal antisera.

1991 **Catalano** *et al*.: Detection of GFLV in the vector *Xiphinema index* by ELISA. Viruliferous nematodes were crushed in standard extraction buffer and tested in batches of 1-50 by means of DAS-ELISA. Reliable results were obtained with samples of 20-50 nematodes. Positive, but less consistent results were obtained with 1-10 nematodes.

1991a **Fuchs** *et al*.: Development of cDNA probes to GFLV genomic and satellite RNAs and their use for virus detection directly in grapevine extracts.

1991b **Fuchs** *et al*.: Co-inoculation of *C. quinoa* with biologically active transcripts of GFLV F-13 satellite RNA and GFLV strains devoid of satellite, delays symptom expression by 1-2 days and adversely affects virus replication. Satellite RNA appears to have a modulating effect on virus pathogenicity.

1991 **Staudt**: Study of the spread of GFLV in several *Vitis* species, hybrids and breeding stocks after infection of the roots by means of viruliferous *X. index*.

1991 **Ritzenthaler** *et al*.: Genomic RNA-1 of GFLV is completely sequenced and its genetic organization determined.

1992 **Staudt and Weischer:** *Vitis rotundifolia* and *Vitis munsoniana* resist infection by GFLV transmitted by *X. index.*

1992 **Goussard and Wiid**: First application of somatic embryogenesis for sanitation of grapevines. GFLV is eliminated from somatic embryos obtained from tissue cultures grown at 35 °C

1992a,b **Hans** *et al*.: Production of GFLV satellite RNA transcripts, identification of their replication determinants and evidence of replication in *Chenopodium quinoa* protoplasts

1993 **Martelli** *et al*.: European virologists propose a certification scheme for grapevine

1993 **Gemmrich** *et al:* Development and use digoxigenin-labelled cDNA probes for molecular detection of GFLV

1993 **Nolasco and De Sequeira:** Design and use of primers for specific amplification of GFLV sequences by IC-PCR

1993 **Nolasco and De Sequeira:** Molecular variability in the genome of GFLV isolates coming from the same vineyard assessed by IC-PCR combined with RFLP and SSCP analysis. GFLV is a quasispecies occurring in the field as a series of minor molecular variants.

1993 **Viry** *et al*.: Production of biologically active transcripts from cloned cDNA of genomic RNAs of GFLV.

1993 **Spielmann** *et al*.: Use of modified GFLV coat protein genes for transformation of different *Nicotiana* species for inducing resistance.

1993 **Walter** *et al.*: In naturally GFLV-infected vineyards the hypovirulent ArMV A1 isolate induces delayed infection by GFLV

1993 **Saldarelli** *et al*.: GFLV satellite RNA detected in 5 of 34 virus isolates from different geographical locations.

1993 **Esmenjaud** *et al*.: Detection of GFLV in *X. index* by biotin-avidin ELISA

1994 **Bardonnet** *et al*.: Evidence that transgenic tobacco plants expressing the coat protein of GFLV are protected from GFLV infection.

1994 **Horvath** *et al*.: GFLV isolated in Hungary from naturally infected symptomatic plants of *Aristolochia clematis* and *Lagenaria siceraria turbinata.* This represents the first substantiated record of a natural GFLV infection in hosts other than *Vitis.*

1994 **Esmenjaud** *et al*.:Detection of GFLV in single nematodes by RT-PCR.

1994 **Walker** *et al*.: Two *Vitis vinifera* x *Muscadinia rotundifolia* rootstock hybrids (O39-16 and O43-43) grafted with Cabernet sauvignon showed a high level of tolerance to GFLV. Both became infected in the course of a 12-year trial but had no reduced crop yields, thus qualifying for use in *X. index* infested soils, O39-16 in particular, which is also resistant to phylloxera.

1995 **Brandt and Himmler**: Use of immunocapture RT-PCR for GFLV detection in host tissues.

1995 **Krastanova** *et al*.: Genetic transformation of American roostocks with the coat protein gene of GFLV for resistance induction.

1995 **Mauro** *et al.*: Genetic transformation of *Vitis vinifera* with the coat protein gene of GFLV for resistance induction.

1995 **Ritzenthaler** *et al.*: Demostration that the movement protein of GFLV is located on the intracellular tubular structures containing rows of virus particles.

1995 **Rowhani** *et al*.: Development of a GFLV detection system based on PCR analysis of immobilized virions.

1996 **Walter and Martelli**: Review article on detrimental effects of viruses on grape yields**.**

1996 **Lahogue and Boulard:** Search for genes of resistance in grapevines. Of 531 accessions of European, American, and Asian *Vitis* species inoculated by green grafting with a GFLV source, except for four, all were susceptible to the virus, including the two accessions reported as resistant by Walker and Meredith (1990).

1997 **Spielmann** *et al*.: Transformation of *Nicotiana* species and *Vitis rupestris* with different virus-derived (coat protein, replicase) and exogenous (2, 5 oligoadenylate synthase, RNase L) genes for inducing resistance to GFLV. The level of resistance obtained looks promising.

1998 **Martelli and Walter**: Review article on certification of grapevines**.**

1998 **Walker and Jin**: *V. rupestris* x *M. rotundifolia* hybrids show high resistance to *X. index* feeding. This resistance is controlled by a single dominant gene.

1999 **Gaire** *et al*.: Demonstration that a 28 kDa protein coded by GFLV RNA-2 is involved in the replication of this RNA.

1999 **Belin** *et al*.: Identification of the molecular signal accounting for the systemic spread of GFLV in infected hosts.

2000 **Naraghi-Aran**i *et al.*: Variations observed following RT-PCR and RFLP analysis of the coat protein gene of nine GFLV isolates grown in different hosts confirm the quasispecies nature of this virus.

2000 **Pinck**: A comprehensive review of the molecular aspects of GFLV genome and its replication strategy.

2000 **Pfeiffer** *et al.*: The membranous structures appressed to the nucleus of infected cells known as vacuolate-vesiculate inclusion bodies are virus factories as they are the likely site of RNA replication and processing of viral polyproteins.

2000 **Gölles** *et al*.: Successful transformation of somatic embryos of an European grape cultivar (Russalska 3) with the normal, truncated or nontranslatable coat protein gene of GFLV*.*

2001 **Belin** *et al.* : Identification of RNA2-encoded proteins in the specific transmission of GFLV by *X. index.*

2002 **Ritzenthaler** *et al.*: Identification of membranes derived from the endoplasmic reticulum as sites of GFLV replication*.*

2003 **Pfeiffer** *et al*.: Up to date account of GFLV replication strategy*.*

2003 **Fuchs**: Review article on genetic transformation of grapevines for resistance to GFLV and other pathogens.

2003 **De Luca** *et al.*: Attempts to characterize molecularly *X. index* populations by PCR-RFLP and sequencing of the ITS region.

2003 **Martelli** *et al*.: Redescription of GFLV in the AAB Descriptions of Plant Viruses.

2003 **Laporte** *et al.*: Movement protein of GFLV is transported via Golgi-derived vesicles along microtubules to specipic receptors present in plasmodesmata.

2003 **Demangeat** *et al*.: Evidence that in soil samples stored at 7 °C and 20 °C *X. index* individuals survive up to four years and remain viruliferous for at least 12 months.

2003 **Izadpanah K.** *et al*.: Detection of GFLV in *Cynodon dactylon* and *Polygonum aviculare.*

2003 **Bouyahia H**. *et al*.: Comparison of sampling methods for ELISA detection of GFLV.

2004 **Fischer and Schillberg**: Generation of recombinant single chain antibody fragments to GFLV and ArMV for resistance induction in grapevines.

2004 **Kieffer** *et al*.: Mannose and xylose proved not suitable for use as selectable marker genes for transformation of cv. Chardonnay.

2004 a **Vigne** *et al.*: Study of the pouplation structure and genetic variability of GFLV. High frequency of mixed infections by distinct molecular variants in natural virus populations and evidence for intraspecific recombination.

2004b **Vigne** *et al.*: Genetically transformed grapevines expressing the coat protein of GFLV do not assist in the emergence of viable recombinant virus strains.

2004 **Andret-Link** *et al*.: The coat protein of GFLV is the sole determinant for the specific transmission of the virus by *X. index.*

2004 **Andret-Link** *et al*.: Updated review of the biological, epidemiological and molecular properties of GFLV and of its interaction with the host.

2004 **Demangeat** *et al.:* Improved method for the detection of GFLV in single individuals of *X. index* from greenhouse rearings of field populations.

3. References

Alfaro A. and A.C. Goheen, 1974. Transmission of strains of grapevine fanleaf virus by *Xiphinema index*. *Plant Disease Reporter* **58**, 549-552.

Altmayer B., 1989. Elimination of different nepoviruses and grapevine leafroll by *in vitro* apical culture of grapevines. *Proceedings of the 9th Meeting of ICVG, Kiryat Anavim, 1987*, 155-158.

Andret-Link P., C. Schmitt-Keichinger, G. Demangeat, G. Komar and M. Fuchs, 2003. The specific transmission of *Grapevine fanleaf virus* by its nematode vector *Xiphinema index* is solely determined by the viral coat protein. *Virology* **291**, 12-22.

Andret-Link P., C. Laporte, L. Valat, C, Ritzenthaler, G. Demangeat, E. Vigne, V. Laval, P. Pfeiffer, C. Stussi-Garaud and M. Fuchs, 2004. Grapevine fanleaf virus: still a major threat to the grape industry. *Journal of Plant Pathology* **86**, 183-195.

Arnaud G., 1937. Les maladies à virus des plantes. VI. Maladies à virus de la vigne et court-noué. *Progrés Agricole et Viticole* **58**, 113, 138-141.

Arnaud G. and M. Arnaud, 1931. Traité de pathologie végétale. Court-noué et Roncet, tome 1, vol. 1, 611-630. Paul Lechevalier & Fils, Paris, 903 pp.

Baccarini P., 1902. Roncet. *Viticoltura Moderna* **8**, 241-248.

Bardonnet N., F. Hans, M.A. Serghini and L. Pinck, 1994. Protection against virus infection in tobacco plants expressing the coat protein of grapevine fanleaf nepovirus. *Plant Cell Reports* **13**, 357-360.

Bass P. and A. Vuittenez, 1977. Amélioration de la thermothérapie des vignes virosées au moyen de la culture d'apex sur milieux nutritifs ou par greffage de vignes de semis, obtenues aseptiquement *in vitro*. *Annales de Phytopathologie* **9**, 539-540.

Belin C., C. Schmitt, F. Gaire, B. Walter, G. Demangeat and L. Pinck, 1999. The nine C-terminal residues of the grapevine fanleaf nepovirus movement protein are critical for systemic virus spread. *Journal of General Virology* **80**, 1347-1356.

Belin C., C. Schmitt, F. Demangeat, V. Komar, L. Pinck and M. Fuchs, 2001. Involvement of RNA2-encoded proteins in the specific transmission of grapevine fnaleaf virus by its nematode vector *Xiphinema index*. *Virology* **291**, 161-171.

Bercks R., 1967. Methodische Untersuchungen über den serologischen Nachweis pflanzenpathogener Viren mit dem Bentonit-Flockungstest, dem Latex-Test und dem Bariumsulfat-Test. *Phytopathologische Zeitschrift* **58**, 1-17.

Bercks R., 1971. Serologische Untersuchungen über Vorkommen und Nachweismöglichkeit von Viren in Weinbergen von Baden-Württemberg. *Die Wein-Wissenschaft* **26**, 328-334.

Bercks R. and G. Querfurth, 1969. Weitere methodische Untersuchungen über den Latextest zum serologischen Nachweis pflanzenpathogener Viren. *Phytopathologische Zeitschrift* **65**, 243-256.

Boubals D. and A. Dalmasso, 1968. Résultats d'essais de désinfection de sols à vigne du sud de la France par des fumigants. *Progrès Agricole et Viticole* **85,** 29-37, 74-81.

Bouquet A., 1981. Resistance to grape fanleaf virus in muscadine grape inoculated with *Xiphinema index. Plant Disease* **65**, 791-793.

Bouquet A., 1983a. Mise en évidence chez l'espèce *Muscadinia rotundifolia* (Small) Michx. d'une résistance à la transmission du virus du court-noué (grape fanleaf virus) par son nématode vecteur *Xiphinema index* Thorne et Allen. *Agronomie* **3**, 94-95.

Bouquet A., 1983b. Détection immunoenzymatique du virus du court-noué de la vigne dans son vecteur *Xiphinema index* Thorne et Allen. *Comptes Rendus Hebdomataires des Séances de l'Académie des Sciences*, *Paris*, **296**, 271-273.

Bouyahia H., O. Potere and D. Boscia, 2003. Sampling methodology for the detection of Grapevine fanleaf virus by ELISA. *Extended Abstracts of the 14th Meeting of ICVG, Locorotondo 2003* , 204.

Bovey R., 1958. Etat actuel des connaissances sur les maladies à virus de la vigne. *Vitis* **1**, 237-256.

Bovey R., J.J. Brugger and P. Gugerli, 1980. Detection of fanleaf virus in grapevine tissue extracts by enzyme-linked immunosorbent assay (ELISA) and immune electron microscopy (IEM). *Proceedings of the 7th Meeting of ICVG, Niagara Falls 1980* , 259-275.

Branas J., G. Bernon and L. Levadoux, 1937. Sur les circonstances qui favorisent le développement du court-noué. *Progrès Agricole et Viticole* **58**, 161-165.

Branas J., G. Bernon and L. Levadoux, 1946. Nouvelles observations sur la transmission du court-noué de la vigne. *Progrès Agricole et Viticole* **67,** 20-25, 42-48, 82-83.

Brown D.J.F. and I.M. Roberts, 1980. Detection of nepoviruses in their nematode vectors by immunosorbent electron microscopy. *XVth International Nematology Symposium, Bari, 1980,* 36-37.

Brandt S. and G. Himmler, 1995. Detection of nepoviruses in ligneous grapevine material by using RT-PCR. *Vitis* **34**, 127-128.

Brückbauer H. and M. Rüdel, 1961. Untersuchungen über die Viruskrankheiten der Rebe. III. Samenübertragbarkeit der Reisigkrankheit des Silvaners bei einer Testpflanze sovie Untersuchungen über das evtl. Vorkommen des Virus in Veinbergsunkräutern. *Die Wein-Wissenschaft* **16**, 187-189.

Cadman C.H., H.F. Dias and B.D. Harrison, 1960. Sap-transmissible viruses associated with diseases of grape vines in Europe and North America. *Nature*, *London* **187**, 577-579.

Cazalis-Allut L.C*x*., 1865. De la dégéneration des vignes. *Ouvres Agricoles*, 57-61.

Catalano L., F. Roca and M.A. Castellano, 1989. Efficiency of transmission of an isolate of grapevine fanleaf virus (GFV) by three populations of *Xiphinema index* (Nematoda: Dorylaimida). *Nematologia Mediterranea* **19**, 349-351.

Catalano L., V. Savino and F. Lamberti, 1991. ELISA for the detection of grapevine fanleaf nepovirus in *Xiphinema index*. *Proceedings of the 10th Meeting of ICVG, Volos, Greece, 1990*, 243-246.

Cholin J.J., 1896. Beobachtungen über die “Reisigkrankheit” der Reben an Ahr. *Mitteilung über Weinbau und Kellerwirtschaft* **8**, 63-64.

Cohn E., E. Tanne and F.E. Nitzany, 1970. *Xiphinema italiae*, a new vector of grape fanleaf virus. *Phytopathology* **60**, 181-182.

De Luca F., A. Agostinelli, S. Fatemy and F. Lamberti, 2003. Molecular characterization of *Xiphinema index* populations by PCR-RFLP and sequence analysis of the ITS region. *Extended Abstracts of the 14th Meeting of ICVG, Locorotondo 2003* , 220.

Das S. and D.J. Raski, 1968. Vector efficiency of *Xiphinema index* in the transmission of grapevine fanleaf virus. *Nematologica* **14**, 55-62.

Demangeat G., R. Voisin, J.C. Minot, N. Bosselut, M. Fuchs and D. Esmenjaud, 2003. Survival of *Xiphinema index* and retention of Grapevine fanleaf virus in a nematode population from a natually GFLV-infected vineyard.*Extended Abstracts of the 14th Meeting of ICVG, Locorotondo 2003* , 208.

Demangeat G., V. Komar, P. Cornuet, D. Esmenjaud and M. Fuchs, 2004. Sensitive and reliable detection of *Grapevine fanleaf virus* in a single *Xiphinema index* nematode vector. *Journal of Virological Methods* **122:** 79-86.

Dias H.F., 1963. Host range and properties of grapevine fanleaf and grapevine yellow mosaic viruses. *Annals of Applied Biology* **51**, 85-95.

Dias H.F., 1970. Grapevine yellow mosaic. In : Virus Diseases of Small Fruits and Grapevines - A Handbook (N.W. Frazier N.W. ed). University of California, Division of Agricultural Sciences, Berkeley, 228-230.

Dias H.F. and B.D. Harrison, 1963. The relationship between grapevine fanleaf, grapevine yellow mosaic and arabis mosaic viruses. *Annals of Applied Biology* **51**, 97-105.

Esmenjaud D., B. Walter, J.C., Minot, R. Voisin, P. Cornuet, 1993. Biotin-Avidin ELISA detection of grapevine fanleaf virus in the vector nematode *Xiphinema index. Journal of Nematology* **25,** 401-405.

Esmenjaud D., P. Abad, L. Pinck and B. Walter, 1994. Detection of a region of the coat protein gene of grapevine fanleaf virus by RT-PCR in the nematode vector *Xiphinema index. Plant Disease* **78**, 1087-1090

Etienne L., J. M. Clauzel and M. Fuchs, 1991. Simultaneous detection of several nepoviruses infecting grapevine in a single DAS-ELISA test using mixed antisera. *Journal of Phytopathology* **131**, 89-100.

Fischer R. and S. Schillberg, 2003. Engineering durable resistance in grapevines. A novel strategy for integrated disease management to overcome environmental impact of pesticides. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 224.

Fuchs M., M. Pinck, M.A. Serghini, M. Ravelonandro, B. Walter and L. Pinck, 1989. The nucleotide sequence of satellite RNA in grapevine fanleaf virus strain F 13. *Journal of General Virology* **70,** 955-962.

Fuchs M., M. Pinck, L. Etienne, L. Pinck and B. Walter, 1991a. Characterization and detection of grapevine fanleaf virus by using cDNA probes. *Phytopathology* **81**, 559-565.

Fuchs M., M. Pinck, M.A. Serghini, L. Pinck and B. Walter, 1991b. The satellite RNA associated with grapevine fanleaf virus strain F13. *Proceedings of the 10th Meeting of ICVG, Volos, Greece, 1990,* 131-137.

Fuchs M., 2003. Transgenic resistance: state of the art. *Extended Abstracts of the 14th Meeting of ICVG, Locorotondo* 2003, 221-223

Gaire F., C. Schmitt, C. Stussi-Garaud, L. Pinck and C. Ritzenthaler, 1999. Protein 2A of grapevine fanleaf nepovirus in implicated in RNA2 replication and colocalizes to the replication site. *Virology* **264**, 25-36.

Galzy R., 1964. Technique de thermothérapie des viroses de la vigne. *Annales des Epiphyties* **15**, 245-256.

Gemmrich A.R., G. Link and M. Seidel, 1993. Detection of grapevine fanleaf virus (GFLV) in infected grapevines by non-radioactive nucleic acid hybridization. *Vitis* **32**, 237-242.

Gerola G.M., M. Bassi and G. Belli, 1969. An electron microscope study of different plants infected with grapevine fanleaf virus. *Giornale Botanico Italiano* **103**, 271-290.

Gifford E.M., Jr. and W.B. Hewitt, 1961. The use of heat therapy and *in vitro* shoot tip culture to eliminate fanleaf virus from the grapevine. *American Journal of Enology and Viticulture* **12**, 129-130.

Goheen A.C. and W.B. Hewitt, 1962. Vein banding, a new virus diseases of grapevines. *American Journal of Enology and Viticulture* **13**, 73-77.

Goheen A.C. and C.F. Luhn, 1973. Heat inactivation of viruses in grapevines. *Rivista di Patologia Vegetale*, Ser. IV, **9**, 287-289.

Goheen A.C., C.F. Luhn and W.B. Hewitt, 1965. Inactivation of grapevine viruses *in vivo. Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis, California, 1965*, 255-265.

Gölles R. A. Da Camara Machado, A. Minafra, N. Buzkan, I. Gribaudo, P.Saldarelli, V. Savino, G.P. Martelli, H. Katinger and M. Laimer da Camara Machado, 2000. Pathogen-derived virus resistance in grapevine: expression of viral coat protein genes in transgenic *Vitis* sp. *Extended Abstracts of the 13th Meeting of ICVG, Adelaide 2000,* 53-54.

Goussard P.G. and J. Wiid, 1992. The elimination of grapevine fanleaf virus from grapevines using *in vitro* somatic embryogenesis combined with heat therapy. *South African Journal of Enology and Viticulture* **13**, 81-83.

Graniti A. and M. Russo, 1965. Some observations on endocellular codons (trabeculae) in fanleaf-affected grapevines. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis, California, 1965*, 271-281.

Hafez S.L., D.J. Raski and B. Lear, 1981. Action of systemic nematicides in control of *Xiphinema index* on grape. *Journal of Nematology* **13**, 24-29.

Hans F., M. Fuchs and L. Pinck, 1992a Replication of grapevine fanleaf virus satellite RNA transcripts in *Chenopodium quinoa* protoplasts. *Journal of General Virology* **73,** 2517-2523.

Hans F., M. Pinck and L. Pinck, 1992b. Location of the replication determinants of the satellite RNA associated with grapevine fanleaf nepovirus (strain F-13) . *Biochimie* **75**, 597-603.

Hévin M., P. Leclair and M. Rives, 1973a. Green-grafting as a quick and secure method for graft-indexing viruses in the grapevine. *Rivista di Patologia Vegetale,* Ser.IV, **9**, 277-278.

Hévin M., M.M. Ottenwaelter, J.P. Doazan and M. Rives, 1973b. Investigating the transmission of marbrure and fan-leaf through the seed in the grapevine. *Rivista di Patologia Vegetale*, Ser. IV, **9**, 253-258.
Hewitt W.B., 1950a. Grapevine mosaic. *Bulletin of the California Department of Agriculture* **39**, 61.
Hewitt W.B., 1950b. Fanleaf -- another vine disease found in California. *Bulletin of the California Department of Agriculture* **39**, 62-63.
Hewitt W.B., 1954. Some virus and virus-like diseases of grapevines. *Bulletin of the California Department of Agriculture* **43**, 47-64.
Hewitt W.B., D.J. Raski and A.C. Goheen, 1958. Nematode vector of soil-borne fanleaf virus of grapevines. *Phytopathology* **48**, 586-595.
Hewitt W.B., A.C. Goheen, D.J. Raski and G.V. Gooding, Jr., 1962. Studies on virus diseases of the grapevine in California. *Vitis* **3**, 57-83.
Hewitt W.B., G.P. Martelli, H.F. Dias and R.H. Taylor, 1970. Fanleaf virus of grapevine. CMI/AAB Descriptions of Plant Viruses No. 28, 4 pp.
Horvath J., I. Tobias and K. Hunyadi, 1994. New natural herbaceous hosts of grapevine fanleaf nepovirus. *Horticultural Science* **26,** 31-32.
Huss B., S. Muller, G. Sommermeyer, B. Walter and M.H.V. Van Regenmortel, 1987. Grapevine fanleaf virus monoclonal antibodies: their use to distinguish different isolates. *Journal of Phytopathology* **119**, 358-370.
Huss B., B. Walter, L. Etienne and M.H.V. Van Regenmortel, 1986. Grapevine fanleaf virus detection in various organs using polyclonal and monoclonal antibodies. *Vitis* **25**, 178-188.
Izadpanah K., M. Zaki-Aghl and A. Rowhani , 2003. Non-*Vitis* hosts of Grapevine fanleaf virus and their possible epidemiological significance. *Extended Abstracts of the 14th Meeting of ICVG*, *Locorotondo 2003*, 210
Kalasian J.A., L.A. Litvak and V.G. Marinesku, 1979. Tubülaren Strukturen in Gewebven der Weinrebe nach Infektion mit dem Virus der Reisigkrankheit (grapevine fanleaf virus). *Archivs für Phytopathologie und Pflanzenschutz* **6**, 373-376
Kieffer F., C. Triouleyre, C. Bertsch, S. Farine, Y. Leva dand B. Walter, 2004. Mannose and xylose cannot be used as selectable marker genes for *Vitis vinifera* L. transformation. *Vitis* **43**, 35-39.
Krake L.R. and R.C. Woodham, 1983. Grapevine yellow speckle agent implicated in the aetiology of vein banding disease. *Vitis* **22**, 40-50.
Krastanova S., M. Perrin, P. Barbier, G. Demangeat, P. Cornuet, N. Bardonnet, L. Otten, L. Pick and B. Walter, 1995. Transformation of grapevine rootstocks with the coat protein gene of grapevine fanleaf nepovirus. *Plant Cell Reports* **14**, 550-554.
Lahogue F. and G. Boulard, 1996. Recherche de gènes de résistance naturelle à deux viroses de la vigne: le court-noué et l'enroulement. *Vitis* **35**, 43-48.
Laporte C., C. Ritzenthaler, G. Vetter, A.M. Loudes, D.G. Robinson, S. Hillmer and C. Stussi-Garaud. Grapevine fanleaf virus movement protein traffics along the secretory pathway and the cytoskeleton for its proper targeting to plasmodesmata. *Extended Abstracts of the 14th Meeting of ICVG, Locorotondo 2003*, 12
Lazar J., M. Kölber and J. Lehoczky, 1990. Detection of some nepoviruses (GFV, GFV-YM, GCMV, ArMV) in the seeds and seedlings of grapevines by ELISA. *Kertgazdasag* **22**(4), 58-72.
Lear B., A.C. Goheen and D.J. Raski, 1981. Effectiveness of soil fumigation for control of fanleaf-nematode complex in grapevines. *American Journal of Enology and Viticulture* **32**, 208-211.
Martelli G.P. and W.B. Hewitt, 1963a. Comparative studies on some Italian and Californian virus diseases of grapevine. *Phytopathologia Mediterranea* **2,** 275-284.
Martelli G.P. and W.B. Hewitt, 1963b. Purification and serology of Italian strains of grape fanleaf virus. *Phytopathologia Mediterranea* **2**, 285-294.
Martelli G.P. and G. Piro, 1975. Virus diseases of the grapevine in a Sicilian herbarium of the past century. Vitis **13**, 329-335.
Martelli G.P. and C.E. Taylor, 1990.Distribution of viruses and their nematode vectors. In: K.F. Harris (ed.) *Advances in Disease Vector Research* **6**, 151-189. Springer-Verlag, New York.
Martelli G.P., O.A. De Sequeira, H.H. Kassemeyer, V. Padilla, U. Prota, A. Quacquarelli, E. Refatti, M. Rudel, I.C. Rumbos, V. Savino, B. Walter, 1993. A scheme for grapevine certification in the European Economic Community. *BCPC Monograph* **54,** 279-284.
Martelli G.P. and B. Walter, 1998. Virus certification of grapevines. In: Plat Virus Disease Control, (A. Hadidi, R.K. Khertapal, and H. Koganezawa, eds) American Phythopathological Society Press, St. Paul, 261-276.
Martelli G.P., B. Walter, and L. Pinck, 2003. Grapevine fanleaf virus. *AAB Descriptions of Plant Viruses*
Mauro M.C, S. Toutain, B. Walter, L. Pinck, L. Otten, P. Coutos-Thevenot, A. Deloire and P. Barbier, 1995. High efficiency regeneration of grapevine plants transformed with the GFLV coat protein gene. *Plant Science* **12,** 97-106.

Monette P.L., 1986. Elimination *in vitro* of two grapevine nepoviruses by an alternating temperature regime. *Journal of Phytopathology* **116**, 88-91.
Morris-Krsinich B.A.M., R.L.S. Forster and D.W. Mossop, 1983. The synthesis and processing of the nepovirus grapevine fanleaf virus proteins in rabbit reticulocyte lysate. *Virology* **130**, 523-526.
Mur G., C. Valat and J. Branas, 1972. Effets de la thermothérapie. *Progrès Agricole et Viticole* **89**, 125-127.
Naraghi-Arani P., A. Rowhani and M.A. Walker, 2000. RFLP analysis indicates that the genome of grapevine fanleaf virus is complex. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 71
Nolasco G. and O.A. Se Sequeira, 1993. Genome diversity of field isolates of grapevine fanleaf virus (GFLV) analyzed by single stranded conformation (SSCP) and restriction fragment length polyphormism (RFLP). *Extended Abstracts of the 11th Meeting of ICVG, Montreux 1993*, 31-32.
Nolasco G. and O.A. Se Sequeira, 1993. Immunocapture polymerase chain reaction (IC/PCR) in the diagnosis of grapevine fanleaf virus (GFLV) in grapevine field samples. *Extended Abstracts of the 11th Meeting of ICVG, Montreux 1993*, 158-159.
Pantanelli E., 1910. Influenza del terreno su lo sviluppo del Roncet od arricciamento della vite. *Rendiconti Regia Accademia dei Lincei,* S.V, **19**, (I sem.), 395-401.
Pantanelli E., 1912. Su la ripartizione dell'arricciamento (roncet) della vite secondo la natura e la giacitura del terreno. *Le Stazioni Sperimentali Agrarie Italiane* **45**, 245-300.
Pantanelli E., 1917. Esperienze di innesto con viti arricciate. *Le Stazioni Sperimentali Agrarie Italiane* **50**, 167-224.
Petri L., 1913. Sul significato patologico dei cordoni endocellulari nei tessuti della vite. *Atti della Reale Accademia dei Lincei. Rendiconti*, Ser.V, **22**, 154-161.
Petri L., 1918. Nuove vedute sulle cause dell'arricciamento della vite. *Atti della Reale Accademia dei Lincei. Rendiconti*, Ser.V, **27**, 271-275.
Petri L., 1929. Sulle cause dell'arricciamento della vite. *Bollettino della Regia Stazione di Patologia Vegetale, Roma*, N.S., **9**, 101-130.
Pfeiffer P., C. Ritzenthaler, F. Gaire, C. Scmitt, O. Rohfritsch, C. Laporte, L. Pinck and C. Stussi-Garaud., 2000. Generation of the viral replication compartment in cells infected with grapevine fanleaf virus. *Extended Abstracts of the 13th Meeting of ICVG, Adelaide 2000*, 63-64.
Pinck L., 2000. The fanleaf nepovirus challenge: where do we stand? *Extended Abstracts of the 13th Meeting of ICVG, Adelaide 2000*, 60-62.
Pinck L., M.Fuchs, M. Pinck, M. Ravelonandro and B. Walter, 1988. A satellite RNA in grapevine fanleaf virus strain F13. *Journal of General Virology* **69**, 233-239.
Quacquarelli A., D. Gallitelli, V. Savino and G.P. Martelli, 1976. Properties of grapevine fanleaf virus. *Journal of General Virology* **32**, 349-360.
Querfurth G. and H.L. Paul, 1979. Protein A-coated latex-linked antisera (PALLAS): new reagents for a sensitive test permitting the use of antisera unsuitable for the latex test. *Phytopathologische Zeitschrift* **94**, 282-285.
Raski D.J. and A.C. Goheen, 1988. Comparison of 1,3-dichloropropene and methyl bromide for control of *Xiphinema index* and grapevine fanleaf degeneration complex. *American Journal of Enology and Viticulture* **39**, 334-336.
Raski D.J., A.C. Goheen, L.A. Lider and C.P. Meredith, 1983. Strategies against grapevine fanleaf virus and its nematode vector. *Plant Disease* **67**, 335-339.
Raski D.J., W.B. Hewitt and R.V. Schmitt, 1971. Controlling fanleaf virus -dagger nematode disease complex in vineyards by soil fumigation. *California Agriculture* **25**(4), 11-14.
Raski D.J., N.O. Jones, S.L. Hafez, J.J. Kissler and D.A. Luvisi, 1981. Systemic nematicides tested as alternative to DBPC. *California Agriculture* **35** (5/6), 10-12.
Raski D.J., A.R. Maggenti and N.O. Jones, 1973. Location of grapevine fanleaf and yellow mosaic virus particles in *Xiphinema index*. *Journal of Nematology* **5**, 208-211.
Raski D.J. and R.V. Schmitt, 1972. Progress in control of nematodes by soil fumigation in nematode-fanleaf infected vineyards. *Plant Disease Reporter* **56**, 1031-1035.
Rathay E., 1882. Die Gabler oder Zwiewipflereben. *Österreiches Botanische Zeitscrift* **32**, 316-320.
Ritzenthaler C., M. Viry, M. Pinck, R. Margis, M. Fuchs and L. Pinck, 1991. Complete nucleotide sequence and genetic organization of grapevine fanleaf nepovirus RNA1. *Journal of General Virology* **72**, 2357-2365.
Ritzenthaler C., A. C. Schmit, P. Michler, C. Stussi-Garaud and L. Pinck, 1995. Grapevine fanleaf nepovirus putative movement protein is located on tubules *in vivo*. *Molecular Plant Microbe Interactions* **8**, 379-387.
Ritzenthaler C., C. Laporte, F. Gaire, P. Dunoyer, C. Schmitt, S. Duval, A. Piequet, A.M. LLoudes, O. Rohfritsch, C. Stussi-Garaud and P. Pfeiffer, 2002. Grapevine fanleaf virus replication occurs on endoplamic reticulum-derived membranes. *Journal of Virology* 1**7**, 8808-8819.

Rowhani A., M.A. Maningas, L.S. Lile, D. Daubert and D.A. Golino, 1995. Development of a detection system for viruses of woody plants based on PCR analysis of immobilized virions. *Phytopathology* **85**, 347-352.

Rüdel M., 1980. *Xiphinema vuittenezi (Nematoda: Dorylaimidae)* Virusüberträger bei Reben. *Die Wein-Wissenschaft* **35**, 177-194.

Rüdel M., 1987. Bekämpfung von Rebvirosen: notwendig und durchführbar? *Rebe und Wein, Weinsberg* **40**, 344-346.

Rüdel M., 1988. Schadnematoden im Weinbau und ihre Bekämpfung. *Rebe und Wein, Weinsberg* **42**, 29-31.

Russo M., G.P. Martelli and V. Savino, 1980. Immunosorbent electron microscopy for detecting sap-transmissible viruses of grapevine. *Proceedings of the 7th Meeting of ICVG, Niagara Falls 1980* , 251-257.

Saldarelli P., A. Minafra A. and B. Walter, 1993. A survey of grapevine fanleaf nepovirus isolates for the presence of satellite RNA. *Vitis* **32**, 99-102.

Savino V., C. Cherif and G.P. Martelli, 1985. A natural serological variant of grapevine fanleaf virus. *Phytopathologia Mediterranea* **24**, 29-34.

Schiff-Giorgini R., 1906. Il roncet delle viti americane in Sicilia. *Bollettino Ufficiale del Ministero dell'Agricoltura,* N.S., **6**, 971-979.

Serghini M.A., M. Fuchs, M. Pinck, J. Reinbolt, B. Walter and L. Pinck, 1990. RNA2 of grapevine fanleaf virus: sequence analysis and coat protein cistron location. J*ournal of General Virology* **71**, 1433-1441.

Spielmann A.,S. Marc-Martin, M.E. Ramel and P. Gugerli, 1993. Expression of several modified grapevine fanleaf nepovirus coat protein genes in transgenic tobacco plants. *Extended Abstracts of the 11th Meeting of ICVG, Montreux 1993,* 173-174.

Spielmann A., S. Krastanova, V. Douet-Ohrant, S. Marc-Martin, M.H. Prince Sigrist and P. Gugerli, 1997. Resistance to nepoviruses in grapevine: expression of several putative resistance genes in transgenic plants. *Extended Abstracts of the 12th Meeting of ICVG, Lisbon 1997,* 143-144.

Staudt G., 1991. Spreading of grapevine fanleaf virus in grapevines after inoculation by *Xiphinema index*. *Proceedings of the 10th Meeting of ICVG, Volos, Greece, 1990*, 138-142.

Staudt G. and B. Weischer, 1992. Resistance to transmission of grapevine fanleaf virus by *Xiphinema index* to *Vitis rotundifolia* and *Vitis munsoniana*. *Wein-Wissenschaft* **47**, 56-61.

Taylor R.H. and W.B. Hewitt, 1964. Properties and serologial relationships of Australian and Califonian soil-borne viruses of the grapevine and arabis mosaic virus. *Australian Journal of Agricultural Research* **15**, 571-585.

Taylor C.E. and W.M. Robertson, 1970. Sites of virus retention in the alimentary tract of the nematode vectors, *Xiphinema diversicaudatum* (Micol.) and *X. index* (Thorne and Allen). *Annals of Applied Biology* **66**, 375-380.

Taylor R.H., 1970. Vein banding of *Vitis*. In*:* Virus Diseases of Small Fruits and Grapevines - A Handbook (Frazier N.W. ed.) University of California, Division of Agricultural Sciences, Berkeley, 230-232.

Uyemoto J.K., A.C. Goheen, C.F. Luhn and L.J. Petersen, 1976. Use of *Chenopodium quinoa* in indexing for grapevine fanleaf virus. *Plant Disease Reporter* **60**, 536-538.

Van Velsen R.J. and J.M. Niejalke, 1974. Green budding of grapevines (*Vitis vinifera*). *Agricultural Record* **1**, 24-25.

Vigne E., M. Bergold, S. Guyader and M. Fuchs, 2004a. Population structure and genetic variability within *Grapevine fanleaf virus* isolates from a naturally infected vineyard in France: evidence for mixed infection and recombination. *Journal of General Vrology* **85**, 2435-2445.

Vigne E., V. Komar, and M. Fuchs, 2004b. Field safety assessment of recombination in transgenic grapevines expressing the coat protein gene of *Grapevine fanleaf virus*. *Transgenic Research* **13**, 165-179.

Viry M. M.A. Serghini, F. Hans, C. Ritzenthaler, M. Pinck and L. Pick, 1993. Biologically active transcripts from cloned cDNA of genomic grapevine fanleaf nepovirus RNAs. *Journal of General Virology* **74**, 169-174.

Vuittenez A., 1958. Activité comparée des fumigants, des insecticides et de divers produits appliqués en traitements du sol sur les contaminations par la dégénérescence infectieuse de la vigne. *Comptes Rendus des Séances de l'Académie d'Agriculture de France* **44**, 901-907.

Vuittenez A. 1960a. Nouvelles observations sur l'activité des traitements chimiques du sol pour l'éradication des virus de la dégénérescence infectieuse de la vigne. *Comptes Rendus des Séances de l'Académie d'Agriculture de France* **46**, 89-96.

Vuittenez A., 1960b. Mise en évidence chez les vignes atteintes de dégénérescence infectieuse, d'un virus transmissible mécaniquement aux Chénopodes (*Chenopodium amaranticolor* et *C. quinoa*). *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, *Paris* **251**, 783-785.

Vuittenez A., 1970. Fanleaf of grapevine. In: Virus Diseases of Small Fruits and Grapevines - A Handbook (Frazier N.W. ed.) University of California, Division of Agricultural Sciences, Berkeley, 217-228.
Vuittenez A., 1980. The new improvements of serological methods and their possible application to detect and identify viruses and virus-like diseases of the grapevine. *Proceedings of the 7th Meeting of ICVG, Niagara Falls, Canada, 1980* (Canada Agricuture, Research Branch), 225-243.
Walker M.A., C.P. Meredith and A.C. Goheen, 1985. Sources of resistance to grapevine fanleaf virus (GFV) in *Vitis* species. *Vitis* **24**, 218-228.
Walker M.A., J.A. Wolpert, E.P. Vilas, A.C. Goheen and L.A. Lider, 1989. Resistant rootstocks may control fanleaf degeneration of grapevines. *California Agriculture* **43**(2), 13-14.
Walker M.A. and C.P. Meredith, 1990. The genetic of resistance to grapevine fanleaf virus in *Vitis vinifera*. *Proceedings of the 5th International Symposium on Grape Breeding, St. Martin 1989*, 228-238.
Walker M.A. and C.P. Meredith, 1990. The genetics of resistance to grapevine fanleaf virus in *Vitis vinifera*. *Proceedings of the 5th International Symposium on Grape Breeding, St. Martin/Pfalz 1989*. *Vitis* special issue, 228-238.
Walker M.A, J.A. Wolpert and E. Weber, 1994. Viticultural characteristics of VR hybrid rootstocks in a vineyard site infected with grapevine fanleaf virus. *Vitis* **33**, 19-23.
Walker M.A. and Y. Jin, 1998. Breeding *Vitis rupestris* x *Muscadinia rotundifolia* rootstocks to control *Xiphinem index* and fanleaf degeneration. *Acta Horticulturae* **528**,
Walter B., J. Kuszala and A. Vuittenez, 1979. Diagnostic sérologique par les tests PALLAS et ELISA. Application aux virus de la rhizomanie de la betterave et du court-noué de la vigne. *Annales de Phytopathologie* **11**, 568-569.
Walter B. and L. Etienne, 1987. Detection of the grapevine fanleaf viruses away from the period of vegetation. *Journal of Phytopathology* **120**, 355-364.
Walter B., B. Huss and L. Etienne, 1989. Improvements in the serological detection of ArMV and GFV. *Proceedings of the 9th meeting of ICVG, Kiryat Anavim1987*, 209-216.
Walter B., P. Bass, R. Legin, C. Martin, R. Vernoy, A. Collas abd G. Vesselle, 1990. The use of a green grafting technique for detection of virus-like diseases of the grapevine. *Journal of Phytopathology* **128**, 137-145.
Walter B., P. Bass, C. Cornuet, R. Legin and M. Fuchs, 1991 Interactions between arabis mosaic virus and grapevine fanleaf virus isolates. *Proceedings of the 9th Meeting of ICVG, Volos 1990*, 120-128.
Walter B., P. Bass, C. Cornuet and P. Guillaume 1993. Preliminary results of cross protection experiments against grapevine fanleaf virus (GFLV) in the vineyards. *Extended Abstracs of the 11th Meeting of ICVG, Montreux 1993*, 167-168.
Walter B. and G.P. Martelli, 1996. Sélection clonale de la vigne: sélection sanitaire et sélection pomologique. Influence des viroses et qualité. 1ere partie: Effects des viroses sur la culture des vignes et ses produits. *Bulletin de l'OIV* **69**, 945-971.

INFECTIOUS DEGENERATION
(EUROPEAN AND MEDITERRANEAN NEPOVIRUSES)

Besides GFLV several other nepoviruses can infect grapevine in Europe, the Mediterranean and Middle East, causing diseases whose symptoms are similar to, or indistinguishable from those of fanleaf. Several of these viruses have distorting and chromogenic strains and may occur in mixed infections with GFLV. All have polyhedral particles about 30 nm in diameter and a positive sense, single-stranded RNA genome occurring as two functional species (RNA-1 and RNA-2), which are separately encapsidated. Many are transmitted by longidorid nematodes (Rüdel, 1992). Serological (ELISA, ISEM) and molecular assays (hybridization, RT-PCR) are routinely used for their detection in grapevine tissues (primarily cortical scrapings from dormant canes). Mechanical transmission to herbaceous hosts or indexing on *Vitis* indicators can also be used. These viruses can readily be eliminated by heat therapy or *in vitro* meristem tip culture. Their detrimental effects to grapevine culture and products have been summari zed by Walter and Martelli (1996).

Nepoviruses, which were originally included in the Nepovirus group (Harrison and Murant, 1977) , a non-taxonomic clustering, are now classified in the genus *Nepovirus,* family *Comoviridae* (Goldbach *et al.*, 1955) and are subdivided into subgroups based on physico-chemical properties of member viruses, i.e. subgroup A typified by *Tobacco ringspot virus* (TRSV); subgroup B, typified by *Tomato black ring virus* (TBRV); subgroup C, typified by *Tomato ringspot virus* (ToRSV) (Martelli *et al.*, 1978; Murant 1981, Le Gall *et al*., 2005). *Strawberry latent ringspot virus* (SLRSV), a nematode-borne virus originally classified as a tentative species in the genus *Nepovirus*, has now been assigned to the newly established genus *Sadwavirus* (Le Gall *et al.*, 2005)

Extensive reviews of the biological, epidemiological, physico-chemical, and molecular characteristics of nepoviruses (Harrison and Murant, 1996; Taylor and Brown, 1997) and their satellite RNAs (Mayo *et al.,* 2000) are available.

References

Goldbach R., G.P. Martelli and R.G. Milne, 1955. Family *Comoviridae*. In: Virus Taxonomy. Sixth Report of the International Committee on Taxonomy of Viruses (F.A. Murphy *et al.*, eds). Springer-Verlag, Vienna, 341-347.

Harrison B.D. and A.F. Murant, 1977. Nepovirus Group. *CMI/AAB Descriptions of Plant Viruses* No. 185.

Harrison B.D. and A.F. Murant (eds), 1996. The Plant Viruses. Polyhedral Virions and Bipartite RNA Genomes. Vol. 5. Plenum Press, New York, 362 pp.

Le Gall O., T. Iwanami, A.V. Karasev, T.A. Jones, K. Lehto, H. Sanfaçon, J. Wellink, T. Wetzel and N. Yoshikawa, 2005. Family *Comoviridae.* In: Virus Taxonomy. Eight Report of the International Committee on Taxonomy of Viruses (C.M. Fauquet, M.A. Mayo, J. Maniloff, U. Desselberger and L.A. Ball, eds) Elsevier/Academic Press, London, 807-818.

Martelli G.P., A. Quacquarelli, D. Gallitelli, V. Savino and P. Piazzolla, 1978. A tentative grouping of nepoviruses *Phytopathologia Mediterranea* **17**, 145-147.

Mayo M.A., C. Fritsch, M.J. Leibowitz, P. Palukaitis, K.B. Scholtof, G. Simons and M. Taliansky, 2000. Satellite nucleic acids. In: Virus Taxonomy. Seventh Report of the International Committee on Taxonomy of Viruses (M.H.V. Van Regenmortel *et al*., eds). Academic Press, San Diego, 1028-1032

Murant A.F., 1981. Nepoviruses. In: Handbook of Plant Virus Infections: Comparative Diagnosis, (E. Kurstak, ed). Elsevier/Noth Holland, Amsterdam, 197-238.

Rüdel M., 1992. Nepoviruses of grapevine and their nematode vectors in the EEC. In: Grapevine Viruses and Certification in EEC Countries: State of the Art, (G.P. Martelli, ed.). Quaderno No. 3, Istituto Agronomico Mediterraneo, Bari, 23-39.

Taylor C.E and D.J.F. Brown, 1997. Nematode Vectors of Plant Viruses. CAB International, Oxon, 286 pp.

Walter B. and G.P. Martelli, 1996. Sélection clonale de la vigne: sélection sanitaire et sélection pomologique. Influence des viroses et qualité. 1ere partie: Effects des viroses sur la culture des vignes et ses produits. *Bulletin de l'OIV* **69**, 945-971.

Genus *NEPOVIRUS*

ARABIS MOSAIC VIRUS (ArMV)

1. Description

ArMV, a typical nepovirus belonging in subgroup A of the genus *Nepovirus*, is serologically related to GFLV. Its particles are about 30 nm in diameter, have a angular outline, and sediment as three components (T, M, and B). Component T is made up of empy protein shells, whereas components M and B contain RNA. Coat protein has a single type of subunits with M_r 54 x 10^3. The genome is a positive sense ssRNA, consisting of two separately encapsidated molecules with Mol. wt 2.2 x 10^6 (RNA-1) and 1.95-2.1 x 10^6 (RNA-2), accounting for 27% (component M) and 41% (component B) of the particle weight. Two types of RNA-2 molecules have been found which differ slightly in size (3852 and 3711 nt) but contain a single ORF encoding polypeptides with M_r of 119 and 124 kDa, respectively. The virus supports the replication of two types of satellite RNAs, linear with Mol. wt of 0.4 x 10^6 and a size of 1104 nt. and circular about 350 nt in size. ArMV occurs often in mixed infections with GFLV in certain areas of France and Italy, and with other nepoviruses in the Reisigkrankheit complex of western Germany. This virus has also been found in grapevine in Switzerland, Bulgaria, Yugoslavia, Hungary, Romania, Turkey, Iran, Israel, Canada, USA (California), and Japan. It can infect many woody and herbaceous plants and is transmitted to grapevine by the nematode *Xiphinema diversicaudatum* but not by *X. index,* the vector of GFLV. In Germany, losses up to 50 % have been recorded, and, always in Germany the severe dieback disease of the cv. Kerner appears to be caused by ArMV infection. In other *V. vinifera* varieties, symptoms are of the fanleaf type. Cross-protection between ArMV and GFLV has been reported. Transgenic plants expressing the coat protein gene of the virus have been produced.

2. Historical review

1963 **Panjan and Saric**: ArMV detected in grapevine in Yugoslavia.

1964 **Gerola** *et al*.: Ultrastructure of ArMV infections in plant tissues

1968 **Martelli and Lehoczky**: Detection of ArMV in grapevine in Hungary.

1970 **Stellmach**: Review paper on ArMV in grapevine.

1970 **Murant**: ArMV description in the CMI/AAB Descriptions of Plant Viruses series.

1972 **Dalmasso** *et al*.: *Xiphinema diversicaudatum* can transmit ArMV to grapevine.

1976 **Brückbauer and Rüdel**: Symptoms of atypical Reisigkrankheit in the vineyard are associated with ArMV in West Germany

1977 **Bercks** *et al*.: ArMV, SLRSV and TBRV found in grapevines with atypical Reisigkrankheit in West Germany.

1978 **Rüdel**: Transmission of ArMV to grape seedlings by *Xiphinema diversicaudatum.*

1978 **Jankulova and Kaitasova**: ArMV found in grapevine in Bulgaria.

1979 **Vuittenez** *et al*.: Interactions between nepoviruses in grapevine and herbaceous hosts.

1979 **Quacquarelli** *et al*.: Physico-chemical properties of GFLV, ArMV, TBRV, AILV and GCMV.

1980 **Kobayashi** *et al*.: ArMV detected in Japan in grapevines imported from Europe.

1980 **Russo** *et al*.: Detection of ArMV by ISEM

1980 **Tanne**: Detection of GFLV, ArMV and TBRV by ELISA in Israel.

1982 **Belli** *et al*.: Isolation of ArMV from grapevine in Italy.

1982 **Brückbauer**: Possibility of distinguishing GFLV, ArMV, RRV, SLRV and TBRV

1984 **Belli** *et al*.: Properties of a strain of ArMV isolated from grapevine in Italy.

1985 **Rüdel**: In the Palatinate (West Germany) ArMV is transmitted by *Xiphinema diversicaudatum* and occurs often in mixed infections with GFLV in grapevine. Yield losses may reach 77% in cv. Faber.

1986 **Stellmach and Berres**: The susceptibility of cv.Kerner to ArMV seems to be limited in time. When a healthy scion is grafted onto an infected rootstock, the virus is recovered from the scion only during the first year, whereas the rootstock remains infected. Hypothesis of a graft incompatibility when the rootstock is infected with ArMV.

1987 **Stellmach**: Kerner disease is probably caused by ArMV.

1988 **Kaper** *et al.*: Nucleotide sequenece of a small circular satelllite RNA

1989 **Steinkellner** *et al*.: Use of cDNA probes for ArMV detection. Molecular assays are as good as ELISA for routine testing.

1989 **Becker** *et al.:* Association of ArMV-infected rootstocks with Kerner disease in West Germany. The virus cannot be recovered from leaves or buds of the Kerner scions, whereas other nepoviruses, such as RpRSV or GFLV can be found in both rootstock and scion. Study of histological changes at the graft union level.

1989 **Eppler** *et al*.: ArMV recorded from Romania

1989 **Huss** *et al*.: Cross-protection experiments in *Chenopodium quinoa* between ArMV and GFLV

1990 **Gugerli** *et al*.: ArMV in Switzerland

1990 **Lázár** *et al*.: ArMV is not seed-transmitted in grapevines

1990 **Liu** *et al*.: Nucleotide sequence of the ArMV satellite RNA

1991 **Liu** *et al*.: The presence of ArMV satellite RNA can attenuate symptoms in certain hosts

1991 **Bertioli** *et al.*: Transgenic *Nicotiana* plants transformed with the coat protien of ArMV produce empty viral shells.

1992 **Ipach** *et al*.: Detection of ArMV by PCR in herbaceous hosts and grapevines

1992 **Steinkellner** *et al.* : Comparison of coat proteins of ArMV and other nepoviruses.

1993 **Walter** *et al.:* A hypovirulent ArMV isolate delays GFLV infection in grapevines under field conditions.

1993 **Steinkellner** *et al*.: *Nicotiana* plants engineerd with ArMV coat protein gene show different degrees of tolerance to the virus

1994 **Flak and Gangl**: ArMV recorded from Austria

1995 **Loudes** *et al*.: Evidence that ArMV has two RNA-2 molecules and complete nucleotide sequence of both RNAs

1995 **Etscheid** *et al*.: Properties of ArMV small satellite RNA.

1995 **Marc-Martin** *et al.*: Transformation of grapevines with the coat protein gene of ArMV.

1996 **MacKenzie** *et al*.: Survey for the presence of ArMV in Canadian vineyards

1996 **Lahogue and Boulard**: Search for genes of resistance in grapevines. Of 407 accessions of

European, American, and Asian *Vitis* species inoculated by green grafting with a ArMV source, 42 were apparently resistant.

1998 **Akbas and Erdiller:** ArMV recorded from Turkey

2000 **Goelles** *et al.* : Transgenic grapevines expressing ArMV coat protein gene

2003 **Fuchs**: Review on transgenic resistance of grapevines to pathogens

2004 **Pourrahim** *et al*.: ArMV identified in Iranian grapevines by mechanical transmission to herbaceous hosts and ELISA

3. References

Akbas B. and G. Erdiller, 1998. Grapevine virus diseases in Karaman, Konya and Nevsheir provinces. *Proceedings VII Congress of the Turkish Phytopathological Society, Ankara 1998,* 149-153.

Becker A., J. Jäger and B. Altmayer, 1989. Association of arabis mosaic virus-infected rootstocks with the dieback of the Vitis vinifera cv."Kerner" in Germany. *Proceedings 9th Meeting of ICVG, Kiryat Anavim, 1987*, 57-61.

Belli G., A. Fortusini and G. Vegetti, 1982. Il virus del mosaico dell' Arabis isolato da vite in Italia. *Rivista di Patologia Vegetale,* S IV, **18**, 175-177.

Belli G., G. Vegetti, S. Cinquanta, C. Soncini, S. Prati and D. Tolentino, 1984. Properties of a strain of arabis mosaic virus isolated from grapevine in Italy. *Rivista di Patologia Vegetale*, S IV, **20**, 56-64.

Bercks R., H. Brückbauer, G. Querfurth and M. Rüdel, 1977. Untersuchungen über die Viruskrankheiten der Rebe unter besonderer Berücksichtigung "atypischer Formen" der Reisigkrankheit. *Weinberg und Keller* **24**, 133-180.

Bertioli D.J., R.D. Harris, M.L. Edwards, J.I.Cooper and W.S. Hawes, 1991. Transgenic plants and insect cells expressing the coat protein of Arabis mosaic virus produce empty virus-like particles. *Journal of General Virology* **72,** 1801-1809.

Brückbauer H. and M. Rüdel, 1976. Untersuchungen über eine "atypische" Form der Reisigkrankheit bei der Rebsorte Silvaner. *Weinberg und Keller* **23**, 53-79.

Dalmasso A., M.C. Munck-Cardin and R. Legin, 1972. Résultats préliminaires d'essais de transmission de sérotypes de la mosaïque de l'*Arabis* trouvés sur vigne, par l'intermédiaire de *Xiphinema diversicaudatum. Annales de Phytopathlogie* **4**, 410

Eppler A., V. Lesan and A. Lázár, 1989 Viruses and virus diseases in some vineyards in Romania. *Meded. Facultet Landbouwwetenschappen Rijkuniversiteit Gent* **54**, 491-497.

Etscheid M., M.E. Tousignat and J.M. Kaper, 1995. Small satellite of arabis mosaic virus autolytic processing of in vitro transcripts of (+) and (-) polarity and infectivity of (+) strand transcripts. *Journal of General Virology* **76**, 271-282.

Flak W. and H. Gangl, 1994. Grobkartierung des Rebenvirosenbefalls in der Weinbauregion Bungerland mittels ELISA. *Mitteilung Klosterneuburg* **44**, 163-167.

Fuchs M., 2003. Transgenic resistance: state of the art. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 221-223.

Gerola F.M. M. Bassi and E. Betto, 1964. Shape and localization of arabis mosaic virus in experimentally infected cells of *Chenopodium amaranticolor*. *Phytopathologische Zeitscrift* **51**, 192-194.

Goelles R., R. Moser, H. Puhringer, H. Katinger, M.L. da Camara Machado, A. Minafra, V. Savino, P. Saldarelli, G.P. Martelli and M. Laimer da Camara Machado, 2000. Transgenic grapevines expressing coat protein gene sequences of grapevine fanleaf virus, arabis mosaic virus, grapevine virus A and grapevine virus B. *Acta Horticulturae* **528**, 305-311.

Gugerli P., J.J. Brugger and P. Basler, 1990. Les maladies de l'enroulement, du bois strié et de l'ècorce liégeuse de la vigne (grapevine leafroll, rugose wod and corky bark). *Revue Suisse de Viticulture, Arboriculture et Horticulture* **22**, 35-36.

Kaper J.M., M.E. Tousignant and M. Steger, 1988. Nucleotide sequence predicts circularity and self-cleavage of 300-nucleotide satellite of arabis mosaic virus. *Biochemical and Biophysical Research Communications* **154**, 318-322.

Lahogue F. and G. Boulard, 1996. Recherche de gènes de résistance naturelle à deux viroses de la vigne: le court-noué et l'enroulement. *Vitis* **35**, 43-48.

Liu Y.Y., C.U.T. Hellen, J.I. Coper, D.J. Bertioli, D. Coates and G. Bauer, 1990. The nucleotide sequence of a satellite RNA associated with arabis mosaic nepovirus. J*ournal of General Virology* **71**, 1259-1263.

Liu Y.Y., J.I. Cooper, M.L. Edwards and C.U.T Hellen, 1991. A satellite RNA of arabis mosaic virus and its pathological impact. *Annals of Applied Biology* **118**, 557-587.

Loudes A.M., C. Ritzenthaler, M. Pinck, M.A. Serghini and L.. Pinck, 1995. The 119 kDa and 124 kDa polyprotiens of arabis mosaic nepovirus (isolate S) are encoded by two distinct RNA2 species. *Journal of General Virology* **76**, 899-906.

MacKenzie D.J., R.C. Johnson and C. Warner, 1996. Incidence of four important viral pathogens in Canadian vineyards. *Plant Disease* **80,** 955-958.

Murant A.F, 1970. Arabis mosaic virus. *CMI/AAB Descriptions of Plant Viruses*, No. 16

Pourrahim R., A. Ahoonmanesh, Sh. Farzdfar, F.Rakhshandehro and A.R. Golanaraghi. Occurrence of Arabis mosaic virus and Grapevine leafroll-associated virus 3 in Iran. *Plant Disease* **88**, 424.

Quacquarelli A., D. Gallitelli, V. Savino, P. Piazzolla and G.P. Martelli, 1979. Some properties of grapevine fanleaf and other nepoviruses infecting the grapevine. *Proceedings 6th Meeting of ICVG, Cordoba, 1976. Monografias INIA No. 18* , 41-49.

Rüdel M., 1978. Übertragung des Arabis-Mosaik-Virus (AMV) durch den Nematoden *Xiphinema diversicaudatum* (Micoletzki) Thorne auf Rebensämlinge (Vorläufige Mitteilung). *Die Wein-Wissenschaft* **33**, 243-247.

Rüdel M., 1985. Grapevine damage induced by particular virus-vector combinations. *Phytopathologia Mediterranea* **24**, 183-185.

Steinkellner H., G. Himmler, M. Laimer, D. Mattanovich, G. Bisztray and H. Katinger, 1989. Konstruktion von cDNA von Arabis Mosaik Virus und deren Anwendung für Diagnose. *Mitteilung Klosterneuburg* **39**, 242-246.

Steinkellner H., G. Himmler, R. Sagl, D. Mattanovich, and H. Katinger, 1992. Amino acid sequence comparison of nepovirus coat proteins. *Virus Genes* **6**, 197-202.

Steinkellner H., A. da Camara Machado, M. Laimer-da Camada Machado, M. Gölles and H. Katinger, 1993. Studies on coat protein mediated cross protection of nepoviruses. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993*, 175.

Stellmach G., 1970. Arabis mosaic in *Vitis*. In: Virus Diseases of Small Fruits and Grapevines- A Handbook (N.W. Frazier, ed). University of California, Division of Agricultural Sciences Berkeley, 233-234.

Stellmach G., 1987. Die Kerner Krankheit: Theoretische und praktische Aspekte einer tödlichen Rebenvirose. *Die Wein-Wissenschaft* **42**, 421-427.

Stellmach G. and R.-E. Berres, 1986. Begrenzte Infektionsanfälligkeit der *Vitis vinifera*- Sorte "Kerner" gegenüber dem Arabismosaik-Virus? *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* **93**, 356-360.

Walter B, P. Bass, P. Cornuet and P.M. Guillaume, 1993. Preliminary results of cross protection experiments against grapevine fanleaf virus (GFLV) in the vineyards. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993,* 167-168

ARTICHOKE ITALIAN LATENT VIRUS (AILV)

1. Description

Artichoke Italian latent virus (AILV), a member of subgroup B of the genus *Nepovirus,* was isolated in Bulgaria from vines with fanleaf-like symptoms. AILV has isometric particles with angular outline, sedimenting as three components: T (empty shells), M (particles contaning a molecule of RNA-2 with Mol. wt of 1.5 x 10^6 daltons accounting for 34% of the particle weight) and B (particles containing a molecule of RNA-1 with Mol. wt of 2.4 x 10^6 daltons, accounting for 41% of the particle weight). Coat protein is made up of a single type of subunits with M_r 54 x 10^3. AILV is transmitted by the Dorylaimoid nematode *Longidorus apulus* in vegetable crops but no field transmission to grapevines has been recorded. The virus has limited distribution and economic importance.

2. Historical review

1976 **Jankulova** *et al.*: AILV isolated in southern Bulgaria in 1976 from a grapevine with fanleaf-like symptoms. Properties of the virus, cultured in *Chenopodium quinoa* determined and positive serological reaction with an antiserum to an Italian strain of AILV ascertained.

1976 **Savino** *et al.*: Comparison of a Bulgarian grapevine isolate of AILV with an Italian isolate from artichoke and two Bulgarian isolates from sowthistle and gladiolus.

1977 **Martelli** *et al.*: AILV description in the CMI/AAB Descriptions of Plant Viruses series.

3. References

Jankulova M., V. Savino, D. Gallitelli, A. Quacquarelli and G.P. Martelli, 1979. Isolation of artichoke Italian latent virus from the grapevine in Bulgaria. *Proceedings of the 6th Meeting of ICVG, Cordoba 1976. Monografias INIA* **18,** 143-148.

Martelli G.P., G.L.. Rana and V. Savino, 1977. Artichoke Italian latent virus. *CMI/AAB Descriptions of Plant Viruses,* No. 176.

Savino V., D. Gallitelli, M. Jankulova and G.L. Rana, 1976. A comparison of four isolates of Artichoke Italian latent virus (AILV). *Phytopathologia Mediterranea* **16**, 41-50.

CHERRY LEAFROLL VIRUS (CLRV)

1. Description

Cherry leafroll virus (CLRV) is a cosmopolitan virus. In Chile it was recovered from vines with fanleaf-like symptoms and in Germany from vines with yellow mosaic-like symptoms. Although CLRV is a definitive nepovirus species classified in subgroup C of the genus *Nepovirus* it differs from most of the other members in the genus being transmitted by pollen rather than nematodes. The vector to grapevine, if any, is unknown. CLRV occurs in nature as multiple strains but is not serologically related to any of the known nepoviruses. Virus particles are isometric, about 30 nm in diameter have angular outline and sediment as three components (T, M, and B). Their coat protein consists of a single type of subunits with M_r of about 54 kDa. The genome is a bipartite, positive sense, single-stranded RNA which has been sequenced only in part. Genomic RNA consists of two separately encapsidated functional molecules with Mol. wt of 2.8×10^6 (RNA-1) , accounting for 46% of the particle weight, and 2.3×10^6 (RNA-2), accounting for 41% of the particle weight. In grapevines CLRV is readily detected by DAS-ELISA. The best woody indicator for the German isolate is reported to be Pinot noir.

2. Historical review

1985 **Jones:** Description of *Cherry leafroll virus* in the AAB Descriptions of Plant viruses series.

1993 **Scott** *et al.*: Partial nucleotide sequence of CLRV RNA-2.

2001 **Herrera and Madariaga**: First record of CLRV from Chile. Field infection is estimated to be 0.2%

2003 **Ipach** *et al.*: Isolation of CLRV from German vines showing yellow mosaic-like symptoms and reduced crop.

3. References

Herrera M.G and V.M. Madariaga, 2001. Presence and incidence of grapeivne viruses in central Chile. *Agricultura Tecnica* **61**, 393-400

Ipach U., L. Kling and D.E. Lesemann, 2003. First record of *Cherry leafroll virus* on grapevine in Germany. *Extended Abstracts 14th Meeting of ICVG, Locorotondo, 2003*, 17-18

Scott N.W., J.I. Cooper, and M.L Edwards, 1993. The identification, cloning, and sequence analysis of the coat protein coding region of a birch isolate of cherry leafroll nepovirus. *Archives of Virology* **131**, 209-215.

GRAPEVINE ANATOLIAN RINGSPOT VIRUS (GARSV)

1. Description

Grapevine Anatolian ringspot Virus (GARSV) was isolated from Turkish grapevines with mild fanleaf-like symptoms. The virus belongs in subgroup B of the genus *Nepovirus* but is not serologically related to any of the known grapevine nepoviruses. Virus particles are isometric *c.* 30 nm in diameter and sediment as three centrifugal components. RNA-1 has a Mol. wt of 2.2×10^6 Da and RNA-2 a Mol. wt of 1.4×10^6 Da and a size of 4607 nt. Coat protein subunits have a Mr 56×10^3 Da. GARSV can be readily detected by ELISA and PCR using primers designed on the coat protein sequence. The virus has no recognized

vector, is not seed borne and was reported only from south-eastern Turkey. The scattered distribution of infected vines in the field suggests that the virus is spread primarily by infected propagative material.

2. Historical review

2002 **Cigsar** *et al*.**:** First isolation by mechanical transmission of an unknown nepovirus from cv. Kizlar tahtasi showing mild fanleaf-like symptoms

2003 **Gokalp** *et al*.: Description and thorough characterization of GARSV identified as a new species in the subgroup B of the genus *Nepovirus*

2005 **Abou Ghanem-Sabanadzovic** *et al.*: Complete nucleotide sequence of GARSV RNA-2

3. References

Abou Ghanem-Sabanadzovic N., S. Sabanadzovic, M. Digiaro and G.P. Martelli, 2005. Complete nucleotide sequence of RNA-2 of two Turkish nepoviruses. *Virus Genes* **30***,* 335-340.

Cigsar I., M. Digiaro and G.P. Martelli, 2002. Sanitary status of grapevine in south eastern and central Anatolia. *Bulletin OEPP/EPPO Bulletin* **32**, 471-475

Gokalp K. M. Digiaro, I. Cigasr, N. Abou Ghanem-Sabanadzovic, A. De Stradis, D. Boscia and G.P. Martelli, 2003. Properties of a previously undescribed nepovirus fron south-east Anatolia. *Journal of Plant Pathology* **85**, 35-41.

GRAPEVINE BULGARIAN LATENT VIRUS (GBLV)

1. Description

Grapevine Bulgarian latent virus (GBLV) owes it name to the fact that it was found for the first time in Bulgaria in 1971, where it is widespread and infects latently several grapevine varieties growing in widely separared areas. GBLV is a typical nepovirus belonging in subgroup C of this genus but its vector is not known. The virus occurs as different closely related but serologically distinguishable strains. Virus particles are about 30 nm in diameter and sediment as three components (T, B_1, and B_2). Component T is made up of empy protein shells, whereas components B_1 and B_2 contain RNA. Coat protein has a single type of subunits with M_r 54 x $10^{3.}$ The genome is a positive sense ssRNA, consisting of two separately encapsidated molecules with Mol. wt of 2.2 x 10^6 (RNA-1) and 1.95-2.1 x 10^6 (RNA-2), accounting for 39% (componet B_1) and 42% (component B_2) of the particle weight. The virus supports the replication of a satellite RNA with Mol. wt 0.5 x 10^6 (less than 1800 nt). A strain of this virus had been found previously in Portugal and described as virus CM112. GBLV has also been recorded from Hungary and Yugoslavia. By contrast, a virus serologically related to GBLV found in Concord grapes in New York State vineyards is a strain of *Blueberry leaf mottle virus* (BLMoV) a North American nepovirus species related to, but different from GBLV. Two isolates of GBLV have been transmitted by mechanical inoculation to seedlings and rooted cuttings of several grapevine cultivars without inducing symptoms. The economic importance of the virus is minor.

2. Historical review

1972 **Ferreira and De Sequeira:** Description and preliminary characterization of an unidentified virus denoted CM112, isolated in 1970 in Portugal from symptomless vines.

1972 **De Mendonça** *et al*.: Isolation of virus CM112 from *in vitro* cultures of grapevine tissues.

1977 **Martelli** *et al*.: Description of GBLV. Biological, physico-chemical and serological characterization of the virus and assignment to the Nepovirus group (now genus *Nepovirus*). The virus can be detected directly in grapevine leaf extracts by immunodiffusion in agar plates.

1977 **Uyemoto** *et al.*: A virus serologically related to GBLV isolated from *Vitis labrusca* cv. Concord in New York State.

1978 **Martelli** *et al*.: GBLV description in the CMI/AAB Descriptions of Plant Viruses series.

1979 **Martelli** *et al.*: A comparative study of three GBLV isolates from Bulgaria shows that they are closely related but serologically distiguishable and that can infect seedlings and rooted cuttings of different grapevine cultivars without inducing symptoms.

1980 **Dimitrijevic**: GBLV found in Yugoslavia

1980 **De Mendonça** *et al*.: Detection of virus CM112 in grapevine leaf extracts by ISEM.

1980 **Martelli** *et al*.: Ultrastructural study of GBLV infections in grapevine and *C. quinoa.*

1980 **Russo** *et al*.: Detection of GBLV in grapevine leaf extracts by ISEM.

1981 **Ramsdell and Stace-Smith**: The New York isolate of GBLV is a strain of BLMoV**.**

1981 **Pocsai**: Occurence of GBLV in Hungary**.**

1982 **Varennes and De Sequeira**: First application of ELISA for the detection of virus CM112**.**

1983 **Gallitelli** *et al*.: A comparative study of Bulgarian GBLV isolates and the Portuguese virus CM112 establishes that CM112 is a serologically close but distinguishable strain of GBLV. The Portuguese strain supports the replication of a satellite RNA.

1985 **De Sequeira and Vasconcelos-Costa**: Use of an immunoradiometric assay for the titration of the Portuguese strain of GBLV.

1992 **Krastanova** *et al*.: Improvement of ELISA protocol for GBLV detection the whole year round.

3. References

De Mendonça A., O.A. De Sequeira and A.A. Ferreira, 1972.Sur l'isolement d'un virus à partir de cultures de tissus de vigne. *Proceeding 4th Meeting of ICVG, Colmar 1970. Annales de Phytopathologie*, Numéro hors série, 143-145

De Mendonça A., O.A. De Sequeira, M. Mota, A.N. Pereira and V. Simoes, 1980. Applicability of immunosorbent electron microscopy (ISEM) for the detection and identification of CM112 virus in grapevine.*Proceedings 7th Meeting of ICVG, Niagara Falls 1980*, 245-250.

De Sequeira O.A. and J. Vasconcelos-Costa, 1985. An immunoradiometric assay for the titration of a Portugese strain of grapevine Bulgarian latent virus (GBLV). A preliminary report. *Garcia de Orta Estacao Agronomica* **12**, 269-272.

Dimitrijevic B., 1980. Some properties of the new latent virus from grapevine rootstocks in Yugoslavia. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980*, 21-24.

Ferreira A.A. and O.A. De Sequeira, 1972. Preliminary studies on an undescribed grapevine virus. *Proceeding 4th Meeting of ICVG, Colmar, France, 1970. Annales de Phytopathologie*, Numéro hors série, 113-120.

Gallitelli D., V. Savino and O.A. De Sequeira, 1983. Properties of a distinctive strain of Grapevine Bulgarian latent virus. *Phytopathologia Mediterranea* **22**, 27-32.

Krastanova S., D. Ganeva and M. Yankulova, 1992. Possibilities for the whole-year ELISA detection of viruses infecting grapevines. *Rasteniev'dni Nauki* **29,** 95-101.

Martelli G.P., D. Gallitelli, P. Abracheva, V. Savino and A. Quacquarelli, 1977. Some properties of grapevine Bulgarian latent virus. *Annals of Applied Biology* **85,** 51-58.

Martelli G.P., A. Quacquarelli and D. Gallitelli, 1978. Grapevine Bulgarian latent virus. *CMI/AAB Descriptions of Plant Viruses*, No. 186

Martelli G.P., D. Gallitelli, P. Abracheva, M. Jankulova, V. Savino and A. Quacquarelli, 1979. A manually transmissible latent virus of the grapevine from Bulgaria. *Proceedings 6th Meeting of ICVG, Cordoba 1976. Monografias INIA* **18** *,* 135-141.

Martelli G.P., A. Di Franco, M. Russo and V. Savino, 1980. The ultrastructure of grapevine Bulgarina latent virus infections in natural and artificial hosts. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980*, 217-222.

Pocsai E., 1981. Occurence of grapevine Bulgarian latent virus in Hungary. *Acta Phytopathologica Academiae Scientiarum Hungaricae* **16**, 349-354.

Ramsdell D.C. and R. Stace-Smith, 1981. Physical and chemical properties of the particles and ribonucleic acid of blueberry leaf mottle virus. *Phytopathology* **71**, 468-472.

Uyemoto J.K., E.F. Taschenberg and D.K. Hummer, 1977. Isolation and identification of a strain of grapevine Bulgarian latent virus in Concord grapevines in New York State. *Plant Disease Reporter* **61**, 949-953.

Varennes A. and O.A. De Sequeira, 1982. Detection of CM122 latent grapevine virus by enzyme-linked immunosorbent assay (ELISA). Evaluation of short reaction times and re-use of α-globulin and conjugate. *Agronomia Lusitana* **41**, 269-277.

GRAPEVINE CHROME MOSAIC VIRUS (GCMV)

1. Description

Grapevine chrome mosaic virus (GCMV) was first found in Hungary, near Lake Balaton, and was originally called Hungarian chrome mosaic virus. It has been recorded also from Czechoslovakia, Croatia and Austria. The genome is bipartite. RNA-1 has Mol. wt of 2.8×10^6, a size of 7212 nt and accounts for 40% of the particle weight. RNA-2 has Mol. wt of 1.6×10^6, a size of 4441 nt and accounts for 31% of the particle weight. The coat protein has a single type of subunits of M_r 52×10^3. Leaves of infected vines are partially or entirely bright yellow or whitish, a symptom virtually indistiguishable from GFLV-induced yellow mosaic. Affected vines lack in vigour and may decline and die. Some virus strains induce leaf deformity, double nodes and short internodes, pretty much like GFLV. However, symptomless infection may occur. The virus belongs in the same subgroup of TBRV (subgroup B) to which is distantly related serologically. Although GCMV particles have been detected by immunosorbent electron microscopy in *Xiphinema index* fed on infected hosts, early reports that this nematode could transmit the virus have not been confirmed. GCMV is transmitted through grapevine seeds. Tobacco pants and the rootstock 110R have been successfully transformed with the viral coat protein for induction of resistance.

2. Historical review

1966 **Martelli** *et al.*: Host range and properties of a spherical virus, called Hungarian chrome mosaic virus, transmitted to herbaceous hosts from Hungarian grapevines with symptoms similar to those of fanleaf and yellow mosaic. The virus appears to be unrelated serologically to GFLV and is not transmitted by *X. index.*

1966 **Martelli:** Purification and serology of the virus isolated from Hungarian grapevines with fanleaf- and yellow mosaic-like symptoms. The virus is not serologically related with GFLV.

1968 **Martelli** *et al.*: The isometric virus associated with Hungarian chrome mosaic is serologically distantly related to *Tomato black ring virus* (TBRV).

1968 **Jakó** *et al:* HCMV affects pigment and sugar content of infected grapevine leaves.

1969 **Pozsár** *et al.*: HCMV adversely affects photosynthetical carbon dioxide fixation.

1969 **Martelli and Sarospataki:** *X. vuittenezi* is very frequently found in vineyards with chrome mosaic patches, sometimes together with *X. index.*

1971 **Lehoczky and Tasnady:** A study of the effect of HCMV on yield and sugar content of infected grapevines.

1972a **Martelli and Quacquarelli** : Physico-chemical characterization of HCMV and comparison with TBRV.

1972b **Martelli and Quacquarelli**: Description of HCMV in the CMI/AAB Descripitons of Plant Viruses series. Virus re-named Grapevine chrome mosaic virus.

1972 **Kenten**: GCMV is distantly serologically related to *Cacao necrosis virus.*

1975 **Mali** *et al.:* GCMV recorded from Slovakia and report of *X. index* as vector of the virus (unconfirmed results). No evidence that *X. vuittenezi* transmits GCMV or GFLV.

1977 **Saric and Hranuelli:** GCMV recorded from Croatia.

1979 **Lehoczky** *et al*.: Characterization of a GCMV strain and confirmation of its serological relationship with TBRV.

1980 **Russo** *et al*.: Detection of GCMV in leaf dips by ISEM.

1980 **Roberts and Brown**: Detection of GCMV in *X. index* extracts by ISEM. This finding does not imply vectoring capacity by this nematode.

1982 **Doz** *et al.*: GCMV cross-protects *Chenopodium quinoa* from the severe apical necrosis induced by a TBRV strain.

1984 **Dodd and Robinson**: GCMV and TBRV are molecularly related.

1985 **Kölber** *et al.*: GCMV detected by ELISA in infected field-grown vines.

1985 **Lehoczky**: Pinot noir and Jubileum 75 are good indicators for GCMV.

1989 **Le Gall** *et al*.: Complete nucleotide sequence of GCMV RNA-1.

1989 **Brault** *et al.*: Complete nucleotide sequence of GCMV RNA-2.

1989 **Bretout** *et al.*: Development of molecular probes for GCMV detection.

1990 **Lázár** *et al*: Seed transmission of GCMV in grapevine.

1993 **Brault** *et al.*: Tobacco plants genetically engineered with the coat protein gene of GCMV are resistant to infection.

1993 **Lehoczky** *et al.*: Description of a certification scheme for the production of virus-free propagating material in Hungary.

1994 **Dimou** *et al*.: GCMV recorded from Austria.

1994 **Le Gall** *et al*.: Transformation of roostock 110R with the coat protein gene of GCMV. No assessment of resistance made.

1995 **Brandt and Himmler**: Development of a IC-PCR protocol for GCMV detection in cortical scrapings from dormant grapevine canes.

1995 **Le Gall** *et al*.: GCMV and TBRV can recombine. Further demonstration that the two viruses are related.

1997 **Taylor and Brown:** Results of GCMV transmission trials with *X. index* are inconclusive. The virus vector is yet to be identified.

2000 **Lázár** *et al*.: Up-to-date report on virus diseases of grapevines in Hungary and description of the clean stock programme implemented in the country.

3. References

Brandt S. and G. Himmler, 1995. Detection of nepoviruses in ligneous grapevine material using IC/PCR. *Vitis* **34**, 127-128.

Brault V., L. Hilbrand, T. Candresse, O. Le Gall and J. Dunez, 1989. Nucleotide sequence and genetic organization of Hungarian grapevine chrome mosaic nepovirus RNA2. *Nucleic Acid Research* 17, 7809-7819.

Brault V., T. Candresse, O. Le Gall, R.P. Delbos, M. Lanneau and J. Dunez, 1993. Genetically engineered resistance against grapevine chrome mosaic virus. *Plant Molecular Biology* **21**, 89-97.

Bretout C., T. Candresse, O. Le Gall, V. Brault, M. Ravelonandro and J. Dunez, 1989. Virus and RNA-specific molecular hydridization probes for two nepoviruses. *Acta Horticulture* **235**, 231-238.

Dimou D, A.M. D'Onghia, M. Laimer da Camara Machado and V. Savino, 1994. Occurrence of grapevine chrome mosaic nepovirus in Austria. *Journal of Phytopathology* **142**, 258-262.

Dodd S.M., and D.J. Robinson, 1984. Nucleotide sequence homologies among RNA species of strains of tomato black ring virus and other nepoviruses. *Journal of General Virology* 65, 1731-1740.
Doz B., R. Delbos and J. Dunez, 1982. Prémunition: une competition entre souches faibles et souches sévères pour un voie commune d'expression de symptômes. *Les Colloques de l'INRA* **11**, 29-44.
Kenten R.H., 1972. The purification and some properties of cocoa necrosis virus; a serotype ot tomato black ring virus. *Annals of Applied Biology* **71**, 119-126.
Kölber M., L. Beczner, S. Pacsa and J. Lehoczky , 1985. Detection of grapevine chrome mosaic virus in field-grown vines by ELISA. *Phytopathologia Mediterranea* **24,** 135-140.
Jakó N., J. Lehoczky and G. Sarospataki, 1966. Studies on the nitrogen metabolism of vines infected with yellow mosaic virus. *Acta Phytopathologica Academia Scientiarum Hungaricae* **1**, 185-192.
Jakó N., S. Muranyi , G. Sarospataki and J. Lehoczky, 1968. The change of pigment and sugar content in the chrome mosaic virus infected leaves of grapevine. *Acta Phytopathologica Academia Scientiarum Hungaricae* **3,** 165-173.
Lázár J., M. Kölber and J. Lehoczky, 1990. Detection of some nepoviruses (GFV, GFV-YM, GCMV, ArMV) in the seeds and seedlings of grapevine by ELISA. *Kertgazdasag* **22**, 58-72.
Lázár J., J. Mikulás, E. Hajdú, M. Kölber M, and S. Sznyegi, 2000. Grapevine virus diseases and clean stock program in Hungary. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 172-173.
Le Gall O., T. Candresse and J. Dunez, 1995. Transfer of the 3' non-translated region of grapevine chrome mosaic virus RNA-1 by recombination to tomato black ring virus RNA-2 in pseudorecombinant isolates. *Journal of General Virology* **76**, 1285-1289.
Le Gall O., T. Candresse, V. Brault and J. Dunez, 1989. Nucleotide sequence of Hungarian grapevine chrome mosaic nepovirus RNA1. *Nucleic Acid Research* **17**, 7795-7807.
Le Gall O., L. Torregrosa , Y. Danglot, T. Candresse and A. Bouquet, 1994. *Agrobacterium*-mediated genetic transformation of grapevine somatic embryos and regeneration of transgenic plants expressing the coat protein of grapevine chrome mosaic nepovirus (GCMV). *Plant Science*, **102,** 171-170.
Lehoczky J., 1985. Detection of grapevine chrome mosaic virus in naturally infected vines by indexing. *Phytopathologia Mediterranea* **24,** 129-134.
Lehoczky J. and G.Tasnady, 1971. The effect of fanleaf and chrome mosaic virus diseases on yield and the fruit sugar content of grapevine. *Kiserletugyi-Kozlemenyek* **64** (1-3), 49-64.
Lehoczky J., G. Sarospataki, J.C. Devergne, L. Cardin, J. Kuszala and A. Vuittenez, 1979. Caractérization d'une souche du virus de la mosaïque jaune crome de la vigne (GCMV) isolée en Hongrie de vignes non panachées. Nouvelle évidence d'une parenté sérologique éloignée entre ce virus et celui deas anneaux noirs de la tomate (tBRV). *Annales de Phytopathologie* **11**, 567-568.
Lehoczky J., O. Luntz, J. Lázár, G. Farkas, S. Szonyegi and M. Kölber, 1993. Certification scheme for production of virus-free grape propagating material and its results in Hungary. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993,* 169-170.
Mali V.R., G. Vanek and V. Bojnansky, 1975. Transmission by nematodes of some grapevine viruses occurring in Czecholovakia and Hungary. *Pol'nohopodarska Veda* ,Ser. A, **3**, 1-130.
Martelli G.P., 1966. Preliminary report on purification and serology of a virus associated with Hungarian grapevines showing macroscopic symptoms of fanleaf and yellow mosaic. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis 1965.* University of California, Division of Agricultural Sciences, 402-410.
Martelli G.P. and A. Quacquarelli, 1972a. Hungarian chrome mosaic of grapevine and tomato black ring: two similar but unrelated plant viruses. *Annales de Phytopathologie*, Numero hors série, 123-141.
Martelli G.P. and A. Quacquarelli, 1972b. Grapevine chrome mosaic virus. *CMI/AAB Descriptions of Plant Viruses,* No. 103.
Martelli G.P. and G. Sarospataki, 1969. Nematodes of the family *Longidoridae* (Thorne 1935) Meyl 1960 found in Hungarian vineyards and virus transmission trials with *Xiphinema index* Thorne et Allen. *Phytopathologia Mediterranea* **8**, 1-7.
Martelli G.P., J. Lehoczky and A. Quacquarelli, 1966. Host range and properties of a virus associated with Hungarian grapevines showing macroscopic symptoms of fanleaf and yellow mosaic. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis 1965*. University of California, Division of Agricultural Sciences, 389-401.
Martelli G.P., A. Quacquarelli and J. Lehoczky, 1968. Serologische Verwandschaft eines mit dem ungarischen "chrome mosaic" vergesellschafteten Virus mit einem Stamm des "tomato black ring virus". *Weinberg und Keller* **15**, 505.
Martelli G.P., J. Lehoczky and A. Quacquarelli, 1970. Hungarian chrome mosaic. In: Virus Diseases of Small Fruits and Grapevines. A Handbook, 236-237. NW Frazier (ed.) University of California, Division of Agricultural Sciences, Berkeley.
Pozsár B.J., L. Horváth, J. Lehoczky and G. Sarospataki, 1969. Effect of the grape chrome mosaic and grape fanleaf-yellow mosaic virus infection on the photosynthetical carbon dioxide fixation in vine leaves. *Vitis* **8,** 206-210.

Russo M., G.P. Martelli and V. Savino, 1980. Immunosorben electron microscopy for detecting sap-transmissible viruses of grapevine. *Proceedings of the 7th Meeting of ICVG, Niagara Falls 1980*, 251-257.
Saric A. and T. Hranuelli, 1977. Investigations on grapevine viruses in Croatia. *Proceedings of the Conference on Excoriosis and Virus Diseases of Grapevine, Mostar 1977*, 149-151.
Taylor C. E. and D.J.F Brown, 1997. Nematode Vectors of Plant Viruses. CAB International, Oxon, 286 pp.

GRAPEVINE DEFORMATION VIRUS (GDefV)

1. Description

Grapevine deformation virus (GDefV) was recovered from Turkish grapevines showing distinct fanleaf-like symptoms. The virus belongs in the subgroup A of the genus *Nepovirus*, is distantly related serologically to ArMV but not to GFLV. Particles are isometric c. 30 nm in diameter and sediment as three components. The genome is bipartite, RNA-1 has a mol. wt of 2.6×10^6 Da and RNA-2, mol. wt of 1.3×10^6 Da and a size of 3753 nt. Coat protein subunits have a M_r 53×10^3. GDefV is readily detected by ELISA and PCR using primers designed on the coat protein sequence.The virus has no recognized vector, is not seed-borne and reported only from south-eastern Turkey. The scattered distribution of infected vines in the field suggests that the virus is spread primarily by infected propagative material.

2. Historical review

2002 **Cigsar** *et al*.: First isolation by mechanical transmission of an unknown nepovirus from cv. showing leaf and cane deformations

2003 **Cigsar** *et al*.: Description and thorough characterization of GDefV, identified as a new species in the subgroup A of the genus *Nepovirus,* distantly serologically related with ArMV.

2005 **Abou Ghanem-Sabanadzovic** *et al.* : Complete nucleotide sequence of GDefV RNA-2

3. References

Abou Ghanem-Sabanadzovic N., S. Sabanadzovic, M. Digiaro and G.P. Martelli, 2005. Complete nucleotide sequence of RNA-2 of two Turkish nepoviruses. *Virus Genes* **30**, 335-340
Cigsar I., M. Digiaro and G.P. Martelli, 2002. Sanitary status of grapevine in south eastern and central Anatolia. *Bulletin OEPP/EPPO Bulletin* **32**, 471-475
Cigsar I., M. Digiaro, K. Gokalp, N. Abou Ghanem-Sabanadzovic, A. De Stradis, D. Boscia and G.P. Martelli, 2003. Grapevine deformation virus, a novel nepovirus from Turkey. *Journal of Plant Pathology* **85**, 35-41.

GRAPEVINE TUNISIAN RINGSPOT VIRUS (GTRSV)

1. Description

Grapevine Tunisian ringspot virus (GTRSV), was isolated from a Tunisian grapevine with mild fanleaf-like symptoms. The virus sediments as three components: T (empty shells), M (particles contaning a molecule of RNA-2 with Mol. wt of 2×10^6 daltons and apparent size of *c*. 5,800 nt) and B (particles containing a molecule of RNA-1 with Mol. wt of 2.4×10^6 daltons and apparent size of *c*. 6,800 nt.). GTRSV is serologically unrelated to any of 19 nepoviruses tested, including all those known to infect grapevine, and belongs in the subgroup C of the genus *Nepovirus*. No vector is known and no information is available on the distribution and economic importance of the virus.

2. Historical review

1991 **Ouertani** *et al*.: A mechanically transmissible virus was recovered by sap inoculation from Tunisian grapevines showing mild fanleaf-like symptoms. Based on its properties the virus appears to be a new nepovirus serologically unrelated to any of 19 members of the genus and has no known vector.

3. References

Ouertani R., V. Savino, A. Minafra, D. Boscia, M.A. Castellano, G.P. Martelli and N. Greco, 1992. Properties of a previously undescribed grapevine nepovirus from Tunisia. *Archives of Virology* **126**, 107-117.

RASPBERRY RINGSPOT VIRUS (RpRSV)

1. Description

Raspberry ringspot virus (RpRSV) is a nepovirus belonging in subgroup A of this genus. Particles are about 30 nm in diameter, have angular outline, and sediment as three components (T, M, and B). The grapevine strain of this virus is serologically very distantly related to the two main serotypes, Scottish and English, and differs from the type strain for it often sediments as if it were a single centrifugal component. These differences strongly suggest that the grapevine-infecting RpRSV may be a different viral species. The viral genome is a bipartite positive sense ssRNA, consisting of two separately encapsidated molecules with Mol. wt of 2.6×10^6 (RNA-1) and 1.6×10^6 (RNA-2), accounting for 29% (component M) and 43% (component B) of the particle weight. RNA-2 is 3928 nt in size and contains a single ORF encoding a polypeptide with M_r of 124 kDa. The coat protein has a single type of subunits with M_r 54×10^3. The virus has only been found in grapevine in western Germany. Symptoms are similar to those of fanleaf. Two strains of different virulence occur in the Palatinate. Crop losses can be higher than 30 %. The type strain of RpRSV is transmitted by *Longidorus macrosoma* but the grapevine strain is transmitted by *Paralongidorus maximus*.

2. Historical review

1970 **Vuittenez** *et al.*: Recovery of RpRSV from grapevines of Palatinate.

1978 **Murant:** Description of RpBRSV in the CMI/AAB Plant Virus Description series

1978 **Stellmach and Querfurth:** Study of a strain of RpRSV isolated from cv. Elbling in West Germany. FS4 is a good indicator. Heat therapy of infected grapevines.

1982 **Brückbauer:** RpRSV can be distinguished from other nepoviruses on the basis of symptoms induced on *Vitis* idicator plants

1992 **Blok** *et al*.: Nucleotide sequence of RpRSV RNA-2

1994 **Jones** *et al*.: Biological and physico-chemical characterization of the grapevine strain of RpRSV. This strain differs considerably from the English type strain of the virus although is serologically closely related to it. The virus is transmitted by *Paralogidorus maximus*

2003 **Ebel** *et al.:* Sequencing and molecular characterization of two German isolates of RpRSV from grapevine

3. References

Blok V.C. Wardell J. C.A. Jolly, A. Manoukian, D.J. Robinson, M.L. Edwards and M.A. Mayo, 1992. The nucleotide sequence of RNA 2 of raspberry ringspot nepovirus. *Journal of General Virology* **73**, 2189-2194.

Brückbauer H., 1982. Mögliche Beziehungen zwischen Virus und Symptomausprägung bei der Rebe. *Die Wein-Wissenschaft* **37**, 88-118.

Ebel R. A Schnabel, G.M. Reustle, G. Krczal and T. Wetzel, 2003. Molecular characterization of two German Raspberry ringspot virus isolates infecting grapevines and construction of full length infectious clones. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 16.

Jones A.T., D.J.F. Brown, W.J. McGavin, M. Rüdel and B. Altmayer, 1994. Properties of an unusual isolate of raspberry ringspot virus from grapevine in Germany and evidence of its possibile transmission by *Paralogidorus maximus*. *Annals of Applied Biology* **124**, 283-300.

Murant A.F., 1978. Raspberry ringspot virus. *CMI/AAB Descriptions of Plant Viruses*, No. 198.

Stellmach G. and G. Querfurth, 1978. Untersuchungen zur Serologie, Pathologie und Thermo-Labilität mehrerer Reben-Isolate des Himbeerringflecken-Virus (raspberry-ringspot- virus). *Weinberg und Keller* **25**, 128-136.

Vuittenez A., J. Kuszala, M. Rüdel and H Brückbauer, 1970. Détection et étude selogique du virus latent des taches annulires du frasier (strawberry latent ringspot), du virus des anneaux noires de la tomate (tomato black ring) et du virus des taches annulaires du framboisier (raspberry ringspot) chez des vignes du Palatinat. *Annales de Phytopathologie* **2**, 279-327

TOMATO BLACK RING VIRUS (TBRV)

1. Description

Tomato black ring virus (TBRV) was first found in grapevines in Germany, then in Yugoslavia, Greece, Israel, Turkey, and Ontario (Canada). The virus is a definitive nepovirus species classified in subgroup A of this genus, its own subgroup. Virus particles are isometric, about 30 nm in diameter have angular outline and sediment as three components (T, M, and B). Their coat protein consists of a single type of subunits with M_r of about 57 kDa. The genome is a bipartite positive sense single-stranded RNA occurring as two separately encapsidated functional molecules with Mol. wt of 2.7 x 10^6 (RNA-1) and 1.65 x 10^6 (RNA-2) accounting for 44% and 37% of the particle weight, respectively. RNA-1 is 7356 nt in size and contains a single open reading frame encoding a polypeptide with M_r of 254 kDa. RNA-2 is 4662 nt in size encoding a polyprotein with M_r of 150 kDa. TBRV supports the replication of a satellite RNA with Mol. wt of 0.5 x 10^6 daltons and a size of 1327 nt. TBRV produces a reduction in growth and yield, chlorotic spots, rings and lines on the leaves of recently infected plants, mottling of the older leaves, and an increase in graft failure. The vector to grapevine is *Longidorus attenuatus.* Losses are not known precisely, but they can be high. Joannes Seyve virus, known to cause severe damage to the grapevine variety Joannes Seyve in Ontario, is a strain of this virus.

2. Historical review

1963 **Stellmach and Bercks**: TBRV detected in rootstock Aramon x *V. riparia* 143 A in West Germany.

1965 **Stellmach and Bercks**: Further investigations on TBRV in grapevine.

1966 **Bercks and Stellmach**: ArMV, RpRV and TBRV detected serologically in grapevine in West Germany, either by agar gel diffusion with extracts of herbaceous hosts previously infected mechanically from grapevine, or directly in grapevine leaf extracts using bentonite flocculation test.

1967 **Bercks:** Comparison of three serological tests for detecting several viruses, including TBRV : bentonite flocculation test, latex test and barium sulfate test. The latex test is considered as the most sensitive and the least time consuming method.

1970 **Vuittenez** *et al*.: RRV, SLRV and TBRV found in grapevine in the Palatinate.

1970b **Stellmach**: Review paper on TBRV in grapevine.

1976 **Bercks and Querfurth**: GFLV, ArMV, RRV and TBRV are not transmitted by contact of roots or foliage in the vineyard.

1977 **Rüdel**: Transmission of TBRV to grapevine by *Longidorus attenuatus.*

1980 **Tanne**: Detection of TBRV by ELISA in Israel.

1984 **Stobbs and Van Schagen**: First record of TBRV from Canada. The virus was detected in grapevines in the Niagara Peninsula, Ontario as the cause of severe damage to cv. Joannes Seyve**.**

1984 **Meyer** *et al*.: Nucleotide sequence of a TBRV satellite RNA.

1986 **Lehoczky and Burgyan**: Occurrence of TBRV in grapevines in Hungary.

1986 **Meyer** *et al*.: Nucleotide sequence of TBRV RNA-2

1988 **Greif** *et al*.: Nucleotide sequence of TBRV RNA-1

1993 **Abkas and Erdiller:** TBRV recorded from grapevines in Turkey

3. References

Akbas B. and G. Erdiller, 1993. Researches on grapevine virus diseases and determination of their incidence in Ankara, Turkiye. *Journal of Turkish Phytopathology* **22**, 55-61.

Greif C., O. Hemmer and C. Fritsch, 1988. Nucleotide sequence of tomato black ring virus RNA-1. *Journal of General Virology* **69**, 1517-1529.

Meyer M., O. Hemmer and C. Fritsch, 1984. Complete nucleotide sequence of a satellite RNA of tomato black ring virus. *Journal of General Virology* **65**, 1575-1583.

Meyer M. O. Hemmer, M.A. Mayo and C. Fritsch, 1986. The nucleotide sequence of tomato black ring virus RNA-2. *Journal of Gerneal Virology* **67**, 1257-1271

Stobbs L.W. and J.G. Van Schagen, 1984. Occurrence of tomato black ring virus on grapevine in southern Ontario. *Canadian Plant Disease Survey* **64**, 3-5.

Vuittenez A., J. Kuszala, M. Rüdel and H. Brückbauer, 1970. Détection et étude sérologique du virus latent des taches annulaires du Fraisier (strawberry latent ringspot), du virus des anneaux noirs de la Tomate (tomato black ring), et du virus des taches annulaires du Framboisier (raspberry ringspot) chez des vignes du Palatinat. *Annales de Phytopathologie* **2**, 279-327.

Genus *SADWAVIRUS*

STRAWBERRY LATENT RINGSPOT VIRUS (SLRSV)

1. Description

Strawberry latent ringspot virus (SLRSV) has been isolated from grapevine in the Palatinate (Germany) and in northern Italy. It was also detected in imported vines in Turkey and Portugal. The virus is a definitive species in the genus *Sadwavirus.* Virus particles are isometric, about 30 nm in diameter have angular outline and sediment as three components (T, M, and B). Their coat protein consists of two types of subunits with M_r 43 x 10^3 and 27 x 10^3, respectively. The genome is a bipartite positive sense single-stranded RNA occurring as two separately encapsidated functional molecules with Mol. wt 2.6 x 10^6 (RNA-1) accounting for 38% of the particle weight, and 1.6 x 10^6 (RNA-2). RNA-2 is 3824 nt in size and encodes a single ORF expressing a polypetide with M_r of about 99 kDa. The virus supports the replication of a satellite RNA 1118 nt in size. Symptoms on affected European grapes are of the fanleaf type. The virus is transmitted by *Xiphinema diversicaudatum.*

2. Historical review

1974 **Murant**: Description of SLRSV in the CMI/AAB Descriptions of Plant vrises series.

1977 **Bercks** *et al*.: SLRSV and other nepoviruses isolated from grapevines in Germany

1981 **Credi** *et al*.: SLRSV recorded from grapevine in Italy.

1982 **Babini and Bertaccini**: Electron microscope study SLRSV infections in plant tissues.

1982 **Brückbauer**: SLRSV can be distinguished from other nepoviruses on the basis of symptoms induced on *Vitis* idicator plants.

1987 **Savino** *et al*.: SLRSV found in grapevine in Turkey.

1993 **Kreiah** *et al*.: Nucleotide sequence of SLRSV satellite RNA.

1994 **Kreiah** *et al*.: Nucleotide sequence of SLRSV RNA-2.

2005 **Le Gall** *et al*. Assignement of SLRSV to the new genus *Sadwavirus.*

3. References

Babini A.R. and A. Bertaccini, 1982. Viral aggregates induced by a distinctive strain of strawberry latent ringspot virus from grapevine. *Phytopathologische Zeitschrift* **104**, 304-308.

Bercks R., H. Brückbauer, G. Querfurth and M. Rüdel, 1977. Untersuchungen überdie Viruskrankheited der rebe unter besonderer Berüchsichtigung “atypischer Formen” der Reisigkrankheit. *Weinberg und Keller* **24**, 133-180.

Brückbauer H., 1982. Mögliche Beziehungen zwischen Virus und Symptomausprägung bei der Rebe. *Die Wein-Wissenschaft* **37**, 88-118.

Credi R., A.R. Babini, L. Betti, A. Bertaccini and C. Gelli, 1981. A distinctive isolate of Strawberry latent ringspot virus from grapevines in Italy. *Phytopathologia Mediterranea* **20**, 56-63.

Kreiah S., J.I. Cooper and G. Strunk, 1993. The nucleotide sequence of a satellite RNA associated with strawberry latent ringspot virus. *Journal of General Virology*, **74**, 1163-1165.

Kreiah S., G. Strunk and J.I. Cooper, 1994. Sequence analysis and location of capsid protein within RNA 2 of strawberry latent ringspot virus. *Journal of General Virology* **75**, 2527-2532.

Le Gall O., T. Iwanami, A.V. Karasev, T Jones, K. Lehto, H. Sanfaçon, J. Wellink, T. Wetzel and N. Yoshikawa, 2005. Genus *Sadwavirus.* In: *Virus Taxonomy*. Eight Report of the International Committee on Taxonomy of Viruses (Fauquet, C.M., Mayo, M.A., Maniloff, J., Desselberger, U., and Ball, L.A. (eds) 799-802 Elsevier/Academic Press, London.

Murant A.F., 1974. Strawberry latent ringspot virus. *CMI/AAB Descriptions of Plant Viruses* No. 126.

Savino V., G.P. Martelli, A.M. D'Onghia and M.A. Yilmaz, 1987. Turkey. Strawberry latent ringspot virus in grapevine. *FAO Plant Protection Bulletin* **35,** 102-104.

GRAPEVINE DEGENERATION AND DECLINE (AMERICAN NEPOVIRUSES)

1. Description

Main synonyms: Yellow vein, grapevine decline, little grape (Eng.), jaunissement des nervures, depérissement de la vigne (Fr.), Adernvergilbung (Germ.), deperimento della vite, ingiallimento nervale (Ital.)

Main symptoms: Symptomatological responses of grapevines vary according to the species (i.e. *Vitis vinifera, V. labrusca,* interspecific hybrids), the infecting virus and the climatic conditions. In cold climates (e.g. New York State and Ontario) own-rooted European grapes affected by *Tomato ringspot virus (*ToRSV) and *Tobacco ringspot virus* (TRSV) decline rapidly, exhibiting stunted growth, mottled (oak leaf pattern, and/or ring spots) and distorted leaves, distortion of canes, poor fruit setting, straggly and shelled clusters. In warmer climates (Maryland, California) yield but not vigour is affected. Bunches are small and straggly (Maryland's grapevine little berry) and leaves may show chrome yellow flecking along the veins (California's yellow vein). *Peach rosette mosaic virus* (PRMV) in *V. labrusca* causes a severe disease characterized by delayed bud burst, malformation and mottling of the leaves, and poor fruit setting. Infected vines decline slowly over time. *Blueberry leaf mottle virus* (BLMoV) infects latently European grapes, whereas in *V. labrusca* cv. Concord it delays bud burst, induces fanleaf-like symptoms on leaves and canes, and poor fruit setting

Agent: The above mentioned four distinct nepoviruses, BLMoV, TRSV, PRMV, and ToRSV separately or in combination, are involved in the aetiology of North American grapevine degeneration and decline. All these viruses, except for BLMoV which may have been introduced from Europe, are endemic in North America and thought to be native of the region.

Transmission: These viruses are all transmitted by grafting and mechanical inoculation. No vector is known for BLMoV, which in blueberry is transmitted by pollen. All other viruses are transmitted by longidorid nematodes: *Xiphinema americanum sensu stricto* and *X. rivesi t*ransmit ToRSV type strain (decline), *X. californicum* transmits ToRSV yellow vein strain. TRSV is transmitted by *X. americanum sensu lato* and PRMV by *X. americanum sensu stricto, Longidorus diadecturus* and *L. elongatus.* PRMV, ToRSV and BLMoV are also seed transmitted in grapes. Alternative weed hosts that have epidemiological significance are known for ToRSV, TRSV and PRMV. Long distance spread takes place primarily through infected propagating material.

Varietal susceptibility: There are great variations in the susceptibility of *Vitis* species and cultivars. A number of rootstocks containing *V. riparia, V. berlandieri* or *V. rupestris* plasma show field resistance to the northern US strain of ToRSV and to TRSV and PRMV. *V. labrusca* is also resistant to TRSV. This type of resistance is hypersensitivity. All roostocks and, interestingly, most *V. vinifera* cultivars are reported as immune to the Californian strain of ToRSV

Detection: All viruses are transmissible to herbaceous hosts mechanically and to woody indicators by grafting, ELISA and molecular tools are useful for testing field-infected material.

Control: Use of virus-free propagating material and resistant rootstocks. Nematicidal control of vectors is possible, but not conclusive.

BLUEBERRY LEAF MOTTLE VIRUS (BLMoV)

1. Description

Blueberry leaf mottle virus (BLMoV) is named after the disease induced in highbush blueberry (*Vaccinium corymbosum)*, its main host. BLMoV is a definitive nepovirus species assigned to subgroup C. Virus particles are isometric, about 30 nm in diameter with angular outline, sedimenting as three components. Their coat protein consists of a single type of subunits with M_r of about 54 x 10^3 Da. The genome is a bipartite, positive-sense, single-stranded RNA occurring as two separately encapsidated functional molecules with Mol . wt of 2.35 x 10^6 (RNA-1) and 2.15 x 10^6 (RNA-2). Partial sequence of the 3'

termini of both RNA molecules has been determined. Grapevines (*Vitis labrusca*) are infected in New York State (USA) by a serologically distinct strain of the virus, which induces fanleaf-type symptoms and is distantly related to GBLV. The virus is seed-transmitted in grapevines and *C. quinoa,* and has no economic importance. The vector is unknown, but in highbush blueberry the virus is pollen-borne and suspected to be pollen-transmitted .

2. Historical review

1977 **Uyemoto** *et al*: BLMoV isolated from New York 'Concord' vines showing fanleaf-like symptoms, but identified as a strain of GBLV. The virus is transmitted through seeds in grapevines and *C. quinoa*

1981 **Ramsdell and Stace-Smith:** Physico-chemical characterization of BLMoV and evidence that the New York grapevine virus is a strain of BLMoV

1994 **Bacher** *et al*. : Partial nucleotide sequence of BLMoV RNA-1 and RNA-2

3. References

Bacher J.W., D. Warkentin, D.Rasmdel and J.F. Hancock, 1994. Sequence analysis of the 3' temini of RNA 1 and RNA 2 of blueberry leaf mottle virus. *Virus Research* **33**, 145-156

Ramsdell D.C. and R. Stace-Smith, 1981. Physical and chemical properties of the particles and ribonucleic acid of blueberry leaf mottle virus. *Phytopathology* **71**, 468-472.

Uyemoto J.K., E.F. Taschenberg and D.K. Hummer, 1977. Isolation and identification of a strain of grapevine Bulgarian latent virus in Concord grapevines in New York State. *Plant Disease Reporter* **61**, 949-953.

PEACH ROSETTE MOSAIC VIRUS (PRMV)

1. Description

Peach rosette mosaic virus (PRMV) is named after the disease induced in peach, one of its crop plant hosts. The virus is a definitive nepovirus species assigned to subgroup C. Virus particles are isometric, about 28 nm in diameter with angular outline, sedimenting as three components. Their coat protein consists of a single type of subunits with M_r of about 57 x 10^3 Da. The genome is a bipartite positive sense single-stranded RNA occurring as two separately encapsidated functional molecules with Mol. wt of 2.4 x 10^6 (RNA-1) and 2.2 x 10^6 (RNA-2) accounting for 44% and 37% of the particle weight, respectively. RNA-1 is 8004 nt in size and contains a single open reading frame encoding a polypeptide with M_r of 240 kDa. Infected grapevines show shortened and crooked shoots, mottled and variously deformed leaves and delayed bud burst. Clusters are straggly, smaller and fewer than normal , and with extensive shelling of the berries. Vines are stunted and show a progressive decline, which may lead to their death. PRMV is soil-borne. Healthy grapevines become infected when planted in soils from diseased vineyards, where the disease occurs in more or less circular patches and spreads slowly, mostly to vines adjacent to previously infected plants. Vectors are the Dorylaimoid nematodes *Xiphinema americanum sensu lato* and *Longidorus diadecturus.* Occasional, possibily non specific transmission by *L. elongatus* has also been reported. As the virus is endemic and seed-borne in some perennial weeds *Taraxacum officinale* (dandelion), *Solanum carolinense* (Carolina horse nettle) and *Rumex crispus* (curly dock), when a vineyard is planted susceptible cultivars may become infected by nematode vectors. PRMV can also be introduced in a site by infected planting material and be spread by vectors to adjacent vines. Pollen grains of cv. Concord grapes are apparently virus-free but 9.5% of seedlings from seeds taken from diseased vines proved to be infected. PRMV is seed-borne in both naturally infected dandelion (4% of infected seeldlings) and in artificially infected *C. quinoa* (90% of infected seedlings). Crop losses up to 60% and death of susceptible *V. labrusca* cultivars (Concord, especially) and a number of American-French hybrids have been recorded. Prolonged fallow is not an effective means of control because viruliferous nematodes remain alive for many years thriving on infected surviving roots and alternative weed hosts. Roguing of infected trees and preplanting autumn fumigation with high rates of fumigant injected at two depths (15-20 cm and 75-90 cm) can effectively reduce, but not eradicate, vector populations .Use of resistant roostock hybrids and of certified planting material is recommended.

2. Historical review

1972a **Dias**: Preliminary characterization of the grapevine isolate of PRMV**.**

1972b **Dias:** Grapevine and peach strains of PRMV can be differentiated serologically**.**

1974 **Ramsdell and Myers**: Description of PRMV-induced grapevine degeneration and association of *X. americanum* with the disease.

1976 **Dias and Cation**: Biological characterization of the grapevine strain of PRMV. The virus is seed-borne in *C. quinoa* and has reproduced in part the field syndrome when inoculated mechanically to Concord grape seedlings.

1978 **Ramsdell and Myers**: Field spread of PRMV is associated with the presence of infected weeds (*T. officinale, S. Carolinense, R. crispus*) and transmission through grapevine seeds.

1979 **Ramsdell** *et al:* Use of ELISA for PRMV detection in grapevines.

1980 **Dias and Allen**: Physico-chemical characterization of PRMV**.**

1982 **Allen** *et al.*: *Longidorus diadecturus* transmits PRMV to grapevines.

1983 **Ramsdell** *et al:* High rates of fumigant injected at two depths (15-20 cm and 75-90 cm) during autumn reduce effectively but do not eradicate nematode vector populations in infested soils.

1984 **Allen** *et al.*: *Xiphinema americanum* is an efficient vector of PRMV.

1985 **Ramsdell and Gillet:** List of grapervine cultivars and roostocks showing differential susceptibility to PRMV**.**

1988 **Ramsdell:** Review article on PRMV**.**

1988 **Allen and Ebsary:** *Longidorus attenuatus* transmits PRMV non specifically and with low efficiency.

1995 **Rasmdell** *et al.*: Investigation on the susceptibility to PRMV infection of American and European grapevines and hybrid rootstocks.

1998 **Ramsdell and Gillet**: Description of PRMV in the AAB Descriptions of Plant Viruses**.**

1999 **Lammers** *et al.*: Nucleotide sequence of RNA-1 of the grapevine strain of PRMV.

3. References

Allen W.R. and B.A Ebsary, 1988. Transmission of raspberry ringspot, tomato black ring and peach rosette mosaic viruses by an Ontario population of *Longidorus elongatus. Canadian Journal of Plant Pathology* **10,** 1-5

Allen W.R., J.G Van Schagen and B.A Ebsary, 1984. Transmission of peach rosette mosaic virus by Ontario populations of *Longidorus diadecturus* and *Xiphinema americanum* (Nematoda: Longidoridae). *Canadian Journal of Plant Pathology* **6,** 29-32

Allen W.R., J.G Van Schagen and E.S Everleigh, 1982. Transmission of peach rosette mosaic virus to peach grape and cucumber by *Longidorus diadecturus* obtained from diseased orchards in Ontario. *Canadian Journal of Plant Pathology* **4,** 16-18.

Dias H.F., 1972a. Purification and some characteristics of peach rosette mosaic virus (grape isolate). *Annales de Phytopathologie*, Numero hors sèrie, 97-103.

Dias H.F., 1972b. Strains of peach rosette mosaic virus differentiated by cross absorption and immunodiffusion tests. *Annales de Phytopathologie*, Numero hors sèrie, 105-106.

Dias H.F. and D. Cation, 1976. The characterization of a virus responsible for peach rosette mosaic and grape decline in Michigan. *Canadian Journal of Botany* **54**, 1228-1239.

Dias H.C. and W.R. Allen, 1980. Characterization of the single protein and the two nucleic acids of peach rosette mosaic virus. *Canadian Journal of Botany* **58**, 1747-1754.
Lammers A.H., R.F Allison and D.C Ramsdell, 1999. Cloning an sequencing of peach rosette mosaic virus RNA1. *Virus Research* **65**, 57-73.
Ramsdell D.C., 1988. Peach rosette mosaic virus decline. In: Compendium of Grape Diseases (R.C. Pearson and A.C. Goheen eds.). American Phytopathological Society Press, St. Paul, 51-52.
Ramsdell D.C. and R.L. , Myers, 1974. Peach rosette mosaic virus, symptomatology and nematodes associated with grapevine 'degeneration' in Michigan. *Phytopathology* **64,** 1174-1178.
Ramsdell D.C. and R.L. Myers, 1978. Epidemiology of peach rosette mosaic virus in a Concord grape vineyard. *Phytopathology* **68**, 447-450
Ramsdell D.C. and J.M. Gillet, 1985. Relative susceptibility of American, French hybrids and European grape cultivars to infection by peach rosette mosaic virus. *Phytopathologia Mediterrenea* **24**, 41-43.
Ramsdell D.C. and J.M. Gillet, 1998. Peach rosette mosaic virus. *AAB Descriptions of Plant Viruses*, No. 364.
Ramsdell D.C., R.W. Andrews, J.M. Gillet and C.E Morris, 1979. A comparison between enzyme-linked immunosorbent assay (ELISA) and *Chenopodium quinoa* for detection of peach rosette mosaic virus in 'Concord' grapevines. *Plant Disease Reporter* **63**, 74-78.
Ramsdell D.C., G.W. Bird GW, J.M. Gillet and L.M. Rose, 1983. Superimposed shallow and deep soil fumigation to control *Xiphinema americanum* and peach rosette mosaic virus reinfection a Concord vineyard. *Plant Disease* **67**, 625-627.
Ramsdell D.C., G.M. Gillet and G.W. Bird, 1995. Susceptibility of American grapevine scion cultivars and French hybrid roostocks and scion cultivars to infection by peach rosette mosaic virus. *Plant Disease* **79,** 154-157.

*TOBACCO RINGSPOT VIRUS (*TRSV)

1. Description

Tobacco ringspot virus (TRSV) is the type species of the genus *Nepovirus* and the prototype of subgroup A. Virus particles are isometric, about 30 nm in diameter with angular outline, sedimenting as three components (T, M, and B). Coat protein consists of a single type of subunits with M_r of about 57 x 10^3 Da. The genome is a bipartite positive sense single-stranded RNA occurring as two separately encapsidated functional molecules with Mol. wt of 2.7 x 10^6 (RNA-1) and 1.3 x 10^6 (RNA-2), accounting for 44% and 28% of B and M particle weight, respectively. RNA-1 is 7514 nt in size and contains a single open reading frame encoding a polypeptide with M_r of 225 kDa. RNA-2 has been sequenced only in part. The virus supports the replication of a circular satellite RNA 359 nt in size. TRSV has a relatively wide natural host range, is endemic in Central and Eastern North America, but was recorded from grapevines only in New York State and Pennsylvania. Symptoms elicited by TRSV are the same as those of ToRSV in native cultivars, but in European grapes responses are similar to those elicited by GFLV. TRSV is soil-borne and is transmitted by *Xiphinema americanum sensu stricto*. There is no evidence of seed trasmission in the grapevine. Preventive control measures are the use of resistant roostock hybrids and of certified planting material.

2. Historical review

1970 **Gilmer** *et al*.: TRSV agent of a new grapevine disease in New York State.

1977 **Uyemoto** *et al.*: A review of viruses infecting grapevines in New York vineyards. American *Vitis* species reported to be resistant to ToRSV and TRSV.

1985 **Stace-Smith:** Description of TRSV in the AAB Descriptions of Plant Viruses series**.**

1985 **Foster and Morris-Krsinich**: *In vitro* translation of TRSV RNA-1 and TRSV RNA-2 yields major polypeptides with Mr of 225K and 116K, respectively.

1986 **Buzayan** *et al*.: Nucleotide sequence of TRSV satellite RNA.

1990 **Powell** *et al.*: Survey of ToRSV and TRSV in Pennsylvanian vineyards.

1993 **Buckley** *et al.* : Partial nucleotide sequence of TRSV RNA-2.

1996 **Zallua** *et al*.: Nucleotide sequence of TRSV RNA-1

3. References

Buckley B., B. Silva and S. Singh, 1993. Nucleotide sequence and in vitro expression of the capsid protein gene of tobacco ringspot virus. *Virus Research* **30,** 335-349.

Buzayan J.M., W.L. Gerlach G. Bruening, P. Keese and A.R. Gould, 1986. Nucleotide sequence of satellite tobacco ringspot virus RNA and its relationship to multimeric forms. *Virology* **151,** 186-199.

Foster R.S.L. and B.A.M. Morris-Krsinich, 1985. Synthesis and processing of the translation products of tobacco ringspot virus in rabbit reticulocyte lysates. *Virology* **144,** 516-519.

Gilmer R.M., J.K. Uyemoto and L.J. Kelts, 1970. A new grapevine disease induced by tobacco ringspot virus. *Phytopathology* **60,** 619-627.

Powell C.A., J.L. Longenecker and L.B. Forer, 1990. Incidence of tomato rigspot virus and tobacco ringspot virus in grapevines in Pennsylvania. *Plant Disease* **74,** 702-704.

Stace-Smith R. 1985. Tobacco ringspot virus. *AAB Descriptions of Plant Viruses,* No. 309.

Uyemoto J.K., J.R. Cummins and G.S. Abawi, 1977. Virus and virus-like diseases affecting grapevines in New York vineyards. *American Journal of Enology and Viticulture* **28,** 131-136.

Zalloua P.A., J.M. Buzayan and G. Bruening, 1996. Chemical cleavage of the 5'-linked protein of tobacco ringspot virus genomic RNAs and characterization of the protein-RNA linkage. *Virology* **219**, 1-8.

TOMATO RINGSPOT VIRUS (ToRSV)

1. Description

Tomato ringspot virus (ToRSV) is a definitive species in the genus *Nepovirus* and the prototype of subgroup C. Virus particles are isometric, about 30 nm in diameter with angular outline, sedimenting as three components (T,M, and B). Coat protein consists of a single type of subunits with M_r of about 58 x 10^3 Da. The genome is a bipartite positive sense single-stranded RNA occurring as two separately encapsidated functional molecules with Mol. wt of 2.8 x 10^6 (RNA-1) and 2.4 x 10^6 (RNA-2) accounting for 44% and 41 % of the particle weight, respectively. RNA-1 is 8214 nt and RNA-2 is 7273 nt in size. Both RNAs contain a single open reading frame encoding polypeptides with M_r of 244 kDa (RNA-1) and 207 kDa (RNA-2). ToRSV has a relatively wide natural host range and is endemic in North America, where it occurs iin the region of the Great Lakes and in the Pacific seaboard from California to British Columbia. The virus has been occasionaly recorded from grapevines outside of North America. Two serological ToRSV variants are known to infect grapevines. Symptomatological responses vary according to the species (*V. vinifera, V. labrusca*, interspecific hybrids), the infecting virus strain, and the climatic conditions. ToRSV-induced decline affects European cultivars, especially if self-rooted, more severely in colder than in warmer climates. Infected vines have small, mottled and distorted leaves and short internodes. Clusters are straggly, smaller and fewer than normal, and with extensive shelling of the berries. Vines are stunted and show a progressive rapid decline, which often leads to death. In California ToRSV affects the yield rather than the vine's growth, "yellow vein" being the characterizing syndrome of its infections. Vines grow vigorously but bear little or no fruit. ToRSV is soil-borne. Vectors are the Dorylaimoid nematodes *Xiphinema americanum sensu stricto* and *X. rivesi* in north American States and Canada and *X. californicum* in California The virus can be introduced in a site by infected planting material and be spread by vectors to adjacent vines. The yellow vein strain of the virus is pollen-borne but is not transmitted through seeds; contrary to the decline strain which is seed-transmitted. Preventive control measures are the use of resistant roostock hybrids and of certified planting material.

2. Historical review

1954 **Hewitt**: Report of an "unfruitful vine" condition in California to which a yellow speckling of the leaves is associated.

1956 **Hewitt:** Successful graft transmission of unfruitful vine condition. Disease named yellow vein.

1962 **Gooding and Hewitt:** A mechanically transmissible virus found to be associated with yellow vein.

1963 **Gooding**: Yellow vein virus identified as a strain of ToRSV.

1966 **Teliz** *et al.*: Transmission of the yellow vein strain of ToRSV by *X. americanum* (now *X. californicum*).

1968 **Cory and Hewitt:** The yellow vein strain of ToRSV is not transmitted through seeds.

1972 **Gilmer and Uyemoto**: ToRSV agent of a decline of Baco noir in New York State.

1972 **Uyemoto and Gilmer:** Spread of ToRSV through the soil of New York State vineyards recorded.

1975 **Uyemoto**: Seed transmission of the decline strain of ToRSV.

1977 **Dias:** Record of ToRSV in the Niagara peninsula.

1977 **Uyemoto** *et al.*: A review of viruses infecting grapevines in New York State vineyards. American *Vitis* species reported to be resistant to ToRSV and TRSV.

1977 **Allen and Dias:** Physico-chemical characterization of ToRSV.

1978 **Martelli:** Review of nematode-borne viruses of grapevines and their epidemiology.

1980 **Gonsalves:** ToRSV is irregularly distributed in infected vines but can be detected by ELISA.

1982 **Podlekis and Corbett:** ToRSV is the agent of little grape disease in Maryland.

1982 **Allen** *et al.*: List of grapevine roostocks and cultivars showing differential susceptibility to ToRSV in Canada.

1984 **Stace-Smith**: Description of ToRSV in the CMI/AAB Descriptions of Plant Viruses series.

1985 **Piazzolla** *et al.*: Confirmation that the grape yellow vein and the the grape decline strains of ToRSV are serological variants of the same virus.

1985 **Corbett and Podleckis**: Ultrastructural study of ToRSV-infected grapevine tissues.

1986 **Yang** *et al.*: ToRSV found in grapevines in Taiwan.

1987 **Stace-Smith and Ramsdell:** Review of nepoviruses of the Americas.

1987 **Bitterlin and Gonslaves:** ToRSV retained and transmitted by viruliferous *Xiphinema rivesi* stored for two years at 1-3°C.

1988 **Allen** *et al.*: *Xiphinema rivesi* identified as the main vector of ToRSV in Ontario vineyards.

1989 **Martelli and Taylor:** Review of nematode-borne viruses and their vectors.

1989 **Bays and Tolin**: ToRSV found in grapevines in Virginia

1990 **Powell** *et al.*: Survey of ToRSV and TRSV in Pennsylvanian vineyards.

1991 **Rott** *et al.*: Complete nucleotide sequence of ToRSV RNA-2.

1992 **Rowhani** *et al:* Description of sampling strategy for detection of ToRSV.

1993 **Baumgartnerova and Subikova**: ToRSV recorded form grapevine in Slovakia.

1995 **Rott** *et al.*: Complete nucleotide sequence of ToRSV RNA-1.

2001 **Herrera and Madariaga**: ToRSV recorded from grapevine in Chile.

2004 **Li** *et al:* ToRSV identified in China in grapevine seedlings grown from seeds imported from France.

3. References

Allen W.R. and H.F. Dias, 1977. Properties of the single protein and two nucleic acids of tomato ringspot virus. *Canadian Journal of Botany* **55**, 1028-1037.

Allen W.R., H.F. Dias and J.G. Van Schagen, 1982. Susceptibility of grape cultivars and rootstocks to an Ontario isolate of tomato ringspot virus. *Canadian Journal of Plant Pathology* 4, 275-277.

Allen W.R., L.W. Stobbs, J.G. Van Schagen and B.A. Ebsary, 1988. Association of *Xiphinema* species with soil types ang grapevines infected with tomato ringspot virus in Ontario, Canada. *Plant Disease* **72**, 861-863.

Baumgartnerova H. and V. Subikova, 1993. Identification of tomato rinsgspot virus in leafroll diseased grapevines. *Works of the Institute of Experimental Phytopathology and Entomology , Ivanka pri Dunaji* **4**, 31-34.

Bays D.C. and S.A. Tolin, 1989. Incidence of tomato ringspot virus in grape in Virginia. *Phytopathology* **79**, 1169.

Bitterlin M.W. and B. Gonsalves, 1987. Spatial distribution of *Xiphinema rivesi* and persistence of tomato ringspot virus and its vector in soil. *Plant Disease* **71**, 408-411.

Corbett M.K. and E.V. Podleckis, 1985. Membrane-associated spherical particles in extracts and tissues of virus-infected grapevines. *Phytopathologia Mediterranea* **24,** 157-164.

Cory L. and W.B. Hewitt., 1968. Some grapevine viruses in pollen and seed. *Phytopathology* **58**, 1316-1320

Dias H.F., 1977. Incidence and geographic distribution of tomato ringspot virus in De Chaunac vineyards in the Niagara peninsula. *Plant Disease Reporter* **61**, 24-28.

Gilmer R.M. and J.K. Uyemoto, 1972. Tomato ringspot virus in "Baco noir" grapevines in New York. *Plant Disease Reporter* **56**, 133-135.

Gonsalves D., 1980. Detection of tomato ringspot virus in grapevines: irregular distribution of virus. *Proceedings 7th Meeting of IGVG, Niagara Falls 1980*, 95-106.

Gooding G.V. 1963. Purification and serology of a virus associated with the grape yellow vein disease. *Phytopathology* **53,** 475-480.

Gooding G.V. and W.B. Hewitt, 1962. Grape yellow vein: symptomatology, identification, and the association of a mechanically transmissible virus with the disease. *American Journal of Enology and Viticulture* **13,** 196-203.

Herrera M.G and V.M. Madariaga, 2001. Presence and incidence of grapevine viruses in central Chile. *Agricultura Tecnica* **61**, 393-400

Hewitt W.B., 1954. Some virus and virus-like diseases of grapevines. *Bulletin of the California Department of Agriculture* **43,** 47-64.

Li M.F., N. Xiang , M.S Whei, G.F. Li, Y.J. Zhang and Y.F. Chen, 2004. Detection and identification of plant viruses for quarantine in China. *Proceedings 15th International Plant Protection Congress, Beijing 2004*, 663

Martelli G.P., 1978. Nematode-borne viruses of grapevine, their epidemiology and control. *Nematologia Mediterranea* **6,** 1-27.

Martelli G.P. and C.E. Taylor, 1989. Distribution of viruses and their nematode vectors. *Advances in Disease Vector Research* **6**, 151-189.

Piazzolla P., V. Savino, M.A. Castellano and D. Musci, 1985. A comparison of Grapevine yellow vein virus and a Grapevine isolate of Tomato ringspot virus. *Phytopathologia Mediterranea* **24,** 44-50.

Podleckis E.V. and M.K. Corbett, 1982. Tomato ringspot virus associated with little grape disease of Vidal 256 grapevines. *Phytopathology* **72**, 710.

Powell C.A., J.L. Longenecker and L.B. Forer, 1990. Incidence of tomato rigspot virus and tobacco rigspot virus in grapevines in Pennsylvania. *Plant Disease* **74,** 702-704.

Rott M.E., J.H. Tremaine and D'A. Rochon, 1991. Nucleotide sequence of tomato ringspot virus RNA-2. *Journal of General Virology* **72**, 1505-1514.

Rott M.E., A. Gilchrist, L. Lee and D'A. Rochon, 1995. Nucleotide sequence of tomato ringspot virus RNA 1. *Journal of General Virology* **76**, 465-473.

Rowhani A., M.A. Walker and S. Rokni, 1992. Sampling strategies for the detection of grapevine fanleaf virus and the grapevine strain of tomato ringspot virus. *Vitis* **31**, 35-44.

Stace-Smith R., 1984. Tomato ringspot virus. *CMI/AAB Descriptions of Plant Viruses*, No. 290

Stace-Smith R. and D.C. Ramsdell, 1987. Nepoviruses of the Americas. *Current Topics in Vector Research* **5***,* 131-166.

Téliz D., R.G. Grogan and B.F. Lownsberry, 1966. Transmission of tomato ringspot, peach yellow bud mosaic, and grape yellow vein viruses by *Xiphinema americanum. Phytopathology* **56**, 658-663.

Uyemoto J.K., 1975. A severe outbreak of virus-induced grapevine decline in Cascade grapevines in New York. *Plant Disease Reporter* **59**, 98-101.

Uyemoto J.K. and R.M. Gilmer, 1972. Spread of tomato ringspot virus in "Baco Noir" grapevines in New York. *Plant Disease Reporter* **56**, 1062-1064.
Uyemoto J.K., J.R. Cummins and G.S. Abawi, 1977. Virus and virus-like diseases affecting grapevines in New York vineyards. *American Journal of Enology and Viticulture* **28,** 131-136.
Yang I.L., T.C. Deng and M.J. Chen, 1986. Sap-transmissiible viruses associated with grapevine yellow mottle disease in Taiwan. *Journal of Agricultural Research China* **35**, 504-510.

LEAFROLL

GRAPEVINE LEAFROLL

1. Description

The first descriptions of grapevine leafroll date back to the mid 19th century. There are reports of early reddening of grapevine leaves regarded as physiological disorders and referred to as “Rugeau” or “Rossore” in the French and Italian literature, respectively. Leafroll is no less important than fanleaf in economic importance, and is probably the most widespread virus disease of grapevine. Its occurrence in viticultural areas is worldwide.

Main synonyms: White Emperor disease (Eng.), Rollkrankheit, Blattrollkrankheit (Germ.), enroulement (Fr.), accartocciamento, accartocciamento fogliare (Ital.), enrollamiento de la hoja, enrollado (Sp.), Enrolamento de la folha (Port.)

Main symptoms: In red-berried cultivars of *Vitis vinifera* reddish spots develop in the lower leaves in late spring or summer, depending on the climate and geographic location. These spots enlarge with time and coalesce so that, in autumn, most of the leaf surface becomes reddish, usually leaving a narrow green band along the primary and secondary veins. The leaf blade becomes thick, brittle and rolls downwards. These symptoms progress towards the top of the canes as the season advances. In the most severe cases, the whole leaf surface becomes deep purple. The fruits often mature late and irregularly, and with many cultivars, they are inferior in quantity and quality, and low in sugar. In white-berried cultivars of *V. vinifera,* the symptoms are similar, but the leaves become chlorotic to yellowish, instead of reddish. Careful observation of field symptoms in infected vines reveals that there are several types of leafroll, differing somewhat in aspect and in severity, thus suggesting that there can be several causal agents. In most cases, infection of rootstocks is symptomless, except for a variable decrease in vigour. Hence, the risk of disseminating the disease is great if untested rootstocks are used. Leafroll decreases grapevine yield (by 15-20% in average) and affects negatively rooting ability, graft take and plant vigour. Also plant anatomy is affected, especially the phloem. Sieve elements are obliterated and crusheds, thus impairing carbohydrate translocation from foliar parenchymas. Starch accumulates in degenerated chloroplasts causing increased thickness and brittleness of the leaf blades, and lowering of sugar content. A number of other physiological parameters are affected, i.e. reduction of protein content, changes in the pattern of peroxidase and polyphenoloxidase isoenzymes, potassium depletion in the leaf blade and accumulation in the petioles. Also the composition and aromatic profile of the musts are modified. These negative effects are reverted if the disease is eliminated by sanitation treatments.

Agents: To date, nine different viruses with filamentous particles, called grapevine leafroll-associated viruses (GLRaV), which are differentiated from one another by a progressive number, have been found in leafroll-infected vines. Other such viruses may exist. Until 1995, differentiation of GLRaVs at the species level was by Roman numerals, now is by Arabic numerals:

Grapevine leafroll-associated virus 1 (GLRaV-1)
Grapevine leafroll-associated virus 2 (GLRaV-2)
Grapevine leafroll-associated virus 3 (GLRaV-3)
Grapevine leafroll-associated virus 4 (GLRaV-4)
Grapevine leafroll-associated virus 5 (GLRaV-5)
Grapevine leafroll-associated virus 6 (GLRaV-6)
Grapevine leafroll-associated virus 7 (GLRaV-7)
Grapevine leafroll-associated virus *8* (GLRaV-8)
Grapevine leafroll-associated virus 9 (GLRaV-9)

A potyvirus isolated in Israel from leafroll-infected vines is now regarded as an occasional contaminant. All GLRaVs belong in the family *Closteroviridae,* GLRaV-2 in the genus *Closterovirus*, GLRaV-1, GLRaV-3, GLRaV-4, GLRaV-5, GLRaV-6, GLRaV-8, and GLRsV-9 in the newly established genus *Ampelovirus*, whereas GLRaV-7 is presently classified as unassigned species to the family. Virus particles are very flexuous filaments about 12 nm wide, exhibiting open structure and distinct cross banding with a pitch of about 3.5 nm. Particle length varies from 1400 to 2200 nm according to individual viruses, the same as the size of coat protein (CP) subunits. GLRaV-2 CP has a M_r of 24 kDa, whereas the M_r of all other viruses ranges between 35 and 44 kDa, as estimated by polyacrylamide gel electrophoresis. Sizes deduced from the nucleotide sequence of the CP cistron are 22 kDa for GLRaV-2 ,

35 kDa for both GLRaV-3 and GLRaV-1, 29.5 kDa for GLRaV-4 . The genome is a monopartite, single-stranded, positive sense RNA molecule. The genome of GLRaV-2 is 15,528 nt in size, contains nine open reading frames (ORF) and has structural organization identical to that of *Beet yellow virus* (BYV), the type member of the genus. GLRaV-3, which is the type species of the novel genus *Ampelovirus* has a genome 17,919 nt in size, contains 13 ORFs, and has structural organization differing from that of other sequenced closteroviruses. The genome of GLRaV-1 is 17,647 nt in size and contains 10 major ORFs. The genome of GLRaV-4 and GLRaV-9 are incompletely sequenced but show a structural organization compatible with that of the genus. GLRaVs differ in various vays (molecularly, biologically, ultrastructurally, and epidemiologically) from most of the known closteroviruses, with none of which they are serologically related. GLRaVs were also thought to be serologically distinct from one another until a distant serological relationship was found between GLRaV-1 and GLRaV-3 using monoclonal antibodies raised to GLRaV-1. GLRaV-5 and GLRaV-9 are phylogenetically close to one another but are serologically unrelated. Regardless of whether they belong to the genus *Closterovirus* or *Amplelovirus*, GLRaVs show molecular variations which give rise to a population of strains, in agreement with the quasispecies nature of viruses. This has been ascertained experimentally for GLRaV-1, GLRaV-2 and GLRaV-3. Other GLRaVs may exist in nature as suggested by reports.

Cytopathology: A characterizing feature of all GLRaV infections is the presence of intracellular inclusions in phloem tissues made up of aggregates of virus particles intermingled with single or clustered mebranous vesicles containing finely stranded material thought to be viral RNA. Membranous vesicles can derive eitrher from peripheral vesiculation of mitochondria followed by disruption of the organelles (GLRaV-1, GLRaV-3, GLRaV-5) or from vesiculation of the endoplasmic reticulum (GLRaV-2 and GLRaV-7)

Transmission: Leafroll is graft-transmissible and persists in propagative material (budwood, roostocks, grafted vines) which is largely responsible for its dissemination over medium and long distances. Spread at a site is mediated by mealybug and soft scale insect vectors. Natural field spread of leafroll disease has been reported from many countries in Europe and elsewhere. So far, only vectors of GLRaV-1, GLRaV-3, GLRaV-5 and GLRaV-9 have been identified. GLRaV-1 is transmitted in nature by the pseudococcid mealybugs *Heliococcus bohemicus* and *Phenacoccus aceris* and the soft scale insects *Pulvinaria vitis*, *Parthenolecanium corni,* and *Neopulvinaria innumerabilis.* Mealybug vectors of GLRaV-3 are *Planococcus ficus*, *Pl. citri*, *Pseudococcus longispinus, Ps. calceolariae, Ps. maritimus, Ps. affinis, Ps. viburni* and *Ps. comstocki.* Its soft scale insects vectors are *Pulvinaria vitis* and *Neopulvinaria innumerabilis*. GLRaV-5 and GLRaV-9 are both transmitted by *Ps. longispinus.*Transmission is semipersistent and does not appear to be vector-specific. None of the GLRaVs is known to be seed-borne.

Varietal susceptibility and sensitivity: No immune variety or rootstock is known. Symptom expression depends on the variety, climate, soil condition and probably, number an types of infecting viruses. Red-berried *V. vinifera* varieties show symptoms most clearly because of the reddening of the leaves, and some of them are used as indicators. American rootstocks are usually symptomless carriers of GLRaVs.

Detection: In many cases, leafroll can be detected by its symptoms in the field on red-fruited varieties. Indexing on red-fruited cultivars such as 'Cabernet sauvignon', 'Cabernet Franc' 'Pinot noir', 'Merlot', or the hybrid LN 33 is still the most popular method for identifying the disease, but it does not discriminate between GLRaVs and was reported to be less sensitive than ELISA. GLRaV-2, the only member of the group to be mechanically transmissible, has a number of minor biological variants which can be differentiated by the reaction of inoculated *Nicotiana* species. or by molecular techniques. All GLRaVs can be identified by serological and nucleic acid-based techniques. Polyclonal antisera and/or monoclonal antibodies have been raised to each single GLRaV . These reagents are routinely used for ISEM, classical double antibody sandwich ELISA (Chromo-ELISA) or Lumino-ELISA, and some are commercially avaliable. Leaf tissues or petioles from mature symptomatic leaves of *V. vinfera* and cortical shavings from mature dormant canes of *V. vinifera,* American *Vitis* species and rootstocks are the best antigen sources for serological assays. Composite samples should be used to minimize false negative responses that may originate from the unven distribution of GLRaVs in chronically infected vines. Foliar tissues are not recommended for serological GLRaVs detection in American *Vitis* species and roostocks. As to nucleic acid-based assays, cloned cDNA probes and riboprobes to GLRaV-1 and GLRaV-3 have been produced from denatured double-stranded RNA (dsRNA) and a number of virus-specific, broad-spectrum, and degenerate primers have been designed and successfully used for PCR detection of virtually all GLRaVs. The presence of high molecular weight double-stranded RNAs (dsRNA) in phloem tissue extracts can be used as infection marker. Disappearance of dsRNAs from vines submitted to

sanitation treatments is regarded as evidence for successful virus elimination. However, dsRNAs cannot be utilized for virus identification, unless they are hybridized with virus-specific probes.

Control: Production and use of clonally selected and sanitized propagation material is very effective and the only preventive method for leafroll control available. No sources of resistance are known in *V. vinifera* and there is no published information on how to protect healthy stocks from vector-mediated reinfection in the field. Introduction of transgenic resistance to GLRaV-2 and GLRaV-3 is being attempted by engineering different viral genes into rootstocks and European grape cultivars.

2. Historical review

1906 **Sannino**: Occurrence in Italy of “rossore”, a grapevine disorder similar to leafroll**.**

1924 **Ravaz and Verge**: Occurrence in France of “rougeau”, a grapevine disorder similar to leafroll

1935 **Scheu**: Demonstration of graft transmission of leafroll from diseased to healthy *Vitis vinifera*. Hypothesis of the viral origin of leafroll.

1936 **Scheu**: Leafroll is widespread in German vineyards.

1946 **Harmon and Snyder**: The "White Emperor" disease is graft-transmissible and is regarded a virus disease.

1954 **Hewitt**: Leafroll in California

1958 **Goheen** *et al*.: White Emperor and leafroll are identical diseases.

1958 **Fraser:** Leafroll in Australia**.**

1958 **Vuittenez:** Leafroll in France**.**

1960: **Blattny** *et al.*: Leafroll in Czechoslovakia.

1965 **Goheen** *et al*.: Leafroll virus can be inactivated *in vivo* by heat therapy.

1967 **Hoefert and Gifford**: Study of the effects of leafroll infection on vine anatomy**.**

1967 **Chamberlain**: Leafroll in New Zealand**.**

1967 **Belli** *et al*.: Leafroll in Italy.

1968 **Bovey**: Leafroll in Switzerland**.**

1969 **Lehoczky** *et al*.: Leafroll in Hungary.

1970 **Dimitrijevic**: Leafroll in Yugoslavia**.**

1970 **Luhn and Goheen**: Leafroll found in the original grapevine stocks imported from Europe into California in 1890. The incidence if the disease was less than 20% as compared with 80 to 100% in commercial vineyards. As no apparent spread of the disease was observed, roostocks are suggested as the major souces of leafroll dissemination.

1971 **Mendgen:** Presence of filamentous particles in grapevines with symptoms of flavescence dorée in West Germany. These particles are probably closteroviruses associated with leafroll.

1973 **Tanne and Nitzany**: Leafroll in Israel

1974 **Tanne** *et al*.: Transmission of a virus to herbaceous plants from a leafroll-infected vine in Israel. Later studies showed that the virus is an occasional contaminant

1975 **Lider** *et al.:* Studies on the effects of leafroll on yield of grapevines in California.

1975 **Martelli and Piro:** Evidence from a herbarium that leafroll occurred in Sicily in the second half of the 19th century.

1976 **Tanaka:** Leafroll in Japan**.**

1976 **Kliever and Lider**: Study of biochemical changes found in grapevine infected with leafroll in California.

1977 **Abracheva**: Leafroll in Bulgaria**.**

1979 **Namba** *et al*.: Closterovirus-like particles with an estimated length of 1000 nm found in thin sections of phloem tissue and in leaf dip preparations of leafroll-diseased grapevines in Japan. Absence of such particles in healthy grapevines. Suggestion that a closterovirus may be the agent of the disease.

1981 **Faoro** *et al.*: Aggregates of closterovirus-like particles observed in thin sections of phloem from leafroll-diseased grapevines, but not in similar praparations from healthy plants.

1981 **Sasahara** *et al*.: First record of successful elimination of leafroll in grapevine by using meristem tip culture in Japan.

1982 **Von der Brelie and Nienhaus**: Light and electron microscope study of cytopathological changes induced by leafroll in grapevines. Presence of virus-like particles in thin sections of leafroll-diseased vines, but not in healthy controls.

1982 **Barlass** *at al.:* Elimination of leafroll by *in vitro* meristm tip culture and apex fragmentation.

1983 **Castellano** *et al*.: Ultrastructural study of leafroll-infected grapevine tissues.

1984 **Gugerli** *et al*.: Extraction and first purification of closterovirus-like particles with maximum particle length of 2200 nm (type I) and 1800 nm (type II) from leafroll-diseased grapevine leaves in Switzerland. Production of polyclonal antisera for use in ELISA.

1984 **Hofmann:** Symptoms of leafroll in affected clones of Pinot noir and performance in West Germany.

1984 **Corbett** *et al*: Electron microscope observations by negative staining of leaf extracts from leafroll-diseased grapevines in South Africa showed the presence of closterovirus- like particles.

1985 **Mossop** *et al*.: Closterovirus-like particles and specific dsRNA found in leafroll-diseased grapevines in New Zealand.

1986 **Rosciglione and Gugerli**: GLRaV-1 and GLRaV-2 with particles of 2200 nm and 1800 nm respectively, previously found in grapevines in Switzerland, are also present in leafroll-affected grapevines from Italy. A third closterovirus type called GLRaV-3, found in grapevines affected by leafroll.

1986 **Martelli** *et al*.: Review on the detrimental effects of viral infection on grapevine physiology.

1987 **Zee** *et al*.: Studies on the cytopathology of leafroll-diseased grapevines. Purification and serology of associated closterovirus-like particles. Antiserum against a New York isolate also reacted with GLRaV-3 from Europe.

1987 **Teliz** *et al.:* ELISA testing reveals that GLRaV-3 has an uneven distribution in grapevine tissues.

1988 **Zimmermann** *et al*.: Closterovirus-like particles purified from leafroll-diseased grapevines in France. Production of rabbit and hen antibodies for ELISA and ISEM to GLRaV-1 and GLRaV-3.

1988 **Hu and Gonsalves**: Monoclonal antibodies produced against GLRaV-3. A large dsRNA molecule is consistently isolated from leafroll-diseased grapes.

1989 **Rosciglione and Gugerli:** GLRaV-3 is transmitted by the mealybug *Planococcus ficus*. Confirmation that GLRaV-3 and the New York closterovirus isolate cross react serologically.

1989 **Tanne** *et al.*: Transmission of GLRaV-3 from grapevine to grapevine by the mealybug *Pseudococcus longispinus* in Israel.

1989 **Téliz** *et al*.: Detection of leafroll-associated closterovirus in recently infected grapevines in New York. The virus was detected in root tissues, later in the leaves. In Mexico leafroll, stem pitting and corky bark spread rapidly. *Pseudococcus longispinus* is present on weeds around diseased vineyards.

1989 **Auger** *et al*.: Leafroll and associated closteroviruses in Chile

1989 **Kuhn**: Leafroll in Brasil

1989 **Li** *et al*.: Leafroll and associated closteroviruses in China

1990 **Engelbrecht and Kasdorf**: Transmission of GLRaV-3 by *Planococcus ficus* from grapevine to grapevine in South Africa. GLRaV-1 and GLRaV-2 were not transmitted. GLRaV-2, but not GLRaV-1, was detected in *P. ficus* fed on infected vines,

1990 **Gugerli** *et al*.: Production of monoclonal antibodies to GLRaV-1 and GLRaV-3.

1990a, b **Hu** *et al*.: Characterization of leafroll-associated closterovirus-like particles from grapevine using also monoclonal antibodies. Identification of GLRaV-4

1990 **Walter** *et al*.: Use of green grafting for detecting virus-like diseases of grapevine. With leafroll, symptoms are obtained within 20-70 days.

1990 **Agran** *et al*.: Leafroll in Tunisia

1990 **Azeri:** Leafroll in Turkey

1990 **Borgo**: Serological detection of GLRaV -1 and GLRaV-3 by ELISA in extracts of leaves or wood shavings. Good results in summer with extracts of basal leaves and in autumn or winter with wood shavings macerated in buffer.

1990 **Zimmermann** *et al*.: Production and characterization of monoclonal antibodies specific to GLRaV-3.

1991 **Boscia** *et al*.: Evidence of the irregular distribution of GLRaV-3 in American rootstocks, especially those containing *V. rupestris* plasma. For reliable testing, ELISA is to be applied to cortical scrapings rather than leaf tissues.

1991 **Credi and Santucci**: GLRaV-1 and GLRaV-3 cannot be detected by direct ELISA in leaves of graft-inoculated American rootstock, but they are easily detected in inoculated LN33 vines and in *V. vinifera* varieties used as inoculum source.

1991 **Gugerli**: Review of grapevine closteroviruses.

1991 **Gugerli** *et al*.: Further characterization of GLRaV-1 and GLRaV-3 by monoclonal antibodies. Transmission of GLRaV-3 by the mealybug *Planococcus ficus.* There is evidence that other GLRaVs are involved in leafroll etiology.

1991 **Savino** *et al*.: Comparison of heat therapy and meristem tip culture for eliminating GLRaV-3 from Italian grape varieties. Heat therapy requires very long treatments and is only 20-30 % successful, whereas meristem tip culture yields up to 100 % sanitation

1991 **Walter and Zimmermann**: Further characterization of closteroviruses associated with leafroll in France. Identification of GLRaV-5. GLRaV-1, -2 and -3 are common whereas GLRaV-5 is rarely detected. Some vines indexing positive for leafroll do not react positively with any ofthe antisera, indicating the presence of other leafroll-associated viruses.

1991 **Faoro** *et al*.: Immunocytological detection and localization of GLRaV-1 and GLRaV-3 by immunogold labelling in grapevine thin sections.

1991 **Hu** *et al*.: Comparison of different assay methods for detecting GLRaVs : ELISA, ISEM and dsRNA analysis. ELISA is recommended for large screening, whereas the other assays are more suitable for analyzing samples that gave inconclusive results with ELISA.

1991 **Boehm and Martins:** Leafroll in Portugal**.**

1991 **Bondarchuk** *et al.:* Leafroll and associated closteroviruses in Moldova.

1991 **Katis** *et al*: Leafroll and associated closteroviruses in Greece.

1991 **Kassemeyer**: Detection of GLRaVs in Germany.

1991 **Milkus** *et al*.: Leafroll and associated closteroviruses in Ukraine.

1991 **Namba** *et al*.: Purification and physico-chemical characterization of grapevine corky bark associated virus, later identified as GLRaV-2.

1992 **Habili** *et al*.: Analysis for the presence of double-stranded RNAs can be used for assessing virus elimination following sanitation treatments.

1993 **Gugerli and Ramel:** Analysis by monolconal antibodies of a Swiss source of cv. Chasselas shows the prsence of two different GLRaV-2, denoted GLRaV 2a and GLRaV 2b.

1993 **Jordan**: In a New Zealand commercial vineyard GLRaV-3 incidence increased from 9.1% in 1988 to 93.1% in 1992

1993 **Ioannou**: Leafroll and natural spread of associated closteroviruses in Cyprus**.**

1993 **Pop** *et al.*: Leafroll and associated closteroviruses in Romania.

1993 **Krake**: Characterization of leafroll disease based on symptoms shown by field-infected vines and graft-transmission tests.

1993 **Segura** *et al.*: Leafroll and associated closteroviruses in Spain

1994a,b **Saldarelli** *et al.*: Production of radioactive and non-radioactive molecular probes to GLRaV-3 from denatured dsRNA template and their use for virus identification.

1994 **Merkuri** *et al.:* Leafroll and associated closteroviruses in Albania.

1994 **Flak and Gangl**: Leafroll and associated closteroviruses in Austria**.**

1994 **Tzeng** *et al.*: Leafroll in Taiwan.

1994 **Belli** *et al*.: Transmission of GLRaV-3 by the soft scale insect *Pulvinaria vitis*.

1994 **Martelli** *et al*. Leafroll and associated closteroviruses in Yemen.

1995 **Boscia** *et al*.: Revision of the nomenclature of GLRaVs and use of Arabic numerals in the species names. Former GLRaV 2 is re-named GLRaV-6.

1994 **Minafra and Hadidi**: Detection of GLRaV-3 in viruliferous mealybugs by PCR**.**

1995 **Castellano** *et al*.: Mechanical transmission of GLRaV-2 and ultrastructural study of infected tissues of *Nicotiana benthamiana*.

1995 **Faoro and Carzaniga**: Ustrastructural study of GLRaV-1 and GLRV-3 infections. Observation of peripherically vesiculated mitochondria**.**

1995 **Golino** *et al*.: Transmission of GLRaV-3 by *Pseudococcus affinis* in California.

1995 **Gozsczynski** *et al*.: Production of antisera to GLRaVs using electrophoretically separated coat protein subunits as antigens**.**

1995 **Greif** *et al*.: Association of GLRaV-2 in Italy and France with a graft incompatibility revealed by Kober 5BB.

1996 **Haidar** *et al*.: Leafroll and associated closteroviruses in Lebanon.

1996 **Gozsczynski** *et al.:* Identification of two different mechanically transmissibile strains of GLRaV-2.

1996 **MacKenzie** *et al*.: Distribution and incidence of GLRaVs in Canadian viticultural districts.

1996 **Choueiri** *et al*.: Identification of GLRaV-7 and production of a polyclonal antiserum.

1996 **Lahogue and Boulard:** Search for genes of resistance in grapevines. None of 223 accessions of European, American, and Asian *Vitis* species inoculated by green grafting with a GLRaV-1 and GLRaV-3 sources were resistant.

1997 **Rowhani and Uyemoto**: Comparative trials between indexing and laboratory detection methods show that the latter are more sensitve for GLRaVs detection. Viruses are irregularly distributed in the vines**.**

1997 **Habili and Nutter**: In an Australian commercial vineyard GLRaV-3 incidence increased from 23.1% in 1986 to 51.9% in 1996. No vector was identified.

1997 **La Notte** *et al.:* Development of a spot-PCR technique for GLRaVs identification.

1997 **Gugerli** *et al*.: Serological characterization of GLRaV-6 and production of monoclonal antibodies.

1997 **Guidoni** *et al.*: Elimination of GLRaV-3 by heat therapy improves agronomic performances of a Nebbiolo clone and the quality of the must.

1997 **Faoro**: Comprehensive review of the ultrastructure of GLRaVs infections.GLRaV-5 induces mitochondrial vesiculation**.**

1997 **Martelli** *et al*.: Comprehensive review of the properties of GLRaVs.

1997 **Cabaleiro** *et al*.: GLRaV-3 is transmitted by *Planococcus citri* in a semipersisten manner.

1997 **Ling** *et al*.: Cloning an sequencing of the coat protein gene of GLRaV-3 and its expression in transgenic tobacco.

1997 **Fortusini** *et al.*: Transmission of GLRaV-1 by the soft scale insects *Parthenolecanium corni* and *Neopuvinaria innumerabilis.*

1997 **Petersen and Charles**: *Pseudococcus calceolariae* acts as vector of GLRaV-3 in New Zealand.

1998 **Al-Tamimi** *et al*.: Leafroll and associated closteroviruses in Jordan.

1998 **Alkowni** *et al*.: Leafroll and associated closteroviruses in Palestine.

1998 **Krastanova** *et al*.: GLRaV-2 and GLRaV-3 genes engineered in grapevine rootstocks to induce resistance.

1998 **Ling** *et al*.: Extensive sequencing of GLRaV-3 genome. GLRaV-3 appears to be a typical closterovirus.

1998 **Zhu** *et al.:* The sequenced genome of GLRaV-2 has the same structural organization of that of *Beet yellows virus*, the type specied of the genus *Closterovirus*.

1998 **Routh** *et al*.: Use of degenerate primers for PCR detection of GLRaV-4 and GLRaV-5.

1998 **Wilcox** *et al.*: GLRaV-3 detected in native American vines in Western New York.

1998 **Saldarelli** *et al*.: Use of degenerate primers for PCR detection of GLRaV-1 and GLRaV-7.

2000 **Abou Ghanem -Sabanadzovic** *et al*.: Identification and partial characterization of a new strain of GLRaV-2.

2000 **Boscia** *et al*.: Intriguing association of GLRaV-6 with cv. Cardinal in Italy and Greece. Production of a new set of monoclonal antibodies.

2000 **Castellano** *et al*: Ultrastructural study of GLRaV-2 and GLRV-7 infections. Demonstration that the membranous vesicles accumulating in the cytoplasm derive from proliferation of the endoplasmic reticulum.

2000 **Kim** *et al*.: Leafroll and associated closteroviruses in South Korea.

2000a **Golino** *et al***.:** Association of an unusual strain of GLRaV-2 with a graft incompatibility condition described from California as young vine decline.

2000b **Golino** *et al*.: Mealybug species *Pseudococcus longispinus, Ps. viburni, Ps. maritimus, Ps. affinis* and *Planococcus citri* transmit with various efficiency GLRaV-3 in California but not GLRaV-1, GLRaV-2 and GLRaV-4.

2000 **Karasev**: Review article on closteroviruses. Proposal for the establishment of *Vinvirus* (*Ampelovirus*) , a new genus having GLRaV-3 as type species.

2000 **Fazeli and Rezaian**: Partial sequencing of GLRaV-1 genome.

2000 **Gugerli**: Detection of GLRaVs by Lumino-ELISA, a chemiluminometric enzyme-linked immuosorbent assay.

2000 **Gonsalves:** Review article on the molecular traits of GLRaVs.

2000 **Monis**: Identification of GLRaV-8 and production of monoclonal antibodies.

2000 **Ling** *et al*.: Completion of the nucleotide sequence of GLRaV-3 genome and use of the HSP90 and coat protein genes for producing transgenic rootstocks.

2000 **Meng** *et al*.: Completion of the nucleotide sequence of GLRaV-2 genome.

2000 **Digiaro** *et al.:* Survey of GLRaVs in Mediterranean and Near East countries.

2000 **Mannini and Credi**.: Evidence that vines sanitized from leafroll have superior qualitative and quantitative traits.

2000 **Zhou** *et al.*: New monoclonal antibodies to GLRaV-2, one of which is especially suited for ELISA testing.

2000 **Turturo** *et al*. : Partial sequencing of GLRaV-7 genome.

2000 **Sforza** *et al*.: New vectors of GLRaV-1 are the mealybugs *Heliococcus bohemicus* and *Phenacoccus aceris* and the soft scale insect *Pulvinaria vitis*.

2000 **Rowhani** *et al*.: Detection in California of a GLRaV-2 strain sharing about 74% sequence homology with GLRaV-2 type strain and reacting weakly serologically with GLRaV-2.

2000 **Seddas** *et al.*: Evidence that GLRaV-1 and GLRaV-3 are serologically related based on the cross-reactivity of a monoclonal antibody raised to GLRaV-1.

2001 **Little** *et al*.: Identification of hypervariable regions in GLRaV-1 genome. Evidence of the quasispecies nature of the virus.

2002 **Martelli** *et al.*: Revision of the family *Closteroviridae*. Establishment and description of *Ampelovirus* , a genus with monopartite RNA species, transmitted by mealybugs and soft scale insects. The type species is GLRaV-3

2002 **Alkowni** *et al.* : Report of a new putative grapevine leafroll associated virus.

2003 **Gugerli:** Updated review of leafroll and associated viruses.

2003 **Gòmez Talquenca** *et al.*: Learoll and GLRaV-1, GLRaV-2, and GLRaV-3 in Argentina.

2003 **Abou Ghanem -Sabanadzovic** *et al.*: Partial molecular characterization of Grapevine leafroll-associated virus 4.

2003 **Cornuet** *et al.*: Identification of a new putative ampelovirus (GLRaV-10?), later identified as a molecular variant of GLRaV-4.

2003 **Little and Rezaian**: Functional analysis of the genes of GLRaV-1. The presence of two ORFs conding for the coat protein duplicate is confirmed and the intracellular localization of some genome expression products is established. In particular, ORF 2-encoded protein induces the formation of endoplasmis reticulum vesicles which may be involved in virus replication.

2003 **Turturo** *et al.*: Genetic variability of GLRaV-3 studied by single-strand conformation polymorphism and nucleotide sequence analysis of fragments of three different genes. Evidence of the quasispecies nature of the virus.

2003 **Zhou** *et al*.: Production of monoclonal antibodies to GLRaV-3 elicited by linear epitopes located in the first portion of the coat protein gene.

2003 **Nölke** *et al.*: Generation of single chain antibody fragments to GLRaV-3 for induction of antibody-based resis tance in grapevine.

2004 **Alkowni** *et al.***:** Description and extensive sequencing of GLRaV-9, an ampelovirus first reported in 2002.

2004 **Ling** *et al*.: Nucleotide sequence of GLRaV-3 completed. The genome has a size of 17 919 nt and contains 13 genes.

2004 **Bertazzon** *et al.*: Molecular polymorphism of GLRaV-2 isolates studied by heteroduplex mobility assay identifies five clusters of molecular variants. The species quasi nature of the virus is confirmed.

2004 **Abou Ghanem-Sabanadzovic** *et al*.: Identification of a putative new closterovirus in cv Carnelian from California

2005 **Bertamini** *et al*.: GLRaV-3 infection reduces the amount of photosynthetis pigments, RuBP, nitrate reductase, photosynthetic activities, and thylakoid membrane proteins of field-grown cv. Lagrein vines, thus inducing a the rapid senesce of the leaves.

3. References

Abou Ghanem-Sabanadzovic N, S. Sabanadzovic, M.A. Castellano, D. Boscia and G.P. Martelli, 2000. Properties of a new isolate of grapevine leafroll-associated virus 2. *Vitis* **39**, 119-121.

Abou Ghanem-Sabanadzovic N., S. Sabanadzovic, G. Roy and A. Rowhani, 2003. Partial molecular characterization of Grapevine leafroll-associated virus 4. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 42.

Abou Ghanem-Sabanadzovic N., S. Sabanadzovic and A. Rowhani, 2004. Preliminary molecular data on a putative new grapevine leafroll-associated virus. *Phytopathology* **94** (Supplement to n° 6): S2

Abracheva P., 1977. Grapevine leafroll. *Rastitelna Zaschtita* **25** (**9**), 32-33.

Agran M.K., B. Di Terlizzi, D. Boscia, A. Minafra , V. Savino, G.P. Martelli and F. Askri, 1990. Occurrence of grapevine virus A (GVA) and other closteroviruses in Tunisian grapevines affected by leafroll. *Vitis* **29,** 43-48.

Al-Tamimi N., M. Digiaro and V. Savino, 1998. Viruses of grapevine in Jordan, *Phytopathologia Mediterranea* **37**, 122-126

Alkowni R., M. Digiaro and V. Savino, 1998. Viruses and virus diseases of grapevine in Palestine. *Bulletin OEPP/EPPO Bulletin* **28**, 189-195.

Alkowni R., A. Rowhani and D.A. Golino, 2002. Partial nucleotide sequence and molecular detection of a putative new grapevine leafroll associated virus. *Phytopathology* **92** (Supplement to n° 6), S3.
Alkowni, R., A. Rowhani, S. Daubert and D.A. Golino, 2004. Partial characterization of a new ampelovirus associated with grapevine lafroll disease *Journal of Plant Pathology* **86,** 123-133.
Auger J., R. Arancibia and P. Gugerli, 1989. Isolation and identification of virus particles in leafroll-infected grapevines in Chile. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 95.
Azeri T., 1990. Detection of grapevine leafroll virus in different varieties by indexing*. Journal of Turkish Phytopathology* **19**, 103-109.
Barlass M., K.G.M. Skene, R.C. Woodham and L.R. Krake, 1982. Regeneration of virus-free grapevines using *in vitro* apical culture. *Annals of Applied Biology* **101**, 291-295.
Belli G. and R. Cesati, 1967. Frequent occurrence of grapevine leafroll in Lombardia (northern Italy). *Rivista di Patologia Vegetale* (S.IV) **3**, 105-112.
Belli G., A. Fortusini, L. Casati, P. Belli, A. Bianco and S. Prati, 1994. Transmission of grapevine leafroll associated closterovirus by the scale insect *Pulvinaria vitis* L. *Rivista di Patologia Vegetale* (S.V) **4**, 105-108.
Bertamini M., K. Muthuchelian and N. Nedunchezhian, 2004. Effect of grapevine leafroll on the photosynthesis of field grown grapevine plants (*Vitis vinfera* L. cv. Lagrein). *Journal of Phytopathology* **152**, 145-152.
Bertazzon N. , E. Angelini and M. Borgo, 2003. Diversity among Grapevine leafroll associated virus 2 detected by heteroduplex mobility assay *Journal of Phytopathology* **152**, 416-422
Blattny C., T. Dohnal and Z. Prochazkova, 1960. Uber das virose Blatrollen der Weinrebe. *Presslia* **32**, 418-419.
Boehm J. and E. Martin, 1991. O virus do enrolamento da videira. *Vida Rural* **40**, 44-48.
Bondarchuk VV., L.A. Litvak and I.S. Kostantinova, 1991. Closterovirus-like particles associated with leafroll of grapevine in Moldavia. *Proceedings 10th Meeting of ICVG*, *Volos 1990,* 408.
Borgo M., 1990. Determinazione sierologica dei virus dell' arricciamento e dell' accartocciamento fogliare mediante test ELISA su organi legnosi della vite. *Rivista di Viticoltura e di Enologia* **43** (3), 3-13.
Boscia D., V. Savino, V. Elicio, S.D. Jebahi and G.P. Martelli, 1991. Detection of closteroviruses in grapevine tissues. *Proceedings 10th Meeting of ICVG*, *Volos1990,* 52-57.
Boscia D., C. Greif, P. Gugerli, G.P. Martelli, B. Walter and D. Gonsalves, 1995. Nomenclature of grapevine leafroll-associated putative closteroviruses. *Vitis* **34**, 171-175.
Boscia D., M. Digiaro, V. Savino and G.P. Martelli, 2000. Grapevine leafroll-associated virus 6 and *Vitis vinifera* cv. Cardinal: an intriguing association. *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000,* 21-22.
Bovey R., 1968. Die Blattrollkrankheit der Rebe in der Schweiz. *Weinberg und Keller* **15**, 471-478
Cabaleiro C. and A. Segura, 1997. Some characteristics of the transmission of grapevine leafroll associated virus 3 by *Planococcus citri* Risso. *European Journal of Plant Pathology* **103**, 373-378.
Castellano M.A., G.P. Martelli and V. Savino, 1983. Virus-like particles and ultrastructural modifications in the phloem of leafroll-affected grapevines. *Vitis* **22**, 23-39.
Castellano M.A., N. Abou-Ghanem, G.P. Martelli, D. Boscia and V. Savino, 1995. Cytopathology of two filamentous grapevine viruses and their intracellular identification by gold immunolabelling. *Journal of Plant Diseases and Protection* **102**, 23-33
Castellano M.A., N. Abou-Ghanem, E. Choueiri and G.P. Martelli, 2000. Ultrastructure of grapevine leafroll-associated virus 2 and 7 infections. *Journal of Plant Pathology* **82**, 9-15.
Chamberlain E.E., 1967. Leafroll virus in the grapevines. *Wine Review* **4**, 29-32.
Choueiri E., D. Boscia, M. Digiaro, M.A. Castellano and G.P. Martelli, 1996. Some properties of a hitherto undescribed filamentous virus of the grapevine. *Vitis* **35**, 91-93.
Corbett M.K., G.G.F. Kasdorf, D.J. Engelbrecht and J. Wiid, 1984. Detection of viral-like particles by electron microscopy of negatively stained extracts from grapevines. *South African Journal for Enology and Viticulture* **5**, 43-49.
Cornuet P., P. Andret, E. Vigne and M. Fuchs, 2003. Identification and characterization of a tentative new ampelovirus specifically associated to grapevine leafroll. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 34.
Credi R. and A. Santucci, 1991. Serological detection of grapevine leafroll-associated closterovirus-like particles: apparent absence of viral antigens in leaves of graft-inoculated American rootstocks. *Proceedings 10th Meeting of ICVG*, *Volos 1990*, 71-78.
Digiaro M., G.P. Martelli and V. Savino, 2000. Phloem-limited viruses of the grapevine in the Mediterranean and the Near East. *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000*, 75-76.
Dimitrijevic B., 1970. The occurrence of leafroll of grapevine in Yugoslavia. *Zastita Bilja* **21**, 373-378.
Engelbrecht D.J. and G.G.F. Kasdorf, 1990. Transmission of grapevine leafroll disease and associated closteroviruses by the vine mealybug *Planococcus ficus*. *Phytophylactica* **22**, 341-346.

Faoro F., 1997. Cytopathology of closteroviruses and trichoviruses infecting grapevines. In: Filamentous Viruses of Woody Plants, 29-47. P.L. Monette (ed.). Research Signpost, Trivandrum.
Faoro F. and R. Carzaniga, 1995. Cytochemistry and immunochemistry of the inclusion bodies induced by grapevine leafroll-associated closteroviruses GLRaV-1 and GLRaV-3. *Rivista di Patologia Vegetale* (S. V) **5**, 85-94.
Faoro F., R. Tornaghi and G. Belli, 1981. Association of a possibile closterovirus with grapevine leafroll in northern Italy. *Rivista di Patologia Vegetale* (**S.V**) **17**, 183-189
Faoro F., R. Tornaghi and G. Belli, 1991. Localization of closteroviruses on grapevine thin sections and their identification by immunogold labelling. *Journal of Phytopathology* **133**, 297-306.
Fazeli C.F.and M.A. Rezaian, 2000. Nucleotide sequence and organization of ten open rading frames in the genome of grapevine leafroll-associated virus 1 and identification of three subgenomic RNAs. *Journal of General Virology* **81**, 605-615.
Flak W. and H. Gangl, 1994. Grobkartierung des Rebvirosenbefalls in der Weinbauregion Bungerland mittels ELISA. *Mitteilung Klsterneuburg* **44**, 163-167.
Fortusini A., G. Scattini, S. Prati, S. Cinquanta and G. Belli, 1997. Transmission of grapevine leafroll virus 1 (GLRV-1) and grapevine virus A (GVA), by scale insects. *Extended Abstracts 12th Meeting of ICVG*, *Lisbon 1997*, 121-122.
Fraser L., 1958. Report on observations on virus diseases of grapevines in the USA and on the occurrence of leafroll and other virus diseases of grapevine in New South Wales. *New South Wales Department of Agriculture Report.*
Goheen A.C., C.F. Luhn and W.B. Hewitt, 1965. Inactivation of grapevine viruses *in vivo*. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis 1965,* 255-265.
Goheen A.C., F.N. Harmon and J.H. Weinberger, 1958. Leafroll (white Emperor disease) of grapes in California. *Phytopathology* **48**, 51-54.
Golino D.A., S. Sim and A. Rowhani, 1995. Transmission studies of grapevine leafroll-associated virus and grapevine corky bark associated virus by the obscure mealybug. *American Journal of Enology and Viticulture* **46**, 408.
Golino D.A., S. Sim and A. Rowhani, 2000a. Identification of the latent viruses associated with young vine decline in California. *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000*, 85-86.
Golino D.A., S. Sim and A. Rowhani, 2000b. Experimental transmission of grapevine leafroll associated viruses by mealybugs. *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000*, 19-20.
Gòmez Talquenca G.G., O. Gracia, S. Garcia Lampasona and O. Grau, 2003. A survey for *Closteroviridae* family in Argentinean vineyards. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 43-44.
Gonsalves D., 2000. Progress towards understanding the genomic organization and expression of grapevine closteroviruses. *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000*, 6-7.
Goszczynski D.E., G.G.F. Kasdorf and G. Pietersen, 1995. Production and use of antisera specific to grapevine leafroll-associated viruses following electrophoretic separation of their proteins and transfer to nitrocellulose. *African Plant Protection* **1**, 1-8.
Goszczynski D.E., G.G.F. Kasdorf, G. Pietersen and H. Van Tonder, 1996. Detection of two strains of grapevine leafroll-associated virus 2. *Vitis* **35**, 133-135.
Greif C., R. Garau, D. Boscia, V.A. Prota, M. Fiori, P. Bass, B. Walter and U. Prota, 1995. The relationship of grapevine leafroll-associated closterovirus 2 with a graft-incompatibility condition of grapevines. *Phytopathologia Mediterranea* **34**, 167-173.
Gugerli P., 1991. Grapevine closteroviruses. *Proceedings 10th Meeting of ICVG*, *Volos 1990,* 40-51.
Gugerli P., 2000. Detection of grapevine leafroll-associated viruses by chemiluminometric enzyme-linked immunosorbent assay (LUMINO-ELSA). *Extended Abstracts 13th Meeting of ICVG*, *Adelaide 2000*, 134-136.
Gugerli P. and M.E. Ramel, 1993. Grapevine leafroll-associated virus II analyzed by monoclonal antibodies. *Extended Abstacts 11th Meeting of ICVG*, *Montreux 1993*, 23-24.
Gugerli P., J.J. Brugger and R. Bovey, 1984. L'enroulement de la vigne: mise en évidence de particules virales et développement d'une méthode immuno-enzymatique pour le diagnostic rapide. *Revue Suisse de Viticulture Arboriculture et Horticulture* 16, 299-304.
Gugerli P., J.J. Brugger and M.E. Ramel, 1997. Identification immuno-chimique du 6e virus associé à la maladie de l'enroulement de la vigne et amèlioration des techniques de diagnostic pour la sélection sanitaire en viticulture. *Revue Suisse de Viticulture, Arboriculture, Horticulture* **29**, 137-141.
Gugerli P., B. Rosciglione, J.J. Brugger, S. Bonnard, M.E. Ramel and F. Tremea , 1991. Further characterization of grapevine leafroll disease. *Proceedings 10th Meeting of ICVG*, *Volos 1990*, 59-60
Gugerli P., B. Rosciglione, J.-J. Brugger, S. Bonnard, M.E. Ramel and F. Tremea, 1990. Etiological studies and diagnostic of grapevine leafroll improved by monoclonal antibodies. In Shots, A. (Ed.): Monoclonal Antibodies in Agriculture. *Proceedings Symposium Perspectives for Monoclonal Antibodies in Agriculture, Wageningen 1990,* 47-54. Pudoc , Wageningen.

Gugerli P., 2003. Grapevine leafroll and related viruses. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 25-31.
Guidoni S., F. Mannini, A. Ferrandino, N. Argamante and R. Di Stefano, 1997. The effect of grapevine leafroll and rugose wood sanitation on agronomic performance and berry and leaf phenolic content of a Nebbiolo clone (*Vitis vinifera* L.). *American Journal of Enology and Viticulture* **48**, 438-442.
Habili N. and F.W. Nutter, 1997. Temporal and spatial analysis of grapevine leafroll-associated virus 3 in Pinot Noir grapevines in Australia. *Plant Disease* **81**, 6625-628.
Habili N., L.R. Krake, M. Barlass and M.A. Rezaian, 1992. Evaluation of biological indexing and dsRNA analysis in grapevine virus elimination. *Annals of Applied Biology* **121**, 277-283.
Haidar M.M., M. Digiaro, W. Khoury and V. Savino, 1996. Viruses and virus diseases of grapevine in Lebanon. *Bulletin OEPP/EPPO Bulletin* **26**, 147-153.
Harmon F.N. and E. Snyder, 1946. Investigations of the occurrence, transmission, spread, and effect of "white" fruit color in the Emperor grape. *Proceedings of the American Society of Horticultural Science* **47**, 190-194.
Hewitt W.B., 1954. Some virus and virus-like diseases of grapevines. *Bulletin of the California Department of Agriculture* **43,** 47-64.
Hoefert L. L. and E.M. Gifford, 1967. Grapevine leafroll virus. History and anatomical effects. *Hilgardia* **38**, 403-426.
Hoffmann E.L.,1984. Untersuchungen über die Blattrollkrankheit und die Frührotverfärbung bei Klonen der Sorte "Blauer Spätburgunder". *Die Wein-Wissenschaft* **39**, 16-29.
Hu J.S., D. Gonsalves and D. Teliz, 1990a. Characterization of closterovirus-like particles associated with grapevine leafroll disease. *Journal of Phytopathology* **128**, 1-14.
Hu J.S., D. Gonsalves, D. Boscia and S. Namba 1990b. Use of monoclonal antibodies to characterize grapevine leafroll associated closteroviruses. *Phythopathology* **80**, 920-925.
Hu J.S., D. Gonsalves, D. Boscia, M. Maixner and D. Golino, 1991. Comparison of rapid detection assays for leafroll disease associated closteroviruses. *Vitis* **30**, 87-95.
Ioannou N., 1993. Occurrence and natural spread of grapevine leafroll-associated closteroviruses in Cyprus. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993*, 111-112.
Jordan D., 1993. Leafroll spread in New Zealand vineyards. *Australian and New Zealand Wine Industry Journal* **8,** 322-324.
Karasev A.A,. 2000. Genetic diversity and evolution of closteroviruses. *Annual Review of Phytopathology* **38**, 293-324.
Kassemeyer H.H., 1991. Investigations about the occurrence of closterovirus-like particles in grapevines in Germany. *Proceedings 10th Meeting of ICVG, Volos 1990*, 81-88.
Katis N., S. Hatziloukas, M. Tsagris, I. Rumbos and K.A Roubelakis-Angelakis, 1991. Presence of closteroviruses and viroids in grapevine varieites with symptoms of leafroll and stem pitting. *Proceedings 10th Meeting of ICVG, Volos 1990*, 450-457.
Kim H.R., Y.M. Choi, B.C. Lee, M.S. Yiem J.D. Chung, K.R Kim, J.W. Park and M.R. Cho, 2000. Occurrence of grapevine leafroll-associated virus 3 in South Korea and analysis of its molecular and biological characteristics. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 24.
Kliewer W.M. and L.A. Lider, 1976. Influence of leafroll virus on composition of Burger fruits. *American Journal of Enology and Viticulture* **27**, 118-124.
Krake L.R., 1993. Characterization of grapevine leafroll disease by symptomatology. *The Australian and New Zealand Wine Industry Journal* **8**, 40-44.
Krastanova T. K.S. Ling, H.Y. Zhu , B. Xue, T. Burr and D. Gonsalves, 1998. Development of transgenic grape rootstocks with genes from grapevine fanleaf virus and grapevine leafroll-associated closteroviruses 2 and 3. *Phytopathology* **88**, 49.
Kuhn G.B., 1989. Identifiçao, incidencia e controle do virus do enrolamento da folha da videira no Estado do Rio Grande do Sul. *Fitopatologia Brasileira* **14**, 220-226.
Lahogue F. and G. Boulard, 1996. Recherche de gènes de résistance naturelle à deux viroses de la vigne: le court-noué et l'enroulement. *Vitis* **35**, 43-48.
La Notte P., A. Minafra and P. Saldarelli, 1997. A spot-PCR technique for detection of phloem-limited grapevine viruses. *Journal of Virological Methods* **66**, 103-108.
Lehoczky J., G.P. Martelli and G. Sarospataki, 1969. Leafroll of grapevine in Hungary. *Acta Phytopathologica Academiae Scientiarium Hungaricae* **4**, 117-124.
Li X., G.P. Martelli and U. Prota, 1989. Virus and virus-like diseases of the grapevine in the People's Republic of China. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 31-34.
Lider L.A., A.C. Goheen and N.L. Ferrari, 1975. A comparison between healthy and leafroll-affected grapevine planting stocks. *American Journal of Enology and Viticulture* **26**, 144-147.
Ling K.S.,H.Y. Zhu, H. Alvizo, J.S. Hu, R.F. Drong, J.L. Slightom and D. Gonsalves, 1997. The coat protein gene of grapevine leafroll-associated closterovirus-3: cloning, nucleotide sequencing and expression in transgenic plants. *Archives of Virology* **142**, 1101-1116.

Ling K. S., H.Y. Zhu, R.F. Drong, J.L. Slightom, J.R McFerson and D. Gonsalves, 1998. Nucleotide sequence of the 3'-terminal two-thirds of the grapevine leafroll-associated virus-3 genome reveals a typical monopartite closterovirus. *Journal of General Virology* **79**, 1299-1307.

Ling K, S. Krastanova, B. Xue, H. Zhu, B. Meng and D. Gonsalves, 2000. Complete genome sequence of grapevine lafroll-associated virus 3 and developing of transgeinc plants expressing its genes. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 52.

Ling K. S., H.Y. Zhu, and D. Gonsalves, 2004. Complete nucleotide sequence and genome organization of *Grapevine leafroll-associated virus 3,* type member of the genus *Ampelovirus*. *Journal of General Virology* **85**, 2099-2102.

Little A., C.F Fazeli and M.A. Rezaian, 2001. Hypervariable genes in Grapevine leafroll-associated virus 1. *Virus Research* **80**, 109-116.

Little A. and M.A. Rezaian, 2003. Gene function analysis and improved detection of Grapevine leafroll associated virus 1. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 35.

Luhn C.F. and A.C. Goheen, 1970. Viruses in early California grapevines. *Plant Disease Reporter* **54**, 1055-1056.

MacKenzie D.J., R.C. Johnson and C. Warner, 1996. Incidence of four important viral pathogens in Canadian vineyards. *Plant Disease* **80**, 955-958.

Mannini F. and R. Credi, 2000. Appraisal of agronomic and enological modification in the performances of grapevine clones after virus eradication. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 151-154.

Martelli G. P. and G. Piro, 1975. Virus diseases of the grapevine in a Sicilian herbarium of the past century. *Vitis* **13**, 329-335.

Martelli G.P., A. Graniti and G.L. Ercolani, 1986. Nature and physiological effects of grapevine diseases. *Experientia* **42**, 933-942.

Martelli G.P., D. Boscia, E. Choueiri , M. Digiaro , M.A. Castellano and V. Savino, 1994. Occurrence of filamentous viruses and rugose wood of grapevine in Yemen. *Phytopathologia Mediterranea* **33**, 146-151.

Martelli G.P., P. Saldarelli and D. Boscia, 1997. Filamentous viruses of the grapevine: Closterovirus. In: Filamentous Viruses of Woody Plants, 1-9. P.L. Monette (ed.). Research Signpost, Trivandrum.

Martelli G.P., A.A. Agranovsky, M. Bar-Joseph, D. Boscia, T. Candresse, R.H.A. Coutts, V.V. Dolja, B.W. Falk, D. Gonsalves, W. Jelkmann, A.V. Karasev, A. Minafra, S. Namba, H.J. Vetten, G.C. Wisler and N. Yioshikawa, 2002. The family *Closteroviridae* revised. *Archives of Virology* **147**, 2039-2043.

Mendgen K., 1971. Untersuchungen über eine Vergilbungskrankheit der Reben an Rhein, Mosel und Saar. *Weinberg und Keller* **18**, 345-431.

Meng B., D.E. Goszczynski, H.Y. Zhu, K.S. Ling and D. Gonsalves, 2000. The 5' sequence of grapevine leafroll associated closterovirus 2 genome. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000,* 28.

Merkuri J, G.P. Martelli, D. Boscia and V. Savino, 1994. Viruses of grapevine in Albania. *Bulletin OEPP/EPPO Bulletin* **24**, 215-220

Milkus B., V. Kartuzova, N. Muljukina and B. Feld, 1991. Detection of virus diseases of grapevine in Ukraine. *Proceedings 10th Meeting ICVG, Volos 1990*, 390-395.

Minafra A. and A. Hadidi, 1994. Sensitive detection of grapevine virus A, B or leafroll associated III from viruliferous mealybugs and infected tissue by cDNA amplification. *Journal of Virological Methods* **47**, 175-188.

Monis J., 2000. Development of monoclonal antibodies reactive to a new grapevine leafroll-associated closterovirus. *Plant Disease* **84,** 858-862.

Mossop D.W., D.R. Elliott and K.D. Richards, 1985. Association of closterovirus-like particles and high molecular weight double-stranded RNA with grapevines affected by leafroll disease. *New Zealand Journal of Agricultural Research* **28**, 419-425.

Namba S., S. Yamashita, Y. Doi, K. Yora, Y. Terai and R. Yano, 1979. Grapevine leafroll virus, a possible member of closteroviruses. *Annals of the Phytopathological Society of Japan* **45,** 497-502.

Namba S., D. Boscia, O. Azzam, M. Maixner, J.S. Hu, D.A. Golino and D. Gonsalves, 1991. Purification and properties of closterovirus-like particles isolated from a corky bark diseased grapevine *Phytopathology* **81,** 964-970

Nölke G. M. Orecchia, P. Saldarelli, M. Dell'Orco, A. Minafra, G.P. Martelli, R. Fischer and S. Schillberg, 2003. Antibody-based resistance in grapevine: generation, characterization and expression of single chain antibody fragments specific to Grapevine leafroll-associated virus 3. *Extended Abtracts 14th Meeting of ICVG, Locorotondo 2003*, 232 bis.

Petersen C.L. and J.G Charles, 1997. Transmission of grapevine leafroll-associated closteroviruses by *Pseudococcus longispinus* and *Ps. calceolariae*. *Plant Pathology* **46**, 509-515

Pop I., P. Gugerli, E. Banu and L. Tomoioaga, 1993. Results regarding the identification of closteroviruses associated with the leafroll disease of some grapevine varieties grown in Romania. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993*, 123-124.

Ravaz L. and G. Verge, 1924. Le rugeau de la vigne. *Progrès Agricole et Viticole* **45**, 11-17, 35-38, 86-89, 110-113, 135-141.
Rosciglione B. and P. Gugerli, 1986. Maladies de l'enroulement et du bois strié de la vigne: analyse microscopique et sérologique. *Revue Suisse de Viticulture, Arboriculture, Horticulture* **18**, 207-211.
Rosciglione B. and P. Gugerli 1989. Transmission of grapevine leafroll disease and an associated closterovirus to healthy grapevine by the mealybug *Planococcus ficus* Signoret. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 67-69.
Routh G., Y.P. Zhang, P. Saldarelli and A. Rowhani, 1998. Use of degenerate primers for partial sequencing and RT-PCR-based assays of grapevine leafroll-associated viruses. *Phytopathology* **88,** 1238-1243.
Rowhani A. and J.K. Uyemoto, 1997. A comparison between serological and biological assays in detecting grapevine leafroll-associated viruses. *Plant Disease* **81**, 799-801.
Rowhani A., Y.P. Zhang , D.A . Golino, and J.K. Uyemoto, 2000. Isolation and partial characterization of two new viruses from grapevine. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 82.
Saldarelli P., H. Guglielmi Montano and G.P. Martelli, 1994a. Non radioactive molecular probes for the detection of three filamentous viruses of the grapevine. *Vitis* **33**, 157-160.
Saldarelli P., A. Minafra, G.P. Martelli and B. Walter, 1994b. Detection of grapevine leafroll-associated closterovirus III by molecular hybridization. *Plant Pathology* **43**, 91-96.
Saldarelli P., A. Rowhani, A. Minafra and M. Digiaro, 1998. Use of degenerate primers in a RT-PCR assay for the identification and analysis of some filamentous viruses, with special reference to closteroand vitiviruses of the grapevine. *European Journal of Plant Pathology* **104,** 945-950.
Sannino F.A., 1906. Il rossore delle viti. *Rivista di Patologia Vegetale* **1**, 162-163.
Sasahara H., K. Tada, M. Iri, T. Takezawa and M. Tazaki, 1981. Regeneration of plantlets by meristem tip culture for virus-free grapevine. *Journal of the Japanese Society for Horticultural Science* **50**, 169-175.
Savino V., D. Boscia, A.M. D'Onghia and G.P. Martelli, 1991. Effect of heat therapy and meristem tip culture on the elimination of grapevine leafroll-associated closterovirus type III. *Proceedings 10th Meeting of ICVG, Volos 1990*, 433-436.
Scheu G., 1935. Die Rollkrankheit des Rebstockes. *Der Deutsche Weinbau* **14**, 222-223, 345-346, 356-358.
Scheu G., 1936. Mein Winzerbuch. Reichnährstand Verlag, Berlin.
Seddas A., M.M. Haidar, C. Greif, C. Jacquet, G. Cloquemin and B. Walter, 2000. Establishment of a relationship between grapevine leafroll closteroviruses 1 and 3 by use of monoclonal antibodies. *Plant Pathology* **49,** 80-85.
Segura A., M.L. Gonzales and C. Cabaleiro, 1993. Presence of grapevine leafroll in North West Spain. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993*, 125-126.
Sforza R., V. Komar and C. Greif, 2000. New scale insect vectors of grapevine closteroviruses. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000,* 14.
Tanaka S., 1976. Indexing grapes in Japan for viruses. *Annals of the Phytopathological Society of Japan* **42**, 192-196.
Tanne E. and F. Nitzany, 1973. Virus diseses of grapevine in Israel. *Vitis* **12**, 222-225
Tanne E., I. Sela and I. Harpaz, 1974. Transmission of grapevine leafroll virus to herbaceous plants. *Phytopathologische Zeitschrift* **80**, 176-180.
Tanne E., Y. Ben-Dov and B. Raccah, 1989. Transmission of closterolike particles associated with grapevine leafroll by mealybugs (Pseudoccidae) in Israel. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987,* 71-73.
Teliz D., D. Gonsalves. J.S. Hu and D.K. Hummer, 1989 Detection of a grapevine leafroll-associated closterovirus in recently infected tissues in New York and spread of the disease in Mexico. *Phytoparasitica* **17**, 68-69.
Teliz D., E. Tanne, D. Gonsalves and F. Zee, 1987. Field serological detection of viral antigens associated with grapevine leafroll disease. *Plant Disease* **71**, 704-709.
Turturo C., M.E. Rott, A. Minafra, P. Saldarelli, W. Jelkmann and G.P. Martelli, 2000. Partial molecular characterization and RT-PCR detection of grapevine leafroll-associated virus 7. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000,* 17-18.
Turturo C., P. Saldarelli, D. Yafeng, M. Digiaro, V. Savino and G.P. Martelli. Preliminary investigations of genetic variability of *Grapeviune leafroll associated virus 3* isolates. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 38.
Tzeng H.L.C., M.J. Chen and D.D.S. Tzeng, 1994. The occurrence of grapevine leafroll disease among the main grapevine cultivars and breeding stocks in Taiwan. *Plant Pathology Bulletin* **3**, 156-167.
Von der Brelie D. and F. Nienhaus, 1982a. Histological and cytological studies on the infectious leafroll disease of the grapevine. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* **89**, 508-517.

Vuittenez A., 1958. Transmission par greffage d'une virose type enroulement foliarie commune dans le vignobles de l'Est e du Centre-Est de la France. *Comptes Rendues de l'Academie d'Agriculture de France* **44,** 313-316.

Walter B. and D. Zimmermann, 1991. Further characterization of closterovirus-like particles associated with the grapevine leafroll disease. *Proceedings 10th Meeting of ICVG, Volos 1990*, 62-66.

Walter B., P. Bass, R. Legin, C. Martin, R. Vernoy, A. Collas and G. Vesselle, 1990. The use of a green-grafting technique for the detection of virus-like diseases of the grapevine. *Journal of Phytopathology* **128**, 137-145.

Wilcox F.W., Z.Y. Jiang and D. Gonsalves, 1998 Leafroll virus is common in cultivated American grapevines in Western New York. *Plant Disease* **82**, 1062.

Zee F., D. Gonsalves, A. Goheen, K.S. Kim, R. Pool and R.F. Lee, 1987. Cytopathology of leafroll diseased grapevines and the purification and serology of associated closteroviruslike particles. *Phytopathology* **77**, 1427-1434.

Zhou Z., N. Abou-Ghanem, D. Boscia, O. Potere, D.E. Goszczynski and M.A. Castellano, 2000. Monoclonal antibodies for detection and characterization of Grapevine leafroll-associated virus 2. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 130.

Zhou Z., C. Turturo, O. Potere, P. Saldarelli, D. Boscia, and G.P. Martelli, 2003. Production and characterization of monoclonal antibodies specific for Grapevine leafroll-associated virus 3 and epitope mapping of the coat protein. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 203.

Zhu H.Y, K.S. Ling, D.E Goszczynski, J.R. McFerson and D. Gonsalves, 1998. Nucleotide sequence and genome organization of Grapevine leafroll-associated virus 2 are similar to Beet yellows virus, the closterovirus type member. *Journal of General Virology* **79**, 1289-1298.

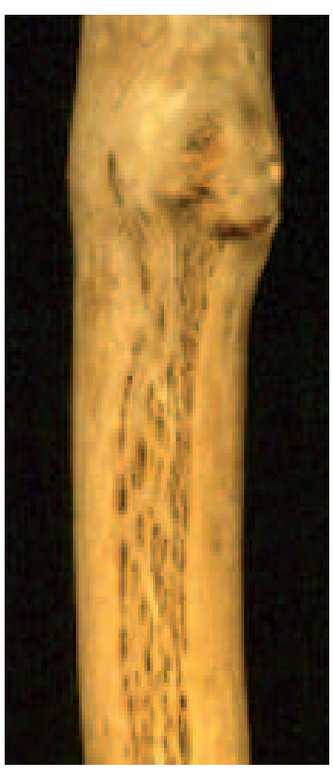
Zimmermann D., B. Walter and O. Le Gall, 1988. Purification de particules virales associées à l'enroulement de la vigne et mise au point d'un protocole ELISA permettant leur détection. *Agronomie* **8**, 731-741.

Zimmermann D., G. Sommermeyer, B. Walter and M.H.V. Van Regenmortel, 1990. Production and characterization of monoclonal antibodies specific to closterovirus-like particles associated with grapevine leafroll disease. *Journal of Phytopathology* **130**, 277-288.



RUGOSE WOOD COMPLEX





RUGOSE WOOD COMPLEX

The rugose wood complex consists of several diseases (Grapevine rupestris stem pitting, Grapevine kober stem grooving, Grapevine corky bark, Grapevine LN33 stem grooving) that are usually latent in ungrafted *Vitis vinifera* and American *Vitis* species and rootstock hybrids, but develop in grafted vines. Woody cylinder alterations resembling rugose wood symptoms are reported in the French literature of the early 1900s as possible physiological disorders. Rugose wood was first identified and described from southern Italy in the early 1960s as a graft-transmissible disease, and was considered to be a local problem until its discovery in Hungary in 1967. Now it is known to occur worldwide.

1. Description

Main synonyms: Stem pitting, stem grooving (Eng.); legno riccio (Ital.); bois strié, cannelures du tronc (Fr.); madera rizada (Sp.); lenho rugoso (Port.); corky bark: rough bark (Eng.); suberosi corticale (Ital.); écorce liégeuse (Fr.); Korkrindenkrankheit (Germ.).

Symptoms: Affected vines appear less vigorous than normal and may show delayed bud opening in spring. Some decline and die within a few years from planting. Grafted vines often show a swelling above the bud union and a marked difference between the relative diameter of scion and rootstock. With certain cultivars, the bark above the graft union is exceedingly thick and corky, has a spongy texture and a rough appearance, a condition known as "corky rugose wood". The woody cylinder is typically marked by pits and/or grooves which correspond to peg-and ridge-like protrusions on the cambial face of the bark. These alterations may occur on scion, rootstock or both. The severity of wood symptoms vary according to scion/stock combinations. Climatic conditions may have a bearing on symptom expression for under cool and wet climates symptoms are milder or absent. Cases of latent infection in grafted vines are not rare. By contrast, self-rooted European grapes and, sometimes, American roostocks, can show wood alterations. No specific symptoms are seen on the foliage, although certain cultivars show rolling, yellowing or reddening of the leaves similar to those induced by leafroll. Bunches may be fewer and smaller than normal and the crop reduced by 20-30%.
The four diseases of the rugose wood complex can be recognized and sorted out by graft transmission to the indicators *Vitis rupestris*, LN 33 and Kober 5BB:

a. *Rupestris stem pitting*. Distinct basipetal pitting limited to a band extending downwards from the point of inoculation in *V. rupestris*. LN 33 and Kober 5BB remain symptomless.

b. *Corky bark*. Grooving and pitting of the entire surface of the stem of *V. rupestris* and LN 33, but no symptoms in Kober 5BB. Severe stunting of LN 33 is accompanied by rolling and reddening of the leaves and by most typical internodal swelling of the canes.

c. *Kober stem grooving*. Marked grooving appear on the stem of Kober 5BB; no symptoms in *V. rupestris* and LN 33.

d. *LN 33 stem grooving*. Grooves occur on the stem of LN 33, much the same as with corky bark, but no internodal swelling of the shoots nor foliar discolorations are present. *V. rupestris* and Kober 5BB show no symptoms.

Agents: Putative agents of individual diseases of the rugose wood complex are members of the genera *Vitivirus* or *Foveavirus*, family *Flexiviridae*, i.e. viruses with flexuous filamentous particles from about 730 to 800 x 12 nm, with distinct transverse cross banding. Vitiviruses and foveaviruses are phloem-restricted in grapevines, but whereas vitiviruses are mechanically transmissibile to herbaceous hosts, though with difficulty, foveaviruses are not. The genome of all viruses consists of a single species of single-stranded positive sense RNA with Mol. wt 2.6-3.05 x 10^6 that accounts for *c.* 5% of the particle weight. Coat protein subunits have a single size and M_r of 22-28 kDa. Rugose wood-associated viruses have a worldwide distribution. Records exist from Europe, the Mediterranean basin, Near and Far East, Australasia, South Africa, and North and South Americas.

Grapevine rupestris stem pitting-associated virus (GRSPaV), a definitive member of the genus *Foveavirus*, is the associated agent of Grapevine rupestris stem pitting disease. Virus particles are about 730 nm in length and are not readily observed with the electron microscope. GRSPaV occurs in nature as

a family of molecular variants. Viral RNA, which has been totally sequenced, has a Mol. wt of about 3.05 x 10^6 Da and a size of 8726 nt. The viral genome comprises 5 or 6 ORFs encoding, in the order, the replication-associated proteins (244 kDa), movement proteins (triple gene block, 25, 13 and 8 kDa) and the coat protein (28 kDa). The 6th ORF, when present, encodes a 14 kDa proteins with unknown function. GRSPaV seems to be more closely related to potexviruses than carlaviruses both of which have a similar genomic organization. These relationships have evolutionary implications and suggest that GRSPaV may have evolved from an ancient recombiantion event between a carlavirus and a potexvirus, in which ORF 4 and 5 but not the 3' non coding region of the carlavirus were replaced by those of the potexvirus.

Grapevine virus A (GVA), the type species of the genus *Vitivirus*, is the putative agent of Grapevine kober stem grooving. Virus particles are flexuous filaments about 800 nm long. Viral RNA has a Mol. wt of about 2.6 x 10^6 Da and a size of 7349 nt. The viral genome consists of 5 ORFs encoding, in the order, the replication-associated proteins (195 kDa), a 20 kDa protein with unknown function, the movement protein (31 kDa), the coat protein (22 kDa) and a 10 kDa product which has nucleotide binding properties, is a pathogenicity factor and a gene silencing suppressor. Minor biological and serological variants of the virus are known.

Grapevine virus B (GVB) is a vitivirus distantly related serologically to GVA and one of the etiological agents associated with Grapevine corky bark. GVB is also involved in young grapevine decline, a graft incompatibility condition recorded from California. Its totally sequenced RNA has a Mol. wt of about 2.7 x 10^6 Da, a size of 7599 nt and the same gene sequence and structural organization as GVA. This virus occurs in nature as a family of molecular variants, but biological variants are also known, two groups of which can be differentiated by the reaction of herbaceous hosts. Virus particles coated by both GVA and GVB coat protein occur in cells infected contemporarily by both viruses (phenotypic mixing).

Grapevine virus C (GVC) is a little known and poorly characterized virus reported from Canada. Virus particles have a vitivirus morphology and an estimated length of about 725 nm. GVC is serologically distinct from GVA and GVB.

Grapevine virus D (GVD), a vitivirus distantly related serologically to GVA and GVB is associated with with corky rugose wood, a field syndrome characterized by the presence of a striking corky condition of affected vines, just above the graft union. Virus particles are flexuous filaments about 825 nm long. The viral genome, which was sequenced only in part, has an estimated size of c. 7600 nt and a 3' terminus structurally comparable to that of GVA and GBV.

Cytopathology: Whereas no information is available on the cytopathology of GRSPaV infections, vitivirus-induced cellular modifications have been extensively studied, primarily in herbaceous hosts. Cytopathological features common to all four vitiviruses (GVA, GVB, GVC, and GVD) consist of: (i) virus particle aggregates of various size, forming bundles, whorls, banded bodies, stacked layers that sometimes fill the entire cell lumen; (ii) variously extended wall thickenings originating from deposits of callose-like substances; (iii) proliferation and accumulation of cytoplasmic membranes; (iv) vesiscular evaginations of the tonoplast protruding into the vacuole and containing finely fibrillar material resembling dsRNA. GVA and GVB movement proteins were found to associate with cell walls and plasmodesmata, as detected by gold immunolabelling.

Transmission: For many years after its discovery there were no records of natural spread of rugose wood in the field. GVA and GVB are now known to be transmitted from grapevine to grapevine by pseudococcid mealybugs and/or scale insects in a semipersistent manner. GVA vectors are the mealybugs *Planococcus citri, Pl. ficus, Pseudococcus longispinus, Ps. affinis, Heliococcus bohemicus,* and the scale insect *Neopulvinaria innumerabilis,* whereas GVB is transmitted by *Ps. longispinus, Ps. affinis,* and *Pl. ficus.* GRSPaV has no known vectors, but is suspected to be pollen-borne. There are, however, conflicting reports on its presence within seed and no evidence that it occurs in seedlings from infected vines. None of the putative agents of rugose wood has alternative hosts in nature and, because of the relatively limited range of vector movement, is not disseminated over long distances by natural means. Transport of infected propagative material represents the major means of dispersal. The presence of rugose wood and its causal agents in phylloxera-free countries with a millenial history of own-rooted grapevine cultivation, suggests that the disease originated in the Old World and was distributed worldwide by commercial trading and planting of infected grafted plants.

Varietal susceptibility: Most if not all *V.vinifera* varieties and American rootstocks are susceptible. Although customarily grapevines are infected symptomlessly when ungrafted, rugose wood symptoms

were observed in self-rooted cultivars and ungrafted roostock stocks (*V. rupestris* and Kober 5BB). Latent infection can occur also in grafted vines. The intensity of wood abnormalities (pitting and grooving) vary, possibly in relation with the scion/stock combination and climatic conditions.

Detection: Indexing on indicators (*V. rupestris*, Kober 5BB and LN 33) is the only reliable method for detecting and sorting out the diseases of the complex. Recently, experimental evidence has been obtained of the very close association of GRSPaV, the putative agent of rupestris stem pitting, with vein necrosis, as shown by 110R. Thus, it is plausible to regard 110R as a specific indicator of rupestris stem pitting in addition to *V. rupestris*. Vitiviruses, but not foveaviruses, are mechanically transmissible, though with difficulty, to a restricted range of herbaceous hosts (mostly *Nicotiana* species). Individual viruses can be identified by ELISA or dot immunobinding on nylon membranes using polyclonal antisera and/or monoclonal antibodies when available. The best antigen sources for serological diagnosis are cortical shavings from mature dormant canes. In addition, other assays include: single step or nested reverse trascription-polymerase chain reaction (RT-PCR), immunocapture RT-PCR, or spot-RT-PCR using degenerate or virus-specific primers. Immuno-capture RT-PCR is 1000-fold more sensitive than ELISA for virus detection in grapevines.

Control: Use for propagation of virus-free scionwood and rootstocks obtained by sanitary selection combined with sanitation is of paramount importance to avoid introduction of infected vines in the vineyards. However, since symptomless infections make sanitary selection not totally reliable, all sources must be indexed and/or laboratory tested. In general, rugose wood agents can be eliminated with reasonable efficiency by heat therapy, meristem tip culture, or a combination of the two. GVA can be eliminated to a very hight rate (up to 97%) by the procedure used for cryopreservation of grapevine shoot tips. Control of mealybugs is difficult for they overwinter under the bark of grapevines and possess an unwettable waxy covering. Thus, no strategy has yet been developed for the chemical control of vectors. No natural sources of resistance to any of the rugose wood agents are known but the possibility of using pathogen-derived resistance in *Vitis* is being explored. Using a *Nicotiana benthamiana* model system, several resistant plant lines were obtained by transformation with the coat protein and the movement protein genes of GVA and GVB. Transgene expression was detected in these plants and in transformed grapevine explants.

2. Historical review

Names like "legno riccio", "stem pitting" and "stem grooving", if not otherwise associated with a specific syndrome, are synonymized with "rugose wood".

1954 **Hewitt**: Rough bark, a virus-like disease, described from California.

1961 **Graniti and Ciccarone**: First record of rugose wood from southern Italy.

1962 **Hewitt** *et al*.: Graft transmission of rough bark to LN 33. Name of the disease changed into corky bark.

1963 **Goidanich and Canova**: First record of corky bark in Europe.

1963 **Faccioli**: First histological study of corky bark-affected grapevines.

1964 **Graniti**: Detailed description of rugose wood symptoms. Suggestion that it may be caused by a virus.

1965 **Graniti and Martelli**: Demonstration of the infectious nature of rugose wood. Histological study of diseased vines. Suggestion that rugose wood may be a disease of combination requiring the contact of scion and rootstock for the development of symptoms, and that it may be a composite disease resulting from the interaction of different viruses among which GFLV.

1965 **Beukman and Goheen**: Brief account of the histological modifications of corky bark-affected LN 33.

1965 **Goheen** *et al*.: Corky bark is remarkably heat stable and difficult to eliminate by heat therapy.

1967 **Martelli** *et al*.: First record of rugose wood outside of Italy.

1968 **Lehoczky** *et al*.: Observation of rugose wood symptoms in self-rooted vines. Rugose wood may not require a grafted plant for full symptom expression.

1968 **Goheen**: Evidence that corky bark and leafroll, despite similarities in the symptoms on the foliage are different diseases. At 38 °C the minimum inactivation period for leafroll is 56 days and for corky bark 98 days.

1968 **Hewitt**: Up-to-date review on grapevine virus and virus-like disease worldwide. First record of rugose wood symptoms outside of Europe (Israel).

1969 **Beukman and Gifford**: Detailed account of adverse effects of corky bark on the anatomy of *Vitis*.

1970 **Beukman and Goheen**: Up-to-date review of corky bark.

1970 **Graniti and Martelli**: Up-to-date review of rugose wood.

1971 **Hewitt and Neja**: First record of rugose wood in USA (California).

1971 **Engelbrecht and Nel**: Rugose wood and fanleaf are not related, based on graft transmission tests.

1972 **Lehoczky**: Destructive effects of rugose wood registered in Hungary in both self-rooted and grafted European grape varieties.

1973 **Bovey and Brugger**: Further evidence that GFLV may not be implicated in the etiology of rugose wood in Switzerland.

1973 **Goheen and Luhn**: Heat treatment of dormant buds grafted onto LN 33 is effective against corky bark.

1975 **Castillo** *et al*.: Green grafting useful for corky bark indexing.

1975 **Hewitt**: Successful graft transmission of Californian rugose wood.

1977 **Mink and Parsons**: Use of growth chambers for rapid symptom expression of corky bark in *Vitis* indicators.

1978 **Goheen and Luhn**: Suggestion that corky bark and rugose wood are the same disease. No nepoviruses implicated in their etiology.

1979 **Legin** *et al*.: Heat therapy effective against rugose wood.

1979 **Anonymous**: A review of rugose wood in Italy.

1980 **Conti** *et al*.: Recovery by mechanical inoculation of a closterovirus with particles 800 nm long, from a rugose wood-infected vine.Virus provisionally called grapevine stem pitting-associated virus (GSP-AV).

1980 **Teliz** *et al*. a,b,c: A series of three papers reporting the occurrence and field spread of corky bark in Mexico and evaluating symptoms induced by natural infections of corky bark in formerly virus-free self-rooted or grafted European grape varieties and rootstocks.

1981 **Boccardo and D'Aquilio**: Physicochemical characterization of GSP-AV

1981 **Abracheva**: Survey of over 650 grapevine cultivars and hybrids for rugose wood reaction in Bulgaria.

1982 **Sarooshi** *et al*.: Rugose wood recorded from Australia.

1983 **Rosciglione** *et al*.: First experimental evidence that a filamentous virus (GVA), is transmitted by the pseudoccid mealybug *Pseudococcus longispinus*.

1984 **Milne** *et al*.: Evidence that GSP-AV can occur in grapevines together with another similar but serologically unrelated virus with short closterovirus-like particles, denoted Grapevine virus B (GVB). GSP-AV re-named Grapevine virus A (GVA).

1985 **Rosciglione and Castellano**: Demonstration that GVA is transmitted also by *Planococcus citri* and *P. ficus*.

1985 **Prudencio**: M.Sc. thesis describing rupestris stem pitting disease in comparison with corky bark.

1985 **Corbett and Wiid**: Closterovirus-like particles found in extracts from vines affected by corky bark and rugose wood in South Africa.

1985 **Garau** *et al*.: Assessment of crop losses induced by rugose wood to two different European grape varieties.

1985a **Savino** *et al*.: Experimental confirmation that rugose wood may not express symptoms in grafted indicators. Rugose wood and corky bark are not the same disease.

1985b **Savino** *et al*.: Evaluation of the effect of rugose wood on cv. Italia propagated on six different rootstocks.

1985 **Gallitelli** *et al*.: Application of spot hybridization for the detection of GVA in grapevine sap.

1985 **Castrovilli and Gallitelli**: Physicochemical comparison of two Italian isolates of GVA.

1985 **Murant** *et al.*: Heracleum latent virus and GVA are distantly serologically related.

1987 **Kuniyuki and Costa**: Rugose wood recorded from Brasil

1988 **Goheen**: First published description of rupestris stem pitting.

1989 **Savino** *et al*.: Experimental confirmation of the complex nature of rugose wood based on the differential reaction of woody indicators. First report of Kober stem grooving.

1989 **Li** *et al*.: First record of rugose wood from China.

1989 **Martelli**: Rugose wood recorded in southern Mediterranean and Arab countries.

1989 **Garau** *et al*.: First indication of the possible existence of LN 33 stem grooving, an additional disease of the rugose wood complex.

1989 **Monette** *et al*.: A low molecular weight dsRNA associated with rupestris stem pitting.

1989 **Tanne** *et al*.: Transmission of corky bark by the mealybug *P.ficus*.

1990 **Monette and James**: Detection of two biologically distinct but serologically indistinguishable isolates of GVA.

1990 **Engelbrecht and Kasdorf**: Natural field spread of corky bark in South Africa associated with the presence of *P. ficus*.

1991 **Engelbrecht** *et al*.: Three types of wood disorders of the stem-grooving type observed in South African grapevines, similar to Kober stem grooving, Corky bark and Rupestris stem pitting. The first two disorders appear to be spreading in the vineyards.

1991 **Azzam** *et al*.: Two distinct dsRNAs with a mol. wt of 5.3 and 4.4 x 10^6 associated with rupestris stem pitting in grapevines from California and Canada. Similar dsRNA species were detected, but not consistently in grapevines from New York. Suggestion that the disease is not related to closteroviruses associated with GLRaV and corky bark. No closterovirus-like particles in samples with rupestris stem pitting.

1991 **Gugerli** *et al*.: Presence of two distinct serotypes of GVA, both associated with a stem pitting condition of grapevines rather than with leafroll.

1991 **Namba** *et al*.: A closterovirus with particles 1440-2000 nm long serologically unrelated to all other known grapevine closteroviruses found in corky bark-affected vines. Virus later identified as *Grapevine leafroll-associated virus 2*

1991 **Tanne and Meir**: A dsRNA with a molecular weight higher than 14 Kd identified in extracts from corky bark-affected vines.

1991 **Garau** *et al*.: Contemporary occurrence of Rupestris stem pitting and Kober stem grooving in symptomless scions of cv. Torbato in Italy.

1991 **Monette and James**: A closterovirus with short particles (725 nm) isolated from a corky bark-affected vine induces necrotic local lesions and systemic symptoms in *Nicotiana benthamiana*.

1991 **Minafra** *et al.:* Synthesis of a cloned probe for GVA.

1991 **Saric and Korosec-Koruza**: Rugose wood recorded from Croatia and Slovenia

1991 **Ioannou:** Rugose wood recorded from Cyprus.

1991 **Boulila** *et al*.:Rugose wood recorded from Tunisia

1991 **Milkus** *et al.*: Rugose wood recorded from Ukraine

1992 **Boscia** *et al*.: Production of monoclonal antibodies to GVA and their use for ELISA detection of the virus in infected vines.

1992 **Martelli** *et al*.: Rugose wood recorded from Malta

1993 **Monette and Godkin**: Recovery of a closterovirus-like virus by mechanical inoculation from a corky bark-affected vine. Virus named Grapevine virus C (GVC).

1993 **Padilla**: Rugose wood recorded from Spain

1993 **Boscia** *et al*.: Purification and properties of GVB. Virus transmission by the mealybug *Ps. ficus* induced corky bark symptoms in LN 33

1993 **Saldarelli** *et al*.: Development and diagnostic use of a cloned probe to GVB.

1994 **Minafra** *et al*.: Sequence of the 3' end of GVA and GVB genome. Both viruses qualify for the inclusion in the genus *Trichovirus.*

1994 **Merkuri** *et al.*: Rugose wood recorded from Albania.

1994 **Garau** *et al*.: GVA and Kober stem grooving are closely associated. Suggestion that GVA may be the causal agent of the disease.

1994 **Martelli** *et al*.: Rugose wood recorded from Yemen.

1994 **Digiaro** *et al*.: Clear-cut connection of GVA and rugose wood. Suggestion that GVA is implicated in the aetiology of the disease.

1994 **Saldarelli** *et al.*: Development of digoxigenin-labelled riboprobes for the detection of GVA and GVB in infected tissue extracts.

1994 **Minafra and Hadidi**: Detection of GVA and GVB in viruliferous mealybugs by PCR.

1994 **Boscia** *et al*. Thorough comparative study of nine GVB isolates from different countries.

1995 **Chavez and Varon de Agudelo**: Rugose wood recorded from Colombia.

1995 **Monette and Godkin**: Detection of non mechanically transmissible capillovirus-like particles in a grapevine affected by rugose wood. Since particle size (600-700 nm in length) is compatible with that of Grapevine rupestris stem pitting-associated virus (GRSPaV) particles identified in 2002, this may be the first visualization of GRSPaV.

1995 **Chevalier** *et al.*: Consistent detection of GVA in Kober stem grooving-infected grapevines by immunocapture-polymerase chain reaction. Further support of the cause-effect relationship between GVA and this disease.

1995 **Boscia** *et al*.: Rugose wood recorded from Jordan.

1995 **Garau** *et al*.: GVA and GVB are transmitted by *Pseudococcus affinis.*

1996 **Bonavia** *et al*.: GVB is consistently associated with corky bark and is present, though not consistently in vines showing a syndrome denoted "corky rugose wood". Efficient detection method based on TAS-ELISA developed.

1996 **Saldarelli** *et al*.: Nucleotide sequence of GVB genome.

1996 **Haidar** *et al*.: Rugose wood recorded from Lebanon.

1996 **Tanne** *et al.*: A study of the spatial distribution pattern of corky bark in aThompson seedless vineyard in Israel. Suggestion that spreading is by a vector that transmits in a semipersistent manner.

1996 **Goszczynski** *et al*.: GVA and GVB are serologically related.

1997 **Choueiri** *et al*.: GVA and GVD are serologically distantly related.

1997 **Boscia** *et al*.: Review of the properties of putative grapevine-infecting trichoviruses (GVA, GVB, GVC, and GVD) later assigned to the genus *Vitivirus*.

1997 **Faoro:** Review of the cytopathology of grapevine trichovirus infections.

1997 **Abou Ghanem** *et al.*: Description of Grapevine virus D (GVD).

1997a **La Notte** *et al.*: GVA is transmitted by by *Ps. longispinus* in a semi-persistent manner.

1997b **La Notte** *et al.*: Development of a PCR technique for the detection of GVA and GVB in nylon membrane-spotted sap.

1997 **Minafra** *et al.*: Nucleotide sequence of GVA genome and taxonomic position of the virus.

1997 **Martelli** *et al*.: Estasblishment of the genus *Vitivirus* with GVA as type species. GVA, GVB, GVC, and GVD removed from the genus *Trichovirus* and assigned to the new genus.

1997 **Rubinson** *et al*.: Antiserum to the movement protein of GVA is useful for virus detection in ELISA.

1997 **Guidoni** *et al*.: Elimination of GVA from cv Nebbiolo clones by heat therapy improves agronomic performance of the vines and quality of the must.

1998 **Meng** *et al*.: Sequence and structrural organization of Grapevine rupestris stem pitting-associated virus genome (GRSPaV).

1998 **Zhang** *et al.*: Sequencing of a Californian isolate of GRSPaV. The virus is not seed-borne.

1998 **Martelli and Jelkmann**: Establishment of the genus *Foveavirus.* GRSPaV is assigned to this genus.

1998 **Alkowni** *et a*l: Rugose wood in Palestine.

1999 **Meng** *et al*.: Consistent association of GRSPaV with vines indexing positive for Rupestris stem pitting. Further support to the cause-effect relationship of GRSPaV with this disease

1999 **Galikparov** *et al*.: Production of an infectious RNA transcript from a full-length cDNA clone of GVA.

2000a **Saldarelli** *et al*.: Movement proteins of GVA and GVB detected by gold immunolabelling in association with cell walls and plasmodemata of infected cells. GVA movement protein is also present in great quantity in the cytoplasm, intermingled with virus particle aggregates.

2000b **Saldarelli** *et al*.: Synthesis of full-length cDNA copies of GVA and GVB genomes.

2000 **Minafra** *et al.*: Production of a polyclonal antiserum to a recombinant coat protein of GRSPaV and its use in dot immunobinding on polyvynil difluoride membranes for virus detection in grapevine tissue extracts.

2001 **Buzkan** *et al*.: One-sided phenotyping mixing, i.e. GVA coat protein encapsidating GVB RNA, occurs in *Nicotiana* plants doubly infected with GVA and GVB.

2001 **Boscia** *et al.*: Production of monoclonal antibodies to GVB. Confirmation of the cause-effect relationship between GVA and Kober stem grooving, GVB and Corky bark and GRSPaV and Rupestris stem pitting.

2001 **Stewart and Nassuth:** An improved extraction method allows RT-PCR detection of GRSPaV virtually thoughout the year in all grapevine tissues. Samples made up of three buds from dormant canes are less laboriour to prepare than cane shavings and yield comparable results. Virus detected in bleached seeds suggesting that it is present inside the seeds.

2002 **Goszczynski and Jooste**: Use of single-strand conformation polymorphism reveals molecular heterogenity in GVA populations.

2002 **Dell'Orco** *et al*.: GVA particles carry a highly structured epitope centered on a common peptide region of the coat protein sequence.

2003 **Petrovic** *et al*.: GRSPaV particles, observed for the first time, are filamentous and measure 723 nm in length.

2003 **Dovas and Katis:** Improved RT-PCR method for the simultanous detection in grapevine extracts of vitivirus (GVA, GVB, GCD) and foveavirus (GRSPaV) sequences in two steps.

2003 **Galiakparov** *et al.*: The function of GVA genes identified by mutation analysis of individual ORFs of a full-length infectious viral clone.

2003 **Wang** *et al*.: Elimination of GVA by cryopreservation.

2003 **Habili** *et al.*: Rugose wood viruses in Iran.

2003 **Ahmed** *et al*.: Rugose wood viruses in Egypt.

2003 **Goszczynski and Jooste**: GVA and GLRaV-3 are both consistently associated with Shiraz disease in South Africa but only GVA seems to be required for disease induction.

2003 **Goszczynski and Jooste**: Thre groups of GVA strains (I, II, and III) identified in South Africa based primarily on sequence homology of the 3' end of the viral genome. Nucleotide sequence identity within groups is 91-99.8% and 78-89.3% among groups.

2003 **Kominek** *et al*.: Rugose wood viruses in the Czeck Republic.

2003 **Nakano** *et al*.: GVA transmission by *Pseudococcus comstocki.*

2003 **Meng** *et al*.: Western blots and ELISA using a polyclonal antiserum to recombinant coat protein of GRSPaV detect the virus in infected grapevine tissues almost with the same efficiecy of RT-PCR. The virus was not detected in 245 seedlings from infected cv. Seyval seedlings.

2003 **Minafra and Boscia**: Review of rugose wood-associated viruses.

2003 **Meng and Gonsalves**: Comprehensive review of the characteristics of GRSaV.

2004 **Adams** *et al.:* Establishment of the family *Flexiviridae*, comprising grapevine viruses belonging in the genera *Vitivirus, Trichovirus* and *Foveavirus.*

2004 **Zorloni** *et al*.: Experimental transmission of GVA by the mealybug *Heliococcus bohemicus.*

2004 **Bouyahia** *et al*.: An association exceeding 95% observed between GRSPaV and 110R vines showing vein necrosis symptoms in indexing trials. No veing necrosis observed in 110R top grafted on GRSPaV-free *V. rupestris*. Suggestion than vein necrosis is a specificic reaction of 110R to GRSPaV.

3. References

Abou Ghanem N., P. Saldarelli, A. Minafra, N. Buzkan, M.A. Castellano and G.P. Martelli, 1997. Properties of Grapevine virus D, a novel putative trichovirus. *Journal of Plant Pathology* **79**, 15-25.

Abracheva P., 1981. La sensibilité de certaines variétés de vigne à la maladie du bois strié (legno riccio). *Phytopathologia Mediterranea* **20**, 203-205.

Adams M.J., J.F Antoniw, M. Bar-Joseph, A.A. Brunt, T. Candresse, G.D. Foster, G.P. Martelli , R.G. Milne and C.M. Fauquet, 2004. The new plant virus family *Flexiviridae* and assessment of molecular criteria for species demarcation. *Archives of Virology* **149**, 1045-1060.

Ahmed MH., M. Digiaro and G.P. Martelli, 2003. A preliminary survey for grapevine viruses in Egypt. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 178-179.

Alkowni R., M. Digiaro and V. Savino, 1998. Viruses and virus diseases of grapevine in Palestine. *Bulletin OEPP/EPPO Bulletin* **28**, 189-195.

Anonymous 1979. Il legno riccio delle vite in Italia. *Informatore Fitopatologico* **29**(**2**), 3-18.

Azzam O.I., D. Gonsalves and D.A. Golino, 1991. Detection of dsRNA in grapevines showing symptoms of rupestris stem pitting disease and the variabilities encountered. *Plant Disease* **75**, 960-964.

Beukman E.F. and E.M. Gifford, 1969. Anatomic effects of corky bark virus in *Vitis. Hilgardia* **40**, 73-103.

Beukman E.F. and A.C. Goheen, 1965. Corky bark, a tumor-inducing virus of grapevines. *Proceedings International Conference on Virus and Vector on Perennial Hosts with Special Reference to Vitis, Davis, California, 1965*, 164-166.

Beukman E.F. and A.C. Goheen, 1970. Grape corky bark. *In* Frazier N.W. (Ed.): Virus Diseases of Small Fruits and Grapevines (A Handbook), Univ. of California, Division of Agric. Sci., Berkeley, 207-209.

Boccardo G. and M. D'Aquilio, 1981. The protein and nucleic acid of a closterovirus isolated from a grapevine with stem-pitting symptoms. *Journal of General Virology* **53**, 179-182.

Bonavia M., M. Digiaro, D. Boscia, A. Boari, G. Bottalico, V. Savino and G.P. Martelli, 1996. Studies on "corky rugose wood" of grapevine and the diagnosis of grapevine virus B. *Vitis* **35**, 53-48.

Boscia D., E. Aslouj, V. Elicio, V. Savino, M.A. Castellano and G.P. Martelli, 1992. Production, characterization and use of monoclonal antibodies to grapevine virus A. *Archives of Virology* **127**, 185-194.

Boscia D., V. Savino, A. Minafra, S. Namba, V. Elicio, M.A. Castellano, D. Gonsalves and G.P. Martelli, 1993. Properties of a filamentous virus isolated from grapevines affected by corky bark. *Archives of Virology* **130**, 109-120

Boscia D., N. Abou Ghanem, P. Saldarelli, A. Minafra, M.A. Castellano, R. Garau, V. Savino and G.P. Martelli, 1994. A comparative study of grapevine virus B isolates. *Rivista di Patologia Vegetale* Ser.V, **4,** 11-24.

Boscia D., K.M. Masannat, A.R. Abou-Zurayk and G.P. Martelli, 1995. Rugose wood of the grapevine in Jordan. *Phytopathologia Mediterrenea* **34**, 126-128.

Boscia D., A. Minafra and G.P. Martelli, 1997. Filamentous viruses of the grapevine: putative trichoviruses and capilloviruses. In: Filamentous Viruses of Woody Plants, 19-28. P.L. Monette (Ed.). Research Signpost, Trivandrum.

Boscia D., M. Digiaro, M. Safi, R. Garau, Z. Zhou, A. Minafra, N. Abou Ghanem, G. Boetalico and O. Potere, 2001. Production of monolconal antibodies to grapevine virus D and contribution to the study of its aetiological role in grapevine diseases. *Vitis* **40**, 69-74.

Boulila M., N. Chabbouh, C. Cherif and G.P. Martelli, 1991. Current knowledge on viruses and virus diseases of grapevines in Tunisia. *Proceedings 10th Meeting of ICVG, Volos 1990,* 104-110.

Bouyahia H., D. Boscia, V. Savino, P. La Notte, C. Pirolo, M.A. Castellano, A. Minafra and G.P. Martelli, 2004. Is Grapevine vein necrosis a reaction to *Grapevine rupestris stem pitting-associated virus*? *Journal of Plant Pathology* **86**, 301.

Bovey R. and J.-J. Brugger, 1973. Stem pitting of grapevine in Switzerland. *Rivista di Patologia Vegetale*, Ser. IV, **9** (suppl.), 37-42.

Buzkan N., A. Minafra, P. Saldarelli, M.A. Castellano, M. Dell'Orco, G.P. Martelli, R. Gölles, nad M. Laimer da Camara Machado, 2001. Heterologous encapsidation in non transgenic and transgenic *Nicotiana* plants infected by grapevine virus A and B. J*ournal of Plant Pathology* **83**, 37-43.

Castillo J., M. Hévin and M. Rives, 1975. Transmission d'une virose de la vigne (maladie de l'écorce liégeuse ou Corky Bark) par la méthode de la greffe en vert. *Comptes Rendus des Séances de l'Académie des Sciences, Paris,* Série D, **281**, 147-150.

Castrovilli S. and D. Gallitelli, 1985. A comparison of two isolates of Grapevine virus A. *Phytopathologia Mediterranea* **24**, 219-220.

Chavez L.B. and F. Varon de Agudelo, 1995. Observaciones sobre emfermedades de posiblemente origen viral en vid (*Vitis* sp.). *Fitopatologia Colombiana* **19** (**2**), 19-26.

Chevalier S., C. Greif, J.M. Clauzel, B. Walter and C. Fritsch, 1995. Use of an immunocapture-polymerase chain reaction procedure for the detection of grapevine virus A in Kober stem grooving-infected grapevines. *Journal of Phytopathology* **143**, 368-373.

Choueiri E., N. Abou Ghanem and D. Boscia, 1997. Grapevine virus A and grapevine virus D are serologically related. *Vitis* **36**, 39-41

Conti M., R.G. Milne, E. Luisoni and G. Boccardo, 1980. A closterovirus from a stem pitting-diseased grapevine. *Phytopathology* **70**, 394-399.

Corbett M.K. and J. Wiid, 1985. Closterovirus-like particles in extracts from diseased grapevines. *Phytopathologia Mediterranea* **24**, 91-100.

Dell'Orco M., P. Saldarelli, M. Minafra, D. Boscia and D. Gallitelli, 2002 .Epitope mapping of Grapevine virus A capsid protein. *Archives of Virology* **147,** 627-634

Digiaro M., M. Popovic Bedzrob, A.M. D'Onghia, D. Boscia and V. Savino, 1994. On the correlation between grapevine virus A and rugose wood. *Phytopathologia Mediterranea* **33,** 187-1293.

Dovas C.I. and N.I. Katis, 2003. A spot nested RT-PCR method for the simultaneous detection of members of the *Vitivirus* and *Foveavirus* genera in grapevine. *Journal of Virological Methods* **170**, 99-106.

Engelbrecht D.J. and G.G.F. Kasdorf, 1990. Field spread of corky bark, fleck, leafroll and Shiraz decline diseases and associated viruses in South African grapevines. *Phytophylactica* **22**, 347-354.

Engelbrecht D.J., G.G.F. Kasdorf and F.A. Maré, 1991. Field spread of stem-grooving diseases in South African grapevines. *Phytophylactica* **23**, 239-240.

Engelbrecht D.J. and A. Nel, 1971. A graft-transmissible stem-grooving of grapevines in the Western Cape Province (South Africa) resembling legno riccio (rugose wood). *Phytophylactica* **3**, 93-96.

Faccioli G., 1963. Indagine istologica su tralci di vite affetti da "suberosi corticale". *Annali della Sperimentazione Agraria (Roma)* N.S. **17**, 491-495.

Faoro F., 1997. Cytopathology of closteroviruses and trichoviruses infecting grapevines. In: Filamentous Viruses of Woody Plants, 29-47. P.L. Monette (ed.). Research Signpost, Trivandrum.

Galiakparov N., E. Tanne, I. Sela and R. Gafny, 1999. Infectious RNA transcripts from gapevine virus A cDNA clone. *Virus Genes* **19**, 235-242.

Galiakparov N., E. Tanne, I. Sela and R. Gafny, 2003. Functional analysis of the grapevine virus A genome. *Virology* **306**, 42-50.

Gallitelli D., V. Savino and G.P. Martelli, 1985. The use of a spot hybridization method for the detection of Grapevine virus A in the sap of grapevine. *Phytopathologia Mediterranea* **24**, 221-224.

Garau R., M. Cugusi, M. Dore and U. Prota, 1985. Investigations on the yields of "Monica" and "Italia" vines affected by legno riccio (stem pitting). *Phytopathologia Mediterranea* **24**, 64-67.

Garau R., U. Prota and M. Cugusi, 1989. Investigations on wood disorders (stem pitting and/or stem grooving) of grapevine in Sardinia. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 135-141.

Garau R., V.A. Prota and U. Prota, 1991. Distribution of Kober stem grooving and Rupestris stem pitting of grapevine in symptomless cv. Torbato scions. *Proceedings 10th Meeting of ICVG, Volos 1990*, 175-181.

Garau R., V.A. Prota, R. Piredda, D. Boscia and U. Prota, 1994. On the possible relationship between Kober stem grooving and grapevine virus A. *Vitis 33*, 161-163.

Garau R., V.A. Prota, D. Boscia, M. Fiori and U. Prota, 1995. *Pseudococcus affinis* new vector of grapevine trichoviruses A and B. *Vitis* **34**, 67-68.

Goheen A.C., 1968. Virustest auf corky bark in den USA. *Weinberg und Keller* **15**, 510-514.

Goheen A.C., 1988. Rupestris stem pitting. *In* Pearson R.C. and A.C. Goheen (Eds.): Compendium of Grape Diseases. American Phytopathological Society Press, St. Paul, Minnesota, USA, 53.

Goheen A.C. and C.F. Luhn, 1973. Heat inactivation of viruses in grapevines. *Rivista di Patologia Vegetale*, Ser. IV, **9**, 287-289.
Goheen A.C. and C.F. Luhn, 1978. Association of stem pitting with corky bark in grapes and detection by indexing in standard indicators. *Phytopathology News* **12**(**9**), 172.
Goheen A.C., C.F. Luhn and W.B. Hewitt, 1965. Inactivation of grape viruses *in vivo*. *Proceedings International Conference on Virus and Vector on Perennial Hosts with Special Reference to Vitis, Davis 1965*, 255-265.
Goidanich G. and A. Canova, 1963. La suberosi corticale della Vite. Una malattia da virus. *Phytopathologia Mediterranea* **2**, 295-297.
Goszczynski D.E., G.G.F Kasdorf and G. Pietersen, 1996. Western blots reveal that grapevine viruses A and B are serologically related. *Journal of Phytopathology* **144,** 581-583.
Goszczynski D.E. and A.E.C. Jooste, 2002. The application of single-strand conformation polymorphism (SSCP) technique for the analysis of molecular heterogeneity of grapevine virus A. *Vitis* **41**, 77-82.
Goszczynski D.E. and A.E.C. Jooste, 2003. Shiraz disease (SD) is transmitted by the mealybug *Planococcus ficus* and associated with Grapevine virus A. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 219.
Goszczynski D.E. and A.E.C. Jooste, 2003. Identification of divergent variants of Grapevine virus A. *European Journal of Plant Pathology* **109**, 397-403.
Graniti A., 1964. Note sintomatologiche e istologiche sulle viti affette da "legno riccio". *Phytopathologia Mediterranea* **3**, 19-25.
Graniti A. and A. Ciccarone, 1961. Osservazioni su alterazioni virosiche e virus-simili della vite in Puglia. *Notiziario sulle Malattie delle Piante* **55(N.S.34)**, 99-102.
Graniti A. and G.P. Martelli, 1965. Further investigations on legno riccio (rugose wood), a graft-transmissible stem-pitting of grapevine. *Proceedings International Conference on Virus and Vector on Perennial Hosts with Special Reference to Vitis, Davis 1965*, 168-179.
Graniti A. and G.P. Martelli, 1970. Legno riccio. *In* Frazier N.W (Eds.): Virus Diseases of Small Fruits and Grapevines (A Handbook), Univ. of California, Division of Agric. Sci., Berkeley, 243-245.
Gugerli P., B. Rosciglione, J.-J. Brugger, S. Bonnard, M.-E. Ramel and F. Tremea, 1991. Further characterization of grapevine leafroll disease. *Proceedings 10th Meeting of ICVG, Volos 1990*, 59-60.
Guidoni S., F. Mannini, A. Ferrandino, N. Argamante and R. Di Stefano, 1997. The effect of grapevine leafroll and rugose wood sanitation on agronomic performance and berry and leaf phenolic content of a Nebbiolo clone (*Vitis vinifera* L.). *American Journal of Enology and Viticulture* **48**, 438-442.
Habili N., A. Afsharifar and R.H. Symons, 2003. First detection of a maculavirus and two vitiviruses in Iranian table grapes. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 162-163.
Haidar M.M., M. Digiaro, W. Khoury and V. Savino, 1996 Viruses and virus diseases of grapevine in Lebanon. *Bulletin OEPP/EPPO Bulletin* **26**, 147-143.
Hewitt W.B., 1954. Some virus and virus-like diseases of grapevine. *Bulletin of the California Department of Agriculture* **43**, 47-64.
Hewitt W.B., 1968. Viruses and virus diseases of the grapevine. *Review of Applied Mycology* **47**, 433-455.
Hewitt W.B., 1975. Graft transmission of a grapevine wood pitting and a flat trunk disease. *Plant Disease Reporter* **59**, 845-848.
Hewitt W.B., A.C. Goheen, D.J. Raski and G.V. Gooding, Jr., 1962. Studies on virus diseases of the grapevine in California. *Vitis* **3**, 57-83.
Hewitt W.B. and R. Neja, 1971. Grapevine bark and wood pitting disease found in California. *Plant Disease Reporter* **55**, 860-861.
Ioannou N., 1991. Incidence and economic importance of virus and virus-like diseases of grapevine in Cyprus. *Proceedings 10th Meeting of ICVG, Volos 1990*, 353-362.
Kominek P., V.F. Holleinova, O. Jandurova and P. Pavlousek, 2003. Occurrence of grapevine viruses in the Czeck Republic. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 182.
Koniyuki H. and A.S. Costa, 1987. Incidencia de virus da videira em Sao Paulo. *Fitopatologia Brasileira* **12**, 240-245.
La Notte P., N. Buzkan, E. Choueiri, A. Minafra and G.P. Martelli. 1997a. Acquisition and transmission of Grapevine virus A by the mealybug *Pseudococcus longispinus*. *Journal of Plant Pathology* **79**, 79-85.
La Notte F., A. Minafra and P. Saldarelli, 1997 b. A spot-PCR technique for the detection of phloem-limited grapevine viruses. *Journal of Virological Methods* **66**, 103-108.
Legin R., P. Bass and A. Vuittenez, 1979. Premiers résultats de guérison par thermothérapie et culture *in vitro* d'une maladie de type cannelure (legno riccio) produite par le greffage du cultivar Servant de *Vitis vinifera* sur le porte greffe *Vitis riparia* x *V. berlandieri* Kober 5BB. Comparaison avec diverses viroses de la vigne. *Phytopathologia Mediterranea* **18**, 207-210.

Lehoczky J., 1972. Destructive effect of legno riccio (rugose wood) on European grapevine varieties. *Annales de Phytopathologie*, Numéro hors série, 59-65.
Lehoczky J., G.P. Martelli, G. Sarospataki and A. Quacquarelli, 1968. Neue Beobachtungen am "legno riccio" der Reben in Ungarn. *Weinberg und Keller* **15**, 506.
Li Z., G.P. Martelli and U. Prota, 1989. Virus and virus-like diseases of the grapevine in the People's Republic of China, a preliminary account. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 31-34.
Martelli G.P., J. Lehoczky, A. Quacquarelli and G. Sarospataki, 1967. A disorder resembling "legno riccio" (rugose wood) of grapevine in Hungary. *Phytopathologia Mediterranea* **6**, 110-112.
Martelli G.P. 1989. Infectious diseases of grapevines. Nature, detection, sanitation and situation in the Arab countries. *Arab Journal of Plant Protection* **7**, 210-219.
Martelli G.P., H. Galea Souchet, D. Boscia and V. Savino, 1992. Viruses of grapevine in Malta. *Bulletin OEPP/EPPO Bulletin* **22**, 607-612.
Martelli G.P., D. Boscia, E. Choueiri, M. Digiaro, M.A. Castellano and V. Savino, 1994. Occurrence of filamentous viruses and rugose wood of grapevine in Yemen. *Phytopathologia Mediterranea* **33,**146-151.
Martelli G.P., A. Minafra and P. Saldarelli, 1997. *Vitivirus*, a new genus of plant viruses. *Archives of Virology* **142**, 1929-1932.
Martelli G.P. and W. Jelkmann, 1998. *Foveavirus*, a new plant virus genus. *Archives of Virology* **142**, 1245-1249.
Meng B. S.Z. Pang, P.L. Forsline, J.R. McFerson and D. Gonsalves, 1998. Nucleotide sequence and genome structure of grapevine rupestris stem pitting associated virus 1 reveal similarities to apple stem pitting virus. *Journal of General Virology* **79**, 2059-2069.
Meng B., R. Johnson, S. Peressini P.L. Forsline, and D. Gonsalves1999. Rupestris stem pitting-associated virus 1 is consistently detected in vines that are infected with rupestris stem pitting. *European Journal of Plant Pathology* **105**, 191-199.
Meng B. and D. Gonsalves,2003. Rupestris stem pitting associated virus of grapevines: genome structure, genetic diversity, detection, and phylogenetic relationship to other plant viruses. *Current Topics in Virology* **3**, 125-135.
Meng B., R. Credi, N. Petrovic, I. Tomazic and D. Gonsalves, 2003. Antiserum to recombinant virus coat protein detects Rupestris stem pitting associated virus in grapevines. *Plant Disease* **87**, 515-522.
Merkuri J., G.P. Martelli, D. Boscia and V. Savino, 1994. Viruses of grapevine in Albania. *Bulletin OEPP/EPPO Bulletin* **34**, 215-220.
Milkus B., V. Kartuzova, N. Muljukina and B. Feld, 1991. Detection of virus diseases of grapevine in Ukraine. *Proceedings 10th Meeting of ICVG, Volos 1990,* 390-395.
Milne R.G., M. Conti, D.E. Lesemann, G. Stellmach, E. Tanne and J. Cohen, 1984. Closterovirus-like particles of two types asociated with diseased grapevines. *Phytopathologische Zeitschrift* **110**, 360-368.
Minafra A., M. Russo and G.P. Martelli, 1991. A cloned probe for the detection of grapevine closterovirus A. *Proceedings 10th Meeting of ICVG, Volos, Greece, 1990*, 417-424.
Minafra A. and A. Hadidi, 1994. Sensitive detection of grapevine virus A, B or leafroll associated III from viruliferous mealybugs and infected tissue by cDNA amplification. *Journal of Virological Methods* **47**, 175-188.
Minafra A., P. Saldarelli, F. Grieco and G.P. Martelli, 1994. Nucleotide sequence of the 3' terminal part of the RNA of two filamentous grapevine viruses. *Archives of Virology* **137**, 249-261.
Minafra A., P. Saldarelli and G.P. Martelli, 1997. Grapevine virus A: nucleotide sequence, genome organization and relationships in the *Trichovirus* genus. *Archives of Virology* **142**, 417-423.
Minafra A., P. Casati, V. Elicio, A. Rowhani, P. Saldarelli, V. Savino anf G.P. Martelli, 2000. Serological detection of grapevine rupestris stem pitting associated virus (GRSPaV) by a plyclonal antiserum to recombinant virus coat protein. *Vitis* **39**, 115-118.
Minafra A. and D. Boscia, 2003. An overwiew of rugose wood-associated viruses: 2000-2203. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 116-119.
Mink G.I. and J.L. Parsons, 1977. Procedures for rapid detection of virus and viruslike diseases of grapevine. *Plant Disease Reporter* **61**, 567-571.
Monette P.L., D. James and S.E. Godkin, 1989. Double-stranded RNA from rupestris stem pitting-affected grapevines. *Vitis* **28**, 137-144.
Monette P.L. and D. James, 1990. Detection of two strains of grapevine virus A. *Plant Disease* **74**, 898-900.
Monette P.L. and D. James, 1991. Detection of a closteroviruslike particle from a corky bark-affected grapevine cultivar. *Vitis* **30**, 37-43.
Monette P.L. and S.E. Godkin, 1993. Mechanical transmission of closterovirus-like particles from a corky bark-affected grapevine to an herbaceous species. *Plant Pathology (Trends in Agricultural Science)* **1**, 7-12

Monette P.L. and S.E. Godkin, 1995. Detection of capillovirus-like particles in a grapevine affected with rugose wood. *Vitis* **34,** 241-242.
Murant A.F, G.H. Duncan and I.M. Roberts, 1985. Heracleum latent virus (HLV) and heracleum virus 6 (HLV6). *Report of the Scottish Crop Institute 1984*, 182.
Nakano M., R. Nakaune and S. Komazaki, 2003. Mealybug transmission of grapevine viruses in Japan. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 218.
Namba S., D. Boscia, O. Azzam, M. Maixner, J.S. Hu, D. Golino and D. Gonsalves, 1991. Purification and properties of closteroviruslike particles associated with grapevine corky bark disease. *Phytopathology* **81**, 964-970.
Padilla V., 1993. Influencia del complejo de la madeira rizada de la vid en el cv Napoleon negra. *Vitivinicultura* **4** (7-8), 33-36.
Petrovic N., B. Meng, M. Ravnikar, I. Mavric and D. Gonsalves, 2003. First detection of rupestris stem pitting associated virus particles by antibody to a recombinant coat protein. *Plant Disease* **87**, 510-514.
Prudencio S. 1985. Comparative effects of corky bark and rupestris stem pitting diseases on selected germplasm lines of grapes. M.Sc. thesis, Department of Plant Pathology, University of California, Davis, 36 pp.
Rosciglione B. and M.A. Castellano, 1985. Further evidence that mealybugs can transmit Grapevine virus A (GVA) to herbaceous hosts. *Phytopathologia Mediterranea* **24**, 186-188.
Rosciglione B., M.A. Castellano, G.P. Martelli, V. Savino and G. Cannizzaro, 1983. Mealybug transmission of grapevine virus A. *Vitis* **22**, 331-347.
Rubinson E., N. Galiakparov, S. Radian, I. Sela, E. Tanne and R. Gafny, 1997. Serological detection of grapevine virus A using antiserum to a non structural protein, the putative movement protein. *Phytopathology* **87**, 1041-1045.
Saldarelli P., H. Guglielmi Montano and G.P. Martelli, 1994. Non-radioactive molecular probes for the detection of three filamentous viruses of the grapevine. *Vitis* **33**, 157-160.
Saldarelli P., A. Minafra and G.P. Martelli, 1996. The nucleotide sequence and genomic organization of grapevine virus B. *Journal of General Virology* **77**, 2645-2652.
Saldarelli P., A. Minafra, M.A. Castellano and G.P. Martelli, 2000a. Immunodetection and subcellular localization of the proteins encoded by ORF 3 of grapevine viruses A and B. *Archives of Virology* **145**, 1535-1542.
Saldarelli P., M. Dell'Orco and A. Minafra, 2000b. Infectious cDNA clones of two grapevine viruses. *Archives of Virology* **145**, 397-405.
Saric A. and Z. Korosec-Koruza, 1991. Occurrence and spread of viruses associated with leafroll (GLR) and stem pitting (GSP) diseases in the north-western part of Yugoslavia. *Proceedings 10th Meeting of ICVG, Volos 1990*, 416
Sarooshi R.A., K.B. Bevington and B.G. Coote, 1982. Performance and compatibility of "Muscat Gordo Blanco" grape on eight rootstocks. *Scientia Horticulturae* **16**, 367-374.
Saldarelli P., A. Minafra, R. Garau and G.P. Martelli, 1993. A cloned probe to grapevine virus B. *Rivista di Patologia Vegetale* **3** (Ser. V), 15-22
Savino V., D. Boscia and G.P. Martelli, 1985a. Incidence of some graft-transmissible virus-like diseases of grapevine in visually selected and heat-treated stocks from Southern Italy. *Phytopathologia Mediterranea* **24**, 204-207.
Savino V., D. Boscia and G.P. Martelli, 1989. Rugose wood complex of grapevine: can grafting to *Vitis* indicators discriminate between diseases? *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987*, 91-94.
Savino V., D. Boscia, D. Musci and G.P. Martelli, 1985b. Effect of legno riccio (stem pitting) on "Italia" vines grafted onto rootstocks of different origin. *Phytopathologia Mediterranea* **24**, 68-72.
Stewart S. and A. Nassuth, 2001. RT-PCR detection of rupestris stem pitting associated virus within field-grown grapevines throughout the year. *Plant Disease* **85**, 617-620
Tanne E., Y. Ben Dov and B. Raccah, 1989. Transmission of the corky-bark disease by the mealybug *Planococcus ficus. Phytoparasitica* **17**, 55.
Tanne E. and E. Meir, 1991. The detection of disease specific double-stranded RNA in corky bark affected grapevine. *Proceedings 10th Meeting of ICVG, Volos, Greece, 1990*, 247-250.
Tanne E., R. Marcus, E. Dubitzky and B. Raccah, 1966. Analysis of progress and spatial patterrn of corky bark in grapes. *Plant Disease* **80**, 34-38.
Téliz D., P. Valle, A. C. Goheen and S. Luévano, 1980a. Grape corky bark and stem pitting in Mexico. I. Occurrence, natural spread, distribution, effect on yield and evaluation of symptoms in 128 grape cultivars. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980,* 51-64.
Téliz D., P. Valle and A. C. Goheen, 1980b. Grape corky bark and stem pitting in Mexico. II. Evaluation of symptoms in 17 rootstocks. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980* , 65-70.

Téliz D. and P. Valle, 1980c. Grape corky bark and stem pitting in Mexico. III. Evaluation of symptoms in 130 cultivars grafted on 17 rootstocks. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980,* 71-75.

Wang Q., R. Gafny, P. Li, M. Mawassi, I. Sela and E. Tanne, 2003. Elimination of grapevine virus A by cryporeservation. *Extended Abstracts 14 Meeting of ICVG, Locorotondo 2003,* 242

Zhang Y.P., J.K. Uyemoto, D.A. Golino and A. Rowhani, 1998. Nucleotide sequence and RT-PCR detection of a virus associated with rupestris stem-pitting disease. *Phytopathology* **88,** 1231-1237.

Zorloni A., S. Prati, P.A. Bianco and G. Belli, 2004. Further data on the experimental transmission of *Grapevine leafroll-associated virus 1* and *3* and of *Grapevine virus A* by mealybugs. *Journal of Plant Pathology* **86**, 339.

GRAFT INCOMPATIBILITY

GRAFT INCOMPATIBILITY

Infection by phloem-limited viruses may damage grapevines in the nursery (reduced graft take) or in the early stages of growth in the field (graft incompatibility). This latter condition has been known for a long time and occurs also in rugose wood-affected vines. However, the increased use of clonal material is disclosing unprecedented conditions of generalized decline that develop dramatically in certain scion-rootstock combinations, so as to represent veritable emerging diseases.

1. Description

Main synonyms: Incompatibilité au greffage (Fr.), incompatibilità d'innesto (Ital.)

Symptoms: Newly planted vines grow weakly, shoots are short, leaves are small-sized, with margins more or less extensively rolled downwards, and the vegetation is stunted The canopy shows autumn colours off season so that leaves turn reddish in red-berried varieties or yellow in white-berried varieties much earlier than normal. A prominent swelling forms at the scion/rooststock junction and variously extended necrotic lesions may develop on the rootstock stem, which are usually not accompanied by wood abnormalities (pitting or grooving). Severely affected vines decline and may die within one or two years. Cases of graft union disorders have been observed in Europe (Kober 5BB incompatibility), California, New Zealand, Australia and Chile (young vine decline), and again California (rootstock stem lesions). A transitory form of incompatibility was reported from Italy under the name of bushy stunt. In this case, scions show a stunted and bushy vegetation due to the contemporary proliferation of apical and axillary buds, but the colour of the canopy remains green. Normal growth resumes with the second or third leaf, but the yield is reduced. The putative agent of bushy stunt was consistenly found in clones of the rootstock 140R in which it is latent. Syrah decline is a severe disease occurring in France, Argentina and probably elsewhere. Foliar and trunk symptoms resemble very much those induced by rugose wood/graft incompatibililty and are shown by aged as well as young (4-year-old) vines. The nature of this disease has not been ascertained but one or more graft-transmissibile agents may be involved in its aetiology, although none of a number of known grapevine-infecting viruses has been found in affected vines, except for GRSPaV. Incompatibility may also develop in the form of a brown line of necrotic tissues at the bud union when grape cultivars hypersensitively resistant to the nepovirus ToRSV are grafted on susceptible rootstocks.

Agents: An ordinary strain of *Grapevine leafroll-associated virus 2* (GLRaV-2) is consistently associated with Kober 5BB incompatibility (Europe), and together with *Grapevine virus B* (GVB), appears to be involved in California's young vine decline. The same virus was detected in diseased Chilean grapes, though not consistently and, consistently, in Argentinian grapes. A virus originally detected in cv. Redglobe in California called Grapevine rootstock stem lesion-associated virus (GRSLaV) proved to be a molecular and biological variant of GLRaV-2 (GLRaV-2 RG). Other molecular variants of GLRaV-2 were reported from New Zealand (Alphie virus), Chile, and Australia in association with young vine decline conditions. Based on the differential responses of a panel of 18 rootstocks, up to five different graft-transmissible agents inducing incompatibility could be differentiated in California. Of these, only GLRaV-2 RG was identified. The heat-labile graft-transmissible agent present in the hybrid 140R, associated with grapevine bushy stunt is still unidentified.

Transmission: GLRaV-2, a member of the genus *Closterovirus*, is not transmitted by mealybugs and does not have a known vector. Infected propagative material is to be blamed for its dissemination. GVB is mealybug-borne and can be spread at a site by these insects.

Varietal susceptibility: Appearance of graft union disorders depends more on the rootstock rather than the scion. European grape varieties grafted on tolerant rootstocks (e.g. Freedom, Harmony, Salt creek , 03916, 101-14) exhibit a green canopy and perform rather well, whereas varieties grafted on susceptible roostocks (e.g. Kober 5BB, 5C, 1103P, 3309) develop a discolored canopy , decline and may die.

Detection: Indexing on Caberent sauvignon is a reliable method for detecting incompatibility conditions. Known viruses associated with this disorder (different GLRaV-2 strains and GVB) can be identified by ELISA using polyclonal antisera and/or monoclonal antibodies The best antigen sources for serological diagnosis are cortical shavings from mature dormant canes. Other assays include nucleic acid-based tecniques such as single step or nested reverse transcription-polymerase chain reaction (RT-PCR) and

immunocapture RT-PCR, using degenerate or virus-specific primers.
Control: Prevent introduction of infected vines in the vineyard by using certified grafted plants or virus-free scionwood and rootstocks. Currently known graft incompatibility agents can be eliminated with reasonable efficiency by heat therapy, meristem tip culture, or a combination of the two. If scionwood is infected, the use of sensitive rootstocks is to be avoided and, whenever feasible, utilization of tolerant roostocks is advisable. Strategies on how to protect healthy stocks from vector-mediated GVB reinfection in the field are yet to be developed.

2. Historical review

1942 **Jacob**: Description of graft incompatibility in different scion/stock combinations.

1950 **Boubals and Huglin**: Report on graft incompatibility of certain varieties grafted on 57R.

1973, 1977 **Durquety** *et al*.: Two papers describing incompatibility phenomena between clonal selections of different cultivars grafted on Kober 5BB

1979 **Fallot** *et al.*: Third paper of a series on incompatibility on Kober 5BB. Graft-transmission of the incompatibility factor.

1986 **Legin and Walter**: The graft-transmissibile agent that causes incompatibility of different varieties on Kober 5BB is a virus which can be eliminated by heat treatment at 37 °C for 58 days.

1991 **Savino** *et al*.: Description of bushy stunt and evidence that it is caused by a graft-transmissibile heat-sensitive agent carried by some clonal rootstocks.

1995 **Greif** *et al*.: GLRaV-2 is the cause of a graft incompatibility revealed by Kober 5BB.

2000 **Golino** *et al*.: GLRaV-2 and GVB are consistently associated with young vine decline in California.

2000 **Boubals**: Report of a national French study group investigating the aetiology of Syrah decline. No conclusion are drawn.

2000 **Boubals:** Syrah decline occurs in Argentina

2001 **Uyemoto** *et al*.: Identification of an apparently new closterovirus denoted Grapevine rootstock stem lesion virus (GRSLV) causing stem necrosis of rootstocks, decline, and death of the vines. GRSLV has about 75% nucleotide homology with GLRaV-2.

2003 **Uyemoto and Rowhani:** Indexing on 18 different grape rootstocks reveals the existence of at least five different agents causing graft incompatibility.

2003 **Bonfiglioli** *et al*.: Report of a new molecular variant of GLRaV-2 from New Zealand.

2003 **Prodan** *et al*.: GLRaV-2 is associated, though not consistently, with a decline condition of young Thomposn seedless vines in Chile.

2003 **Gomez Talquenca** *et al*: GLRaV-2 is consistently associated with declining Cabernet sauvingon vines grafted on different roostocks in Argentina.

2003 **Martelli**: GRSLV and GLRaV-2 are serologically related and are both recognized by a panel of 18 monoclonal antibodies. Suggestion that they are molecular variants of the same virus species. GRSLV re-named Redglobe strain of GLRaV-2.

2003 **Renault Spilmont** *et al*.: Updated report on the state of the art of investigations carried out in France on Syrah decline. The problem is very complex and may involve several still unidentified factors.

2004 **Bertazzon and Angelini**: Comparison of several detection methods for the broad or specific identification of *Grapevine leafroll-associated virus 2* variants.

3. References

Bertazzon N. and E. Angelini, 2004. Advances in the detection of *Grapevine leafroll-associated virus 2* variants. *Journal of Plant Pathology* **86**, 283-290.

Bonfiglioli R., F. Edwards and A. Pantaleo, 2003. Molecular studies on a graft incompatibility syndrome in New Zealand vineyards yields another probable variant of Grapevine leafroll-associated virus 2. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 141.

Boubals D. and P. Huglin, 1950. Etude de l'incompatibilité au graffege de certain cépages et du 57R. *Progrés Agricole et Viticole* **67**, 183-189.

Boubals D., 2000. Le dépérissement de la Syrah. Compte-rendu de la réunion du Groupe de Travail National. *Progrés Agricole et Viticole* **117,** 137-141

Boubals D., 2000. Le dépérissement de la Syrah existe aussi en Argentine. *Progrés Agricole et Viticole* **117,** 277.

Durquety P.M., J. Fallot, C. Ruchaud, J.P. Benassac and R. Dauty, 1973. Le clone et ses reactions au greffage. I. Existence dans un cépage population de clones présentant divers degrés de compatibilité avec certains porte-greffes. *Progrés Agricole et Viticole* **90**, 122-129 and 171-178.

Durquety P.M., C. Ruchaud, J.P. Gazeau and J. Fallot, 1977. Le clone et ses reactions au greffage.II. Nouvelles recherches sur l'incompatibilité clonale d'Abouriou greffé sur 5BB. Autres cas chez la vinge. *Progrés Agricole et Viticole* **94**, 420-427

Fallot J., C. Ruchaud, P.M. Durquety and J.P. Gazeau, 1979. Le clone et ses reactions au greffage.III. La trasmission de l'incompatibilité au greffage entre 5BB et *Vitis vinifera. Progrés Agricole et Viticole* **96**, 211-216.

Golino D.A, S. Sim and A. Rowhani, 2000. Identification of the latent viruses associated with young vine decline in California. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 85-86.

Gomez Talquenca G.S., O. Gracia, S. Garcia Lampasona and O. Grau., 2003. A young grafted vine decline syndrome in Argentina vineyards. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 85-86.

Greif C., R. Garau, D. Boscia, V.A. Prota, M. Fiori, P. Bass, B. Walter and U. Prota, 1995. The relationship of grapevine leafroll-associated virus 2 with a graft incompatibility condition of grapevines. *Phytopathologia Mediterranea* **34,** 167-173.

Jacob H.E., 1942. Examples of incompatibility between grape varieties and roostocks. *Proceeding of the American Society of Horticultural Science* **41**, 201-203.

Legin R. and B. Walter, 1986. Etude de phénomènes d'incompatibilité au greffage chez la vigne. *Progrés Agricole et Viticole* **103,** 279-283.

Martelli G.P., 2003. Grapevine virology highlights 2000-2003. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 3-10.

Prodan S., J. Montalegre and N. Fiore, 2003. Aetiology of decline in Thompson seedless grafted table grape plants. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 142-143.

Renault Spilmont A.S., S. Grenan and J.M. Boursiquot, 2003. Syrah decline in French vineyards. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 144.

Savino V., B. Di Terlizzi, S. Rivieccio and F. Di Silvio. 1991. Presence in clonal rootstocks of a graft-transmissible factor that induces stunting and bushy growth in European grapevines. *Proceedings 10th Meeting of ICVG, Volos 1990*, 202-210

Uyemoto J.K., A. Rowhani, D. Luvisi and R. Krag, 2001. New closterovirs in 'Redglobe' grape causes decline of grafted plants. *California Agriculture* **55** (**4**), 28-31.

Uyemoto J.K. and A. Rowhani, 2003. Discovery of different grapevine sources with graft-transmissible agents causing union-incompatibility on sensitive rootstocks. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 139-140.

FLECK COMPLEX

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The fleck complex consists of several diseases (grapevine fleck, grapevine asteroid mosaic, grapevine rupestris necrosis, and grapevine rupestris vein feathering) and viruses (*Grapevine redglobe virus*) that cause latent or semi-latent infections in *Vitis vinifera* and most American *Vitis* species and rootstock hybrids. Although the elusive nature of the complex hinders the assessment of its economic impact, adverse influence on vigour, rooting ability of rootstocks and on graft take has been reported.

1. Description

Main synonyms:

A. Grapevine fleck: Marbrure (Fr.), maculatura infettiva, screziatura (Ital.), Marmorierung der Rebe (Germ.).

B. Grapevine asteroid mosaic: Mosaïque étoilée (Fr.), mosaico stellare (Ital.), Sternmosaik der Rebe (Germ.).

Symptoms:

a. *Fleck.* The disease is latent in European grapevine varieties and in most American rootstocks. Symptoms are expressed in *Vitis rupestris* and consist of clearing of the veins of third and fourth order, producing localized translucent spots. Leaves with intense flecking are wrinkled, twisted and may curl upward. Severe strains induce also varying degrees of stunting. Fleck is an ubiquitous disease reported from most viticultural countries in the world.

b. *Asteroid mosaic.* In *V. vinifera*, leaf symptoms are characterized by star-shaped chlorotic spots, sometimes with necrotic center, irregularly distributed over the leaf blade. Leaves are asymmetric, twisted and puckered along the veins. Affected vines are often stunted, and produce little or no fruit. Leaf symptoms usually become less severe in summer. In *V. rupestris*, which is used as indicator, the disease elicits creamy-yellow bands developing along the major veins of the leaves, which are twisted and asymmetric. Asteroid mosaic symptoms have been observed in several varieties of *V. vinifera* in California. Records from Italy and South Africa have not been confirmed experimentally and a record from Greece was proven to refer to Grapevine rupestris vein feathering. The putative causal agent of the disease has only been found in California.

c. *Rupestris necrosis*. This disease, reported only from Japan, is latent in European grapevine varieties. *V. rupestris* reacts with localized necrosis of the shoots, leaf petioles and veinlets.

d. *Rupestris vein feathering*. Mild asteroid mosaic-like symptoms are shown by some European grapevine varieties (e.g. Sultanina). Transient mild chlorotic discolourations of the primary and secondary leaf veins develop in *V. rupestris* following graft inoculation. The putative causal agent of the disease so far has been found in Greece, Italy and California.

e. *Grapevine red globe virus* (GRGV) is *a Grapevine fleck virus* (GFkV)-like virus which apparently does not induce symptoms in European grapevine varieties (e.g. Red globe) nor in *V. rupestris*. Recorded from California and Italy , but likely to occur elsewhere.

Agents: All viruses of the complex, GFkV, GRGV, *Grapevine asteroid mosaic-associated virus* (GAMaV), and *Grapevine rupestris vein feathering virus* (GRVFV) are all phloem-limited and non mechanically transmissible. All have isometric particles about 30 nm in diameter with rounded contour and prominent surface structure with clusters of coat protein subunits arranged as pentamers and hexamers. GFkV particles sediment as two centrifugal components, T made up of empty protein shells and B, containing the genome, which is a monopartite single-stranded, capped, positive sense RNA with high cytosine content (c. 50%). GFkV genomic RNA constitutes about 35% of the particle weight. The coat protein (CP) of GFkV and GRGV particles is made up of a single protein species with Mr of c. 25 kDa, whereas the CP of GAMaV and GRVFV consists of a major protein of 21 kDa and a minor prtotein of 25 kDa. The complete sequence of GFkV and partial sequences of GRGV, GAMaV, and GRVFV genomes are available. GFkV genomic RNA (Mol. wt of 2.6 x 10^6) is 7564 nt in size and contains four open reading frames (ORF) that

encode a 215.4 polypeptide with the conserved motif of replication associated proteins (ORF 1), the CP (ORF 2), and two proline rich polyproteins of 31.4 kDa (ORF 3) and 15.9 kDa (ORF 4) with unknown function. The 3' end of GRGV genome is structurally similar to that of GFkV except for the lack of ORF 4. The genomic structure of GAMaV and GRVFV differs from the above in that both these viruses have a single ORF encoding a large polypeptide which is proteolitically processed to yield individual proteins. Because of its molecular characteristics, GFkV was identified as the representative of a new genus denoted *Maculavirus*, of which it represents the type species, whilst GAMaV and GRVFV were assigned to the genus *Marafivirus*. Further physico-chemical, molecular and ultrastuctural studies disclosed sufficient similarities between maculaviruses, marafiviruses and members of the genus *Tymovirus* to warrant the establisment of the a new family denoted *Tymoviridae.* The current taxonomic classification of viruses of the fleck complex is therefore the following:

Family *Tymoviridae*
- Genus *Marafivirus*
  - *Grapevine asteroid mosaic-associated virus*
  - Grapevine rupestris vein feathering virus
- Genus *Maculavirus*
  - Grapevine fleck virus
  - Grapevine redgloble virus

Cytopathology: GFkV infections are characterized by a severe modification of mitochondria into structures called "multivesiculate bodies", whereas GAMaV induces peripheral vesiculation of chloroplasts. These deranged organelles are thought to be sites of virus replication.

Transmission: No vector is known for any of the viruses of the fleck complex. Although observations from Italy, South Africa and Japan suggest natural field spread of GFkV and a similar behaviour was reported in Greece for a disease formerly thought to be asteroid mosaic but now identified as grapevine rupestris vein feathering, primary dissemination of these and the other viruses of the complex is through infected propagative material. Transmission through dodder of GFkV has been reported but it is of no epidemiological importance. GFkV is not seed transmitted.

Varietal susceptibility: GFkV and possibly all the other viruses of the complex infect naturally a large number of varieties and *Vitis* species. No information is available on individual susceptibility.

Detection: Indexing on *V. rupestris* allows with a reasonable level of confidence the discrimination of the different viruses of the complex based on the differential reaction of the indicator. Polyclonal antisera and monoclonal antibodies to GFkV heve been raised. Therefore, ELISA is currently employed for routine detection of GFkV, but cannot be used for any of the other members of the complex due to the unvailability of antisera. Virus specific and degenerate primers have been designed for single or multiplex RT-PCR detection of GFkV, GRGV, GAMaV, and GRVFV.

Control: Because of the latency of symptoms sanitary selection of European grapevine cultivars and most American rootstock hybrids is unrealiable. GFkV can be eliminated by heat therapy, meristem tip or fragmented shoot apex culture. The same sanitation procedures are likely to operate successfully with the other viruses of the complex, but no experimental data are available.

2. Historical review

1954 **Hewitt**: First description of asteroid mosaic in California. As the disease is rare and does not appear to be spreading, its economic importance is low.

1962 **Hewitt** *et al*.: First record of fleck as an unidentified symptom different from fanleaf and transmissible from symptomless varieties to *V. rupestris* St.George.

1966 **Vuittenez** et al.: "Marbrure", a disease inducing symptoms similar to those of fleck in *V.rupestris* described in France.

1966 **Refatti**: Review paper on asteroid mosaic. Comparison of symptoms with those of other mosaic diseases of grape. Attempts to transmit the disease by mechanical inoculation to herbaceous test plants or by *Xiphinema index* were unsuccessful.

1970 **Refatti**: Symptoms resembling asteroid mosaic as described in California are reported from Italy and South Africa.

1972 **Bovey:** Identification of fleck in Switzerland as a latent disease of Chasselas transmissible to *V. rupestris.*

1972 **Hewitt** *et al*.: Description of fleck as an independent graft-transmissible disease present in many European varieties and American rootstocks.

1972 **Rives:** Further demonstration that fleck is distinct from fanleaf based on differential responses to heat treatment.

1973 **Ottenwaelter** *et al*.: Successful elimination of fleck through heat therapy.

1973 **Goheen and Luhn**: A novel heat therapy system based on virus inactivation in buds grafted onto healthy LN 33 rootstocks is effective against fleck.

1973 **Hévin** *et al*.: Fleck is not seed transmissible.

1974 **Milku**s: Suggestion of a prokaryotic etiology for fleck.

1977 **Mink and Parsons**: Use of a growth chamber with controlled temperature for a quicker and improved symptom expression of fleck and other virus or virus-like diseases (fanleaf, leafroll and corky bark).

1982 **Barlass** *et al.:* Successful elimination of fleck through fragmented shoot apex culture *in vitro.*

1983 **Verderevskaya** *et al*.: Observation of an isometric non mechanically transmissible virus in the phloem of diseased vines.

1983 **Castellano** *et al*.: Observation of a non mechanically transmissible virus, later called grapevine phloem-limited isometric virus (GPLIV), in sieve tubes of field-grown vines with leafroll symptoms but likely to be affected by other diseases. Report of multivesiculate inclusion bodies probably connected with GPLIV infection.

1983 **Woodham and Krake**: Dodder transmission of fleck from vine to vine.

1984 **Castellano and Martelli**: Confirmation that GPLIV is associated with multivesiculate bodies and demonstration that these derive from deranged mitochondria.

1985 **Castellano** *et al*.: Purification of GPLIV from naturally diseased vines and production of a specific antiserum.

1985 **Savino** *et al*.: Report of widespread occurrence of fleck in visually selected grapevine clones in southern Italy. The efficiency of heat treatment for disease elimination is unsatisfactory.

1987 **Triolo and Materazzi**: Fleck has a detrimental effect on the quality *V. rupestris* propagating wood. Rooting ability and graft take are adversely affected

1989 **Yamakawa**: Field spread of fleck in Japan

1990 **Boulila** *et al*.: Physicochemical characterization of GPLIV. Confirmation that the virus can be eliminated by heat therapy and is not related to leafroll.

1990 **Dolja** *et al*.: Identification of a dsRNA of about 7 Kb pairs in diseased vines.

1990 **Engelbrecht and Kasdorf**: Observation of natural field spread of fleck in South Africa. Report that a virus serologically similar to GPLIV is associated with the disease.

1991 **Triolo and Resta**: Tetracycline treatments are ineffective against fleck. Dismissal of the prokaryote etiology hypothesis.

1991 **Gugerli** *et al*.: Report of the close association with fleck symptoms in *V.rupestris* of an isometric virus latent in *V. vinifera*.

1991a **Boscia** *et al*.: Report of a highly consistent association of GPLIV with fleck in naturally infected and graft-inoculated *V. rupestris.* Meristem tip culture effectively eliminates the virus.

1991b **Boscia** *et al*.: GPLIV shown to be the agent of fleck. Virus renamed *Grapevine fleck virus* (GFkV). ELISA used successfully for virus detection in large scale survey.

1991 **Kyriakopoulou**: Description of a disease similar to asteroid mosaic observed in *V. vinifera* cv. Sultanina in Greece. Symptoms are severe and affected vines are almost fruitless. The disease seems to be spreading naturally.

1991 **Namba** *et al*.: A spherical virus purified from berries of Ajinashica disease-affected vines is serologically related to GPLIV (= GFkV) and has physicochemical properties comparable to those of GFkV.

1993 **Walter and Cornuet**: Confirmation by ELISA of the consistent association of GFkV with fleck disease. June-July are the best months for ELISA detection of the virus in Alsace.

1994 **Boscia** *et al*.: A non mechanically transmissible isometric virus similar but unrelated to GFkV identified in asteroid mosaic-infected grapevines. Virus named Grapevine asteroid mosaic-associated virus (GAMaV)

1995 **Boscia** *et al*.: Two GFkV-specific monoclonal antibodies raised in Italy can successfully be used in ELISA

1995 **Kuniyuki and Costa**: Three strains of GFkV reported from Brazil, based on the differential reactions of indicators

1996 **Credi and Babini**: Infection by fleck, vein necrosis and vein mosaic has a detrimental effect on rootstock growth. Pruning wood is reduced by 51% in 420A and by 37% in Kober 5BB. Adverse effect on Teleki 5A is negligible.

1996 **Fortusini** *et al*.: Natural field spread of GFkV observed in Northern Italy

1997 **Schieber** *et al*.: Additional monoclonal antibodies raised in France. One of these antibodies is more sensitive than the polyclonal antiserum for GFkV detection by ELISA

1997 **Faoro and Gugerli**: An unidentified phloem-limited isometric virus serologically differing from GFkV observed in vines showing double-membraned peripheral invaginations of chloroplast envelope. This cytological feature recalls that later found in vines infected by *Grapevine rupestris vein feathering virus*.

1998 **Marsumoto and Ohki**: A spherical virus resembling GFkV identified in thin sectioned cells of *V. rupestris* with a necrotic disease. GFkV-like multivesiculate bodies derived from deranged mitochondria are present in infected cells.

2000 **Sabanadzovic** *et al*.: Use of degenerate primers designed on the methyl transferase and polymerase cistrons of members of *Tymovirus* and *Marafivirus* genera and of GFkV amplified a genome fragment of GFkV, GAMaV and of another virus with GFkV-like particles phylogenetically but not serologically related to GFkV present in a cv Red globe vine. Virus named *Grapevine redglobe virus*.

2001 **Sabanadzovic** *et al*.: Complete nucleotide sequence of GFkV genome. Molecular properties of this virus further support the notion that it warrants classification in a genus of its own.

2001 **Elbeaino** *et al*.: Molecular reagents (degenerate primers) developed for the specific identification of viruses of the fleck complex (GFkV, GAMaV, GRGV). Detection of sequences of an undentified virus from a Greek grapevine, later named Grapevine rupestris vein feathering virus (GRVFV).

2002a **Martelli** *et al*.: Description of *Maculavirus*, a new genus of plant viruses having GFkV as type species and GRGV as tentative species.

2002b **Martelli** *et al*.: Description of the family *Tymoviridae*, comprising the genera *Maculavirus* and *Marafivirus* that include GFkV/GRGV and GAMaV/GRVFV, respectively.

2003a **Abou Ghanem-Sabanadzovic** *et al*.: Sequencing of the 3' end of the genome of GRGV, GAMaV and of a virus of Greek origin which induces vein feathering in *V. rupestris* confirms the assignment of GRGV to the genus *Maculavirus* and of GAMaV and the Greek virus to the genus *Marafivirus*. Greek virus recognized as a species in its own right denoted *Grapevine rupestris vein feathering virus* (GRVFV).

2003b **Abou Ghanem-Sabanadzovic** *et al*.: Development of a multiplex RT-PCR protocol for the simultaneous detection of GFkV-like viruses using plant mRNA as an internal control. GRVFV recorded from California and confirmation that GAMaV does not occur outside of California.

2003 **Shi** *et al*.: A sequence variant of GFkV (GFkV416) with a 63 nucleotide insertion in the replicase gene identified in Australia and New Zealand. In other countries (USA, South Africa, Argentina, Iran, and Japan) only the variant without insertion (GFkV353) was detected.

3. References

Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic and G.P. Martelli, 2003a. Sequencing of the 3' end of three grapevine fleck virus-like viruses . *Virus Genes* **27**, 11-16

Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic , A. Rowhani and G.P. Martelli, 2003b. Multiplex RT-PCR detection of Grapervine fleck virus-like viruses in grapevine with co-amplification of control plant mRNA. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 195.

Barlass M., K.G.M. Skene, R.C. Woodham and L.R. Krake, 1982. Regeneration of virus-free grapevines using in vitro apical culture. *Annals of Applied Biology* **101**, 291-295.

Boscia D., G.P. Martelli, V. Savino and M.A. Castellano, 1991b. Identification of the agent of grapevine fleck disease. *Vitis* **30**, 97-105.

Boscia D., V. Savino, G.P. Martelli and M.A. Castellano, 1991a. Association of a phloem-limited non mechanically transmissible isometric virus with grapevine fleck disease. *Proceedings 10th Meeting of ICVG, Volos 1990,* 173-174.

Boscia D., S. Sabanadzovic, V. Savino, P.E. Kyriakopoulou and G.P. Martelli, 1994. A non mechanically transmissible virus associated with asteroid mosaic of the grapevine. *Vitis* **33**, 101-102

Boscia D., V. Elicio, V. Savino, and G.P. Martelli, 1995. Production of monoclonal antibodies to grapevine fleck virus. *Plant Pathology* **44**, 160-163.

Boulila M., D. Boscia, B. Di Terlizzi, M.A. Castellano, A. Minafra, V. Savino and G.P. Martelli, 1990. Some properties of a phloem-limited non mechanically-transmissible grapevine virus. *Journal of Phytopathology* **129**, 151-158.

Bovey R., 1972. Un virus latent dans le Chasselas. *Annales de Phytopathologie,* Numéro hors série, 31-34.

Castellano M.A. and G.P. Martelli, 1984. Ultrastructure and nature of vesiculated bodies associated with isometric virus-like particles in diseased grapevines. *Journal of Ultrastructure Research* **89,** 56-64.

Castellano M.A., G.P. Martelli and V. Savino, 1983. Virus-like particles and ultrastructural modifications in the phloem of leafroll-affected grapevines. *Vitis* **22**, 23-39.

Castellano M.A., G.P. Martelli, V. Savino and D. Boscia, 1985. Progress in the study of the phloem-limited isometric virus-like particles associated with leafroll-diseased grapevines. *Phytopathologia Mediterranea* **24**, 165-169.

Credi R. and A.R. Babini, 1996. Effect of virus and virus-like infections on the growth of grapevine rootstocks. *Advances in Horticultural Science* **10**, 95-98.

Dolja V.V., O. Tomashevskaya, U.P. Boyko, A.V. Karsev, T.D. Verderevskaya and J.G. Atabekov, 1990. Double stranded RNA associated with fleck disease of grapevine. *Proceedings 8th Congress of the Mediterranean Phytopatological Union, Agadir 1990*, 191.

ElBeaino T., S. Sabanadzovic, M. Digiaro, N. Abou Ghanem-Sabanadzovic, A. Rowhani P.E. Kyriakopoulou and G.P. Martelli 2001. Molecular detection of Grapevine fleck virus-like viruses. *Vitis* **40**: 65-68.

Engelbrecht D.J. and G.G.F. Kasdorf, 1990. Field spread of corky bark, fleck, leafroll and Shiraz decline diseases and associated viruses in South African grapevines. *Phytophylactica* **22**, 347-354.

Faoro F and P. Gugerli, 1997. Cytological alterations associated with an unidentified isometric grapevine virus (UIGV). *Extended Abstracts 12th Meeting of ICVG, Lisbon 1997*, 31-32.
Fortusini A., G. Scattini, S. Cinquanta and S. Prati, 1996. Diffusione naturale del virus 1 (GLRaV-1) e del virus 3 (GLRaV-3) dell'accartocciamento fogliare e del virus della maculatura infettiva o "fleck" (GFkV) della vite. *Informatore Fitopatologico* **46 (12),** 39-43.
Goheen A.C. and C. Luhn, 1973. Heat inactivation of viruses in grapevines. *Rivista di Patologia Vegetale,* **Ser.IV, 9**, 287-289.
Gugerli P., B. Rosciglione, J.-J. Brugger, S. Bonnard, M.-E. Ramel and F. Tremea, 1991. Further characterization of grapevine leafroll disease. *Proceedings 10th Meeting of ICVG, Volos 1990,* 59-60.
Hévin M., M.M. Ottenwaelter, J.P. Doazan and M. Rives, 1973. Investigating the transmission of marbrure and fan-leaf through the seed in the grapevine. *Rivista di Patologia Vegetale*, **Ser. IV, 9,** 253-258.
Hewitt W.B., 1954. Some virus and virus-like diseases of grapevines. *Bulletin of the California Department of Agriculture* **43**, 47-64.
Hewitt W.B., A.C. Goheen, D.J. Raski and G.V. Gooding, Jr., 1962. Studies on virus diseases of the grapevine in California. *Vitis* **3**, 57-83.
Hewitt W.B., A.C. Goheen, L. Cory and C. Luhn, 1972. Grapevine fleck disease, latent in many varieties, is transmitted by graft inoculation. *Annales de Phytopathologie*, Numéro hors série, 43-47.
Kyriakopoulou P.E., 1991. Symptoms of grapevine asteroid mosaic in Greece. *Proceedings 10th Meeting of ICVG, Volos 1990*, 143-146.
Kuniyuki H. and A.S. Costa, 1995. Occorrencia de mais um isolado do virus do mosaico da nervuras da videira que no causa sintomas no porta-enxerto Kober 5BB. *Fitopatologia Brasileira* **20**, 618-622.
Martelli G.P., S. Sabanadzovic, N. Abou Ghanem-Sabanadzovic and P. Saldarelli, 2002a. *Maculavirus*, a new genus of plant viruses. *Archives of Virology* **147**, 1847-1853.
Martelli G.P., S. Sabanadzovic, N. Abou Ghanem-Sabanadzovic, M.C Edwards and T. Dreher, 2002b. The family *Tymoviridae*. *Archives of Virology* **147**, 1837-1846.
Matsumoto T. and S.T. Ohki, 1998. A possible new necrotic diseases of grapevine associated with small isometric particles and novel membrane-bound large particles. *Annals of the Phytopathologial Society of Japan* **64**, 560-564.
Milkus B., 1974. Mycoplasma- or chlamidia-like bodies in grape, affected by marbour. *Acta Phytopathologica Academiae Scientiarum Hungaricae* **9**, 385-388.
Mink G.I. and J.L. Parsons, 1977. Procedures for rapid detection of virus and viruslike diseases of grapevine. *Plant Disease Reporter* **61**, 567-571.
Namba S., D. Boscia, S. Yamashita, T. Tsuchizaki and D. Gonsalves, 1991. Purification and properties of spherical virus particles associated with grapevine Ajinashica disease. *Plant Disease* **75**, 1249-1253.
Ottenwaelter M.M., M. Hévin, P. Leclair, J.P. Doazan and M. Rives, 1973. Heat therapy eliminates the ability to transmit the causal agent of "marbrure" in several *V. vinifera* clones and in *V. rupestris* "du Lot" (St. George). *Rivista di Patologia Vegetale,* **Ser.IV, 9,** 281-285.
Refatti E., 1966. Grapevine asteroid mosaic. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis 1965*, 157-164.
Refatti E., 1970. Asteroid mosaic of grapevine. In Frazier N.W. (Ed.): Virus Diseases of Small Fruits and Grapevines (A Handbook). University of California, Division of Agricultural Sciences, Berkeley, 212-214.
Rives M. 1972. Séparation de la marbrure et du court-noué (panachure) chez la vigne par thermothérapie. *Annales de Phytopathologie,* Numéro hors série, 75-77.
Sabanadzovic S., N. Abou Ghanem, M.A. Castellano, M. Digiaro and G.P. Martelli, 2000. Grapevine fleck virus-like viruses in Vitis. *Archives of Virology* **145**, 553-565.
Sabanadzovic S., N. Abou Ghanem-Sabanadzovic, P. Saldarelli and G.P. Martelli, 2001. Complete nucleotide sequence and genome organization of grapevine fleck virus. *Journal of General Virology* **82**, 2009-2015
Savino V., D. Boscia and G.P. Martelli, 1985. Incidence of some graft-transmissible virus-like diseases of grapevine in visually selected and heat-treated stocks from Southern Italy. *Phytopathologia Mediterranea* **24**, 204-207.
Shi B.J., N. Habili and R.H. Symons, 2003. Nucleotide sequence variation in a small region of Grapevine fleck virus replicase provide evidence for two sequence variants of the virus. *Annals of Applied Biology* **142**, 349-355.
Schieber O., A. Seddas, C. Belin and B. Walter, 1997. Monoclonal antibodies for detection, serological characterization and immunopurification of grapevine fleck virus. *European Journal of Plant Pathology* **103**, 767-774.
Triolo E. and E. Resta, 1985. The responses of the Grapevine fleck agent to tetracycline-HCl antibiotic and Dienes' stain. *Phytopathologia Mediterranea* **24**, 197-203.

Triolo E. and A. Materazzi., 1987. La maculatura infettiva della vite: influenza di isolati diversi sull'attitudine alla propagazione vegetativa di *Vitis rupestris* St. George. *La Recherche Agtonomique en Suisse* **26**, 3209-324.

Verderevskaja T.D., V.G. Marinesku and E.S. Semtschik, 1983. Ätiologie und Diagnose der Marmorierung der Weinrebe. *Archiv für Phytopathologie und Pflanzenschutz* **19**, 221-226.

Vuittenez A., R. Legin and J. Kuszala, 1966. Observations sur une mosaïque de la Vigne, probablement indépendante du virus du Court-noué. *Annales des Epiphyties* **17**, Numéro hors série, 67-73.

Walter B. and P. Cornuet, 1993. ELISA detection of grapevine fleck virus (GFkV). *Agronomie* **13**, 651-657.

Woodham R.C. and L.R. Krake, 1983. Investigations on transmission of grapevine leafroll, yellow speckle and fleck diseases by dodder. *Phytopathologische Zeitschrift* **106,** 193-198.

Yamakawa Y., 1989. Virus reinfection of virus-free Cabernet sauvingon and Cabernet franc vines. *Journal of the Japanese Society of Horticultural Science* **58,** 297-302.

MINOR VIRUS DISEASES

Several graft-transmissible diseases are known, with which specific viruses are associated and thought to be their possible causal agents. Some of these diseases have been recorded only from Europe, others occur in Japan. Their overall importance is minor if compared with that of the major diseases dealt with in previous chapters, but some are of economic relevance locally (e.g. Grapevine berry inner necrosis).

A. European diseases

GRAPEVINE YELLOW MOTTLE

1. Description

Main synonyms: None.

Main symptoms: Various patterns of yellow discolouration characterize the disease. The spring growth shows more or less extensive yellowing of the leaf blades that does not extend to the veins. Faint yellow speckling, rings and lines are typical summer responses of infected vines. Plant vigour and yield do not seem appreciably affected. Yellow mottle has been reported from Germany, Switzerland, Hungary, former Czechoslovakia, Bulgaria, and Turkey.

Agent: *Alfalfa mosaic virus* (AMV), the type species of the genus *Alfamovirus,* is the putative causal agent. AMV, a mechanically transmissible virus, has differently shaped particles, from quasi isometric to bacilliform, 30 to 57 nm in size, and a tripartite RNA genome accounting for c. 18% of the particle weight, with the following mol. wts: RNA-1, 1.04 x 10^6 Da (3644 nt); RNA-2, 0.73 x 10^6 (2593 nt); RNA-3, 0.62 x 10^6 (2037 nt). Capsid proteins subunits are of one type, with Mr 24x 10^3 Da.

Transmission: AMV is efficiently transmitted by aphids in a non persistent manner and can cause epidemic outbreaks in many of its natural hosts. In grapevines, however, infections are scattered and occasional, suggesting that the virus spreads primarily through infected planting material.

Varietal susceptibility: Little information available. There may be differential susceptibility among cultivars.

Detection: AMV is mechanically transmissible to herbaceous hosts and can also be identified by ELISA and moleculat techniques in infected vines.

Control: Use of healthy material obtained by heat treatment.

2. Historical review

1973 **Bercks** *et al.*: First record of AMV infections and description of symptoms in German grapevines.

1975 **Bovey and Brugger**: AMV recorded from Switzerland in grapevine and transmitted by grafting to *V. rupestris* and the hybrid Grézot 1 x 5C.

1976 **Novak and Lanzova**: AMV infections recorded from hop and grapevine in Czechoslovakia.

1979 **Bovey and Cazelles**: AMV particles visualized in thin sectioned grapevine leaves. Virus elimination by treating 37 days at 37-38°C.

1978 **Jankulova**: AMV infections recorded from Bulgaria.

1981 **Beczner and Lehoczky**: AMV infections recorded from Hungary. Chardonnay and Veltliner rouge précoce identified as reliable indicators.

1985 **Francki:** Comprehensive review of the properties of AMV and other viruses with tripartite genome**.**

1993 **Martelli**: Yellow mottle suggested as the name for the disease caused by AMV in grapevines.

1993 **Akbas and Erdiller:** AMV infections recorded from Turkey**.**

3. References

Akbas B. and G. Erdiller, 1993. Researches on grapevine virus diseases and determination of their incidence in Ankara Turkiye. *Journal of Turkish Phytopathology* **22**, 55-63.

Beczner L. and J. Lehoczky, 1981. Grapevine disease in Hungary caused by alfalfa mosaic virus infection. *Acta Phytopathologica Academiae Scientiarum Hungaricae* **16**, 119-128.

Bercks R. , D. Lesemann and G. Querfurth, 1973. Über den Nachweis des *Alfalfa mosaic virus* in einer Weinrebe. *Phytopathologische Zeitschrift* **76**, 166-171.

Bovey R. and J.-J. Brugger, 1975. Le virus de la mosaïque de la luzerne sur la vigne. *Revue Suisse de Viticulture, Arboriculture, Horticulture* **7**, 63-65.

Bovey R. and O. Cazelles, 1979. Alfalfa mosaic virus on grapevine. *Proceedings 6th Meeting of ICVG, Cordoba 1976. Monografias INIA No.18* , 131-134.

Francki R.I.B., 1985. The viruses and their taxonomy. In: The Plant Viruses. Polyhedral Virions with Tripartite Genomes (R.I.B. Francki, ed.), 1-18. Plenum Press, New York .

Jankulova M., 1978. Investigation on certain viruses spread on grapevines in Bulgaria. *3rd International Congress of Plant Pathology, Munich 1978*, 39.

Martelli G.P. (ed.), 1993. Detection and Diagnosis of Graft Transmissible Diseases of Grapevines. FAO Publication Division, Rome, 263 pp.

Novak J.B. and J. Lanzova, 1976. Identification of alfalfa mosaic virus and tomato bushy stunt virus in hop (*Humulus lupulus* L.) and grapevine (*Vitis vinifera* subsp. *sativa* DC.Hegi) plants in Czechoslovakia. *Biologia Plantarum* **18**, 152-154.

GRAPEVINE LINE PATTERN

1. Description

Main synonyms: None.

Main symptoms: Leaves show bright yellow discolourations that form marginal rings, scattered spots or blotches, or maple leaf-like line patterns typically confined to the petiolar area, or the upper part of the blade, roughly following its contour. Vigour and yield are reduced. This disease is known to occur only in Hungary.

Agent: The putative agent, Grapevine line pattern virus (GLPV) a possible member of the genus *Ilarvirus,* has differently shaped particles, quasi spherical 25-30 nm in diameter to bacilliform 40 to 75 nm in length, and a multipartite genome.

Transmission: GLPV has no known vector, is seed-transmitted and spreads with diseased propagative materials.

Varietal susceptibility: No information. Several *V. vinifera* cultivars are susceptible.

Detection: GLPV is mechanically transmissible to herbaceous hosts. Graft transmission to cv. Jubileum 75.

Control: No information.

2. Historical rewiev

1985 **Francki:** Comprehensive review of the properties of AMV an other viruses with tripartite genome.

1987 **Lehoczky** *et al*.: Description of line pattern disease in Hungary. Evidence that a graft-and mechanically transmissible virus is associated with it.

1989 **Lehoczky** *et al*.: Purification and characterization of GLPV and suggestion that it is the causal agent of the disease.

1992 **Lehoczky** *et al*.: Evidence that GLPV is transmitted through grapevine seeds.

3. References

Francki R.I.B., 1985. The viruses and their taxonomy. In: The Plant Viruses. Polyhedral Virions with Tripartite Genomes (R.I.B. Francki, ed.), 1-18. Plenum Press, New York .

Lehozcky J., D. Boscia, J. Burgyan, M.A. Castellano, L. Beczner and G. Farkas, 1989. Line pattern, a novel virus disease of grapevine in Hungary. *Proceedings 9th Meeting of ICVG, Kiryat Anavim, Israel, 1987*, 23-30.

Lehoczky J., D. Boscia, G.P. Martelli, J. Burgyan, M.A. Castellano, L. Beczner and G. Farkas, 1987. Occurrence of the line pattern hitherto unknown virus disease of grapevine in Hungary. *Kertgazdasag* **19**, 61-79

Lehoczky J., G.P. Martelli and J. Lazar, 1992. Seed transmission of grapevine line pattern virus. *Phytopathologia Mediterranea* **31**, 115-116.

RODITIS LEAF DISCOLORATION

1. Description

Main synonyms: None.

Main symptoms: Symptoms are prominent in late summer and consist of yellow and/or reddish discolourations of the tissues along the veins, the interveinal areas, or variously extended sectors of the leaf blade, especially near the petiole Leaves are deformed in correspondence of discoloured sectors. Bunches are reduced in numbers, size and have low sugar content. The disease has been recorded only from Greece.

Agent: Symptomatic grapevines were reported to be doubly infected by GFLV and *Carnation mottle virus* (CarMV) the type species of the genus *Carmovirus,* family *Tombusviridae.* CarMV is an isometric virus 30 nm in diameter, has a monopartite RNA genome accounting for *c.* 18% of the particle weight, with Mol. wt 1.4×10^6 (4003 nt in size) and coat protein subunits of M_r 38×10^3 Da. However, according to more recent findings, GFLV may not be involved in the aetiology of the disease. By converse, *Grapevine virus B* (GVB), one of the putative agents of corky bark (rugose wood complex) has a very high association with diseased grapevines.

Transmission: No vector is known. The disease is graft-transmissible and spreads through infected propagating material.

Varietal susceptibility: No information.

Detection: Graft-transmission to *V. vinifera* cv. Mission. Viruses associated with the disease are readily transmitted by sap inoculation and can be detected by ELISA and molecular techniques.

Control: No information.

2. Historical review

1989 **Rumbos and Avgelis**: Roditis leaf discoloration described in Greece. Evidence of its graft-transmissibility.

1991 **Avgelis and Rumbos**: Double infection of diseased vines by GFLV and CarMV reported.

3. References

Avgelis A.D. and I.C. Rumbos, 1991. Carnation mottle virus isolated from vines affected with "Roditis leaf discoloration". *Proceedings 10th Meeting of ICVG, Volos 1990*, 437-443.

Rumbos I.C. and A.D. Avgelis, 1989. Roditis leaf discoloration -- a new virus disease of grapevine: symptomatology and transmission to indicator plants. *Journal of Phytopathology* **125**, 274-278.

GRAPEVINE ANGULAR MOSAIC

1. Description

Main synonyms: None

Main symptoms: Symptoms are chlorotic angular spots on the leaf blades, discoloration of tissues bordering the veins, crinkling and deformation of the leaves. Infected grapevines are stunted, decline gradually and some die. Flowers abortion results in straggly bunches with small wrinkled berries bearing non viable seeds. The disease has been recorded only from Greece.

Agent: Grapevine angular mosaic virus (GAMV), a virus with a tripartite RNA genome and a 30 kDa coat protein, reproduced the field syndrome in mechanically inoculated grapevine seedlings, thus is regarded as the agent of the disease. GAMV is molecularly related to a number of ilarviruses, the closest being *Tobacco streak virus* (TSV), but differs from GLPV, the only other ilarvirus reported from grapevine.

Transmission: GAMV is pollen-borne in herbaceous hosts and was able to infect pollinated plants. Whether this mechanism operates with grapevines has not been ascertained. Infected grafting material is likely to be responsible for virus dissemination.

Varietal susceptibility: No information

Detection: Indexing on cv. Baresana x Baresana, mechanical transmision to herbaceous hosts, and ELISA.

Control: No information

2. Historical review

2000 **Girgis** *et al.*: First record of GAMV.

2003 **Girgis** *et al.*: Evidence that GAMV is the agent of grapevine angular mosaic disease.

3. References

Girgis S.M., F. P. Bem, P.E. Kyriakopoulou, C.I. Dovas, A.P. Sklavounos, A. Avgelis, N. Katis, S. Tzortzakakis and M. Tsagris, 2000. A new ilarvirus isolated from grapevine in Greece. *Plant Disease* **84**, 1345.

Girgis S.M., F. P. Bem, P.E. Kyriakopoulou, C.I. Dovas, A. Avgelis and N. Katis, 2003. The etiology of a new virus disease: grapevine angular mosaic. *Extended Abstracts 14th Meeting of ICVG Locorotondo 2003,* 19.

YELLOW LINE PATTERN *(Rasperry bushy dwarf virus)*

1. Description

Main synonyms: None

Main symptoms: Grapevines of cv. Laski Rizling from Slovenia exhibit a yellow line pattern syndrome resembling the grapevine line pattern disease described from Hungary.

Agent: *Raspberry bushy dwarf virus* (RBDV) was isolated from symptomatic vines. RBDV, the type species of the genus *Idaeovirus* is a pollen and seed-borne virus with quasi spherical particles made up of a sigle type of coat protein subunits (Mr *c*. 30 x 10^3), a dimeter of about 33 nm, and a bipartite single-stranded RNA genome accounting for *c*. 24% of the particle weight and consisting of two functional species RNA-1 with Mol. wt of 2 x 10^6 Da (5.5 Kb in size) and RNA-2 with Mol. wt 0.8 x 10^6 Da (2.2 kb in size).

Transmission: In raspberry the virus infects progeny seedlings and pollinated plants through pollen. The vay of natural spreading in grapevine, if any, is unknow. However, infected propagative material can disseminate the RBDV.

Varietal susceptibility: No information

Detection: Mechanical transmission to herbaceous hosts, ELISA , and RT-PCR.

Control : No information

2. Historical review

1976 **Murant**: Description of RBDV**.**

2003 **Mavric** *et al*.: First record of RBDV in grapevine.

3. References

Mavric I., M. Virscek Marn and I. Zezlina, 2003. Raspberry bushy dwarf virus infection of grapevine in Slovenia. *Extended Abstracts 14th Meeting of IGVG, Locorotondo 2003,* 20

Murant A. F., 1976. Raspberry bushy dwarf virus. *CMI/AAB Description of Plant Viruses,* No. 165

B. Japanese diseases

GRAPEVINE BERRY INNER NECROSIS

1. Description

Main synonyms: None

Main symptoms: Infected grapevines have low vigor, delayed bud break and young shoots with short internodes and internal browning. Chlorotic mottling, rings and line patterns are shown by leaf blades. Ripening of bunches is delayed, berries are small and show external discolorations and internal necrosis. Grapevine berry inner necrosis has been reported only from Japan, representing the most important virus disease in Yamanashi Prefecture.

Agent: The disease agent is *Grapevine berry inner necrosis virus* (GINV), a mechanically transmissible definitive member of the genus *Trichovirus*. GINV has filamentous particles about 750 nm in length and a single-stranded RNA genome with Mol. wt of 7.5 x 10^6 Da, the 3' terminal region of which (2469 nts) has been sequenced.

Transmission: GINV is transmitted by grafting to grapevines and by mechanical inoculation to herbaceous hosts. The virus spreads naturally in the vineyards, being transmitted by the eryophid mite *Colomerus vitis.* Healthy vines of cvs Kyoho and Pione became naturally infected in the field within one year from planting.

Varietal susceptibility: Symptom severity varies with the cultivar. Almost all Japanese table grape cultivars derived from crosses with cv. Campbell Early are suscetible as well as cvs Takao, Kyoho, and Pione whereas cvs. Delaware, Koshu, and Kaiji are infected latently. Some rootstocks (e.g. *Vitis riparia* Gloire) are also susceptible.

Detection: Indexing on cvs Kyoho or Pione. GINV is mechanically transmissible to herbaceous hosts and can be identified by ELISA and moleculat techniques in infected vines.

Control: Use of tolerant cultivars in areas where the disease spreads epidemically.

2. Historical review

1984 **Tanaka:** Description of a mosaic disease in cv. Kyoho in Japan

1985 **Yanase:** Purification of a filamentous virus isolated from mosaic-diseased grapevines

1987 **Yanase and Terai:** Induction of mosaic symptoms in grapevines inoculated with the filamentous virus

1992 **Terai and Yanase**: Induction of berry internal necrosis in cv. Kyoho back inoculated with the filamentous virus isolated from mosaic-diseased grapevines. Disease re-named Grapevine berry inner necrosis

1993 **Terai** *et al*.: First account of grapevine berry inner necrosis disease in a non Japanese publication.

1997 **Yoshikawa** *et al.***:** Partial sequencing of GINV genome and assignement of the virus in the genus *Trichovirus*

2000 **Nishijima** *et al.*: An account of the varietal susceptibility to the disease and natural field spread

2000 **Kunigi** *et al*.: Experimental evidence that GINV is transmitted by the the grape erineum mite *Colomerus vitis*

3. References

Kunugi Y., S. Asari, Y. Terai and A. Shinkai 2000. Studies on the grapevine berry innner necrosis virus disease. 2. Transmission of grapevine berry inner necrosis virus by the grape erineum mite *Colomerus vitis* in Yamanashi. *Bulletin of Yamanashi Fruit Tree Experimental Station* **10**, 57-63.

Nishijima T., Y. Terai and Y. Kunugi, 2000. Studies on the grapevine berry innner necrosis virus disease. 1. Symptoms on vines, varietal susceptibility and natural spread. *Bulletin of Yamanashi Fruit Tree Experimental Station* **10**, 47-56.

Tanaka H., 1984. Mosaic symptoms on cv Kyoho. *Annals of the Phytopathological Society of Japan* **55**, 536

Terai Y. and H. Yanase, 1992. Induction of berry necrosis in Kyoho back-inoculated with the virus isolate from grapevine mosaic diseased clones and renaming to grapevine berry inner necrosis.*Annals of the Phytopathological Society of Japan* **58**, 617.

Terai, Y., Kunigi Y. and Yanase H., 1993. A new virus disease, grapevine berry inner necrosis with natural spread in Japan. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993*, 77-78

Yanase H., 1985. Purification of a filamentous virus isolated from grapevine berry inner necrosis and foliar mosaic. *Annals of the Phytopathological Society of Japan* **51,** 362.

Yanase H. and Terai Y., 1987. Back-transmission of a grapevine filamentous virus to grapevine seedlings and induction of foliar and berry symptoms in grapevine.*Annals of the Phytopathological Society of Japan* **53**, 423.

Yoshikawa N., H. Iida, S. Goto, H. Magome, T. Takahashi and Y. Terai, 1997. Grapevine berry inner necrosis, a new trichovirus: comparative studies with several known trichoviruses. *Archives of Virology* **142**, 1351-1363

GRAPEVINE STUNT

1. Description

Main synonyms: None.

Main symptoms: Spring vegetation is delayed, internodes are short, leaves are small, curled and, sometimes, with scorched margins. Inflorescences are undersized, fruit setting is impaired and bunches are few and shelled. Because of heat recovery, summer vegetation is apparently normal. The disease has only been reported from Japan.

Agent: An isometric, phloem-limited, non mechanically transmissible virus about 25 nm in diameter is consistently associated with diseased vines and regarded as the possible causal agent. This virus is serologically distinct from the putative agent of ajinashika disease.

Transmission: The disease is transmitted by the leafhopper *Arboridia apicalis*. Spread occurs also through infected propagative material.

Varietal susceptibility: No information. The disease is apparently restricted to the *V. vinifera* cv. Campbell Early.

Detection: Grafting to Campbell Early and ELISA using extracts from infected vine tissues.

Control: Use of disease-free material obtained through heat therapy.

2. Historical review.

1981 **Namba** *et al.*: A small isometric virus associated with stunt disease in Japan.

1982 **Hatamoto** *et al.*: Successful graft-transmission of stunt disease.

1984 **Hatamoto** *et al.*: Evidence that the disease is transmitted by the leafhopper *Arboridia apicalis*.

1986 **Namba** *et al.*: Purification and characterization of the virus associated with stunt disease. Evidence that it is not related to the presumed agent of ajinashika disease.

3. References

Hatamoto M., M. Fujii, S, Namba, S. Yamashita and Y. Doi, 1982. Graft transmissibility of grapevine stunt disease. *Annals of the Phytopathological Society of Japan* **48**, 396

Hatamoto M., M. Fujii, S. Namba, S. Yamashita and Y. Doi, 1984. Transmission of grapevine stunt disease by the grapevine leafhopper *Arboridia apicalis* Nawa. *Annals of the Phytopathological Society of Japan* **50**, 85

Namba S., S. Yamashita, Y. Doi and K. Yora, 1981. A small spherical virus associated with grapevine stunt disease. *Annals of the Phytopathological Society of Japan* **47**, 137

Namba S., T. Iwanami, S. Yamashita, Y. Doi and M. Hatamoto, 1986. Three phloem-limited viruses of grapevine: direct fluorescence detection. *In* Plant Virus Diseases of Horticultural Crops in the Tropics and Subtropics, p.109-126. FFTC Book series, No. 33. Food and Fertilizer Technology Center for the Asian and Pacific Region, Taipei, Taiwan (Reference 2951 in the *Review of Plant Pathology* **66**, 316, 1987). The same paper appears in *Taiwan Food and Fertilizer Technology Center Technical Bulletin* **92**, 1-17.

GRAPEVINE AJINASHIKA DISEASE

1. Description

Main synonyms: none.

Main symptoms: No appreciable symptoms are visible on the foliage of cv. Koshu nor any apparent reduction of vigour and yield. The berries, however, are pale-coloured and have a low sugar content, which makes the crop unmarketable. This condition gives the name to the disease which in Japanese means "unpalatable fruits with low sugar content". American rootstocks are infected without showing symptoms. The disease has only been reported from Japan.

Agent: The disease was reported to be caused by the concurrent infection of leafroll and fleck. However, an isometric, phloem-limited, non mechanically transmissible virus about 25 nm in diameter, consistently found in infected vines, was suggested as the possible causal agent.

Transmission: No vector is known. Dissemination is through infected propagative material.

Varietal susceptibility: No information. The disease seems to be restricted to *V. vinifera* cv. Koshu.

Detection: Graft transmission to cv. Koshu and ELISA using extracts from infected vine tissues.

Control: Use of disease-free material obtained through heat therapy.

2. Historical review.

1979 **Namba** *et al.*: First mention of ajinashika disease and report of the association with it of a non mechanically transmissible virus with isometric particles.

1980 **Terai and Yano**: Description of ajinashika disease and suggestion that it is caused by the concomitant infection of leafroll and fleck.

1986 **Namba** *et al.*: Partial characterization of the isometric virus associated with the disease and its detection by ELISA in infected vines. No relationship found with fleck.

1991 **Terai**: Additional report on ajinashika disease as derived from the combined effect of leafroll and fleck.

1991 **Namba** *et al.*: Further characterization of the isometric virus and claim that it is the putative agent of the disease.

3. References

Namba S., S. Yamashita, Y. Doi and K. Yora, 1979. A small spherical virus associated with the ajinashika disease of Koshu grapevine. *Annals of the Phytopathological Society of Japan* **45**, 70-73.

Namba S., T. Iwanami, S. Yamashita, Y. Doi and M. Hatamoto, 1986. Three phloem-limited viruses of grapevine: direct fluorescence detection. *Taiwan Food and Fertilizer Technology Center Technical Bulletin* **92**, 1-17.

Namba S., D. Boscia, S. Yamashita, T. Tsuchizaki, and D. Gonsalves, 1991. Purification and properties of spherical virus particles associated with grapevine ajinashika disease. *Plant Disease* **75**, 1249-1253.

Terai Y. 1991. Ajinashika disease: a combined effect of grapevine leafroll and grapevine fleck viruses on sugar content in the Japanese grape cultivar Koshu. *Proceedings 10th Meeting of ICVG, Volos 1990*, 67-70.

Terai Y. and R. Yano, 1980. Ajinashika disease of the grapevine cultivar Koshu in Japan. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980*, 15-19.

VIRUS-LIKE DISEASES

VIRUS-LIKE DISEASES

Several latent or semi-latent grapevine diseases are known, some of which have a clear-cut detrimental effect on the crop. All persist in propagative material and are transmitted by grafting. Their agents are still unknown, but some are heat-labile and can be eliminated by heat therapy.

ENATION DISEASE

1. Description

Enation disease of grapevine is one of the oldest known disorders of European grapes, its description dating back to the late 1800s

Main synonyms: Enationenkrankheit der Rebe (Germ.), maladie des énations (Fr.), malattia delle enazioni, omeoplasie crestiformi (Ital.).

Main symptoms: Affected vines show a delayed opening of the buds and a slow growth of the shoots in the spring, which gives a bushy aspect to the plant. Later in the year, growth tends to become normal again. Enations develop mostly on the underside of the leaves at the base of the shoots. They are outgrowths 2-3 mm high and 3-5 mm long or more, which run more or less parallel to the main veins. Basal leaves, whether they bear enations or not, are often mis-shapen, with a fanlike aspect and abnormal indentation. They are often thicker than normal, with prominent veins. Severely affected leaves drop prematurely. The basal internodes are short, irregular and mis-shapen, and often show longitudinal cracks between the nodes. Leaves developed later in the season are usually normal. The crop can be drastically reduced (up to about 50%, according to the cultivar) and is of poor quality. Symptom expression varies year by year, apparently in relation with climatic conditions. The disease has been reported from many European and extra-European countries

Agent: The etiology of enation disease is not yet clear. Graft transmission suggests that it is a virus disease, and the frequent occurrence of fanleaf virus in enation bearing vines supported the hypothesis that enation disease could be due to a severe strain of fanleaf virus. This hypothesis, however, has now been dismissed

Transmission: By vegetative propagation. The transmission by graft is rather erratic. The infectious agent of the disease perennates in propagating material.

Varietal susceptibility and sensitivity: There is little information available. Symptoms have been observed on many *V. vinifera* varieties in Europe, North America (California), North (Tunisia) and South Africa, Latin America (Venezuela), Australia and New Zealand. The varieties Panse Precoce, Primus, Italia, Riesling, Grenache and Tokay appear to be quite susceptible and develop severe symptoms when infected.

Detection: By observing the symptoms on the leaves and by indexing on LN 33 hybrid. However, as symptom expression is variable in successive years and graft transmission not 100 % successful, the absence of symptoms does not necessarily mean that the plant is healthy.

Control: Use of healthy material. There is no information on the possibility of curing this disease by heat treatment or meristem culture.

2. Historical review

1891 **Buchenau**: First description of enation disease of grapevine occurring in Germany, with drawings of symptoms.

1937 **Gigante** : Research on histological and cytological aspects of enations.

1954 **Hewitt**: Description of symptoms in California. The disease is perpetuated by vegetative propagation, and is probably due to a virus-like agent, but attempts to transmit it by graft or mechanical inoculation gave no results.

1966 **Graniti** *et al*.: Detailed description of macroscopic and microscopic symptoms of enation disease, historical account, attempts to transmit the disease by graft, with negative results. There is some evidence that enation can be carried in the rootstocks. Mechanical transmission tests were also negative, only fanleaf virus was recovered. The authors conclude that the disease is probably of European origin, and possibly caused by a virus. The possible role of fanleaf virus in the etiology of enation requires further investigation.

1966 **Refatti**: Hypothesis of a correlation between fanleaf and enation disease.

1966 **Martelli** *et al*.: Successful transmission of enation disease from diseased to healthy grapevine by graft strongly supports the hypothesis of a viral origin.

1968 **Brückbauer**: Description of symptoms of enation in Germany and confirmation of graft transmission of its agent.

1970 **Graniti and Martelli**: Review paper on enation. The authors discuss the hypothesis that enation is caused by a strain of fanleaf virus, but report on observations made in Australia where no fanleaf virus could be recovered from enation-affected vines.

1970 **McGechan**: Enation disease in Australia

1971 **Tekinel** *et al*.: Enation disease in Turkey

1973 **Hevin** *et al*.: Enation disease in France

1975 **Pozdena** *et al*.: Enation disease in Czechoslovakia

1978 **Avgelis and Xafis**: Enation disease in Greece

1979 **Prota and Garau**: Enation disease found in Sardinia. In the vineyards under observation, the proportion of diseased vines was highest in cv. Malvasia (10.5%), lowest in cv. Vernaccina (1.5%). The mean yield loss of diseased vines ranged from 17.4 to 48.3% . Confirmation of graft transmissibility of the disease.

1980 **Marinesku and Bondarchuk**: Enation disease in Moldova

1980 **Brückbauer**: Influence of enation disease on growth and yield of grapevine in West Germany.

1981 **Prota** *et al*.: More data on the effects of enation on the yield of cv. Italia in Sardinia. Enation-affected vines produced less than 50 % of the yield of healthy plants, but diseased vines which had not shown enation symptoms for several years had almost normal yields.

1983 **Nieder**: Enation disease in Austria

1989 **Garau** *et al*.: In experiments on graft transmission of enation disease aimed at determining the best indicator, the hybrid LN 33 was found to be the most sensitive and reliable indicator variety, although the rate of symptom expression does not exceed 30%

1996 **Credi**: Enation diseasae affects the vegetative vigour of cv. Trebbiano romagnolo and reduces the yield from 13% to 23% according to the severità of symptom expression.

1997 **Padilla** *et al*. ; Enation disease in Spain

1997 **Chabbouh and Savino**: Enation disease in Tunisia

3. References

Avgelis A. and C. Xafis, 1978. Presence of enations in Razaki grapevine in Crete (Greece). *Phytopathologia Mediterranea* **17**, 195

Brückbauer H., 1968. Beobachtungen und Untersuchungen über die Enationenkrankheit der Rebe. *Weinberg und Keller* **15**, 79-112.

Brückbauer H., 1980. Einfluss von Virusinfektionen auf Wachstum und Ertrag der Rebe. *Deutsches Weinbau-Jahrbuch* **31**, 145-152.
Buchenau F., 1891. Abnorme Blattbildungen. *Bericht der deutschen botanischen Gesellschaft* **9**, 326-332.
Chabbouh N and V. Savino, 1997. Occurrence of enation disease in Tunisia. *Extended Abstracts 12th Meeting of ICVG, Lisbon 1997*, 47.
Credi R., 1996. Effetto della malattia delle enazioni della vite sulla produzione e sullo sviluppo vegetativo della cv Trebbiano romagnolo. *Petria* **6**, 59-64.
Garau R., U. Prota and M. Cugusi,1989. Studies on reproduction of enation symptoms by grafting in Sardinia. *Proceedings 9th Meeting of ICVG, Kiryat Anavim, Israel, 1987,* 203-206.
Gigante R., 1937. Ricerche istologiche sulle omeoplasie crestiformi (Enations) delle foglie di vite affette da rachitismo. *Bolletino della Regia Stazione di Patologia Vegetale, Roma,* **n.s. 17**, 169-192.
Graniti A. and G.P. Martelli, 1970. Enations. *In*: Virus Diseases of Small Fruits and Grapevines (A Handbook), (N.W. Frazier N.W.), University of California, Division of Agricultural Sciences, Berkeley, 241-243.
Graniti A., G.P. Martelli and F. Lamberti, 1966. Enation disease of grapevine in Italy. *Proceedings International Conference on Virus and Vector on Perennial Hosts, with Special Reference to Vitis, Davis, California, 1965*, 293-306.
Hevin M, G.P. Gazeau, O. Leclair and M. Rives, 1973. Enation symptoms found in France. *Rivista di Patologia Vegetale* **S. IV**, **9**, 251-252
Hewitt W.B., 1954. Some virus and virus-like diseases of grapevines. *Bulletin of the California Department of Agriculture* **43**, 47-64.
Marinesku V.G. and V.V. Bondarchuk, 1983. Occurence of grapevine enations in the Moldavian SSR. In: Verderevskaya T.D. (ed.) Virus and mycoplasma-like diseases of fruit trees, small fruit and grapevine in Moldavia. Moldavian Research Institute of Horticulture Kishinev, 46-51.
Martelli G.P., A. Graniti, F. Lamberti and A. Quacquarelli, 1966. Trasmissione per innesto della "malattia delle enazioni" della vite. *Phytopathologia Mediterranea* **5**, 122-124.
McGechan J.K., 1970. Important virus diseases of grapevine in New South Wales. *Agricultural Gazette of New South Wales* **81**, 349-352.
Nieder G., 1983. Die Eantionenkrankheit der rebe erstmal auch in Osterreich nachgewiesen. *Pflanzenharzt* **36**, 97-98.
Padilla V., B. Garcia, I. Ita and F. Benayas, 1997. Grapevine enation disease in Murcia (Spain). *Extended Abstracts 12th Meeting of ICVG, Lisbon 1997*, 48.
Pozdena J. And G. Vanek, 1975. The research of the virus diseases of grapevine in CSSR. *Mededel. Facultet Landbouwwetenschap* (Gent) **40**, 823-827.
Prota U. and R. Garau, 1979. Enations of grapevine in Sardinia. *Proceedings 6th Meeting of ICVG, Cordoba, Spain, 1976. Monografias INIA* **18**, 179-189.
Prota U., Garau R. and M. Cugusi, 1981. Studies on some variable characters of grapevines affected by enation disease in Sardinia. *Phytopathologia Mediterranea* **20**, 7-12.
Refatti E., 1966. Su una possibile correlazione fra il virus del complesso dell'arricciamento e la malattia delle enazioni della vite. *Rivista di Patologia Vegetale*, **Ser.IV**, **2**, 207-217.
Tekinel N., M.S. Dolar, Z. Nas, H. Salih and Y. Salcan, 1971, A study of infectious degeneration (fanleaf) in vineyards of the Mediterranean region. *Bitki Koruma Buletin* **11**, 225-246.

VEIN MOSAIC

1. Description

The symptoms of vein mosaic have been confused for some time with those of fanleaf/yellow mosaic, but when fanleaf virus transmission to herbaceous hosts became possible, it was clear that vein mosaic was not caused by fanleaf virus. This disease is widespread and probably worldwide. A similar disease has been reported in Australia under the name of summer mottle. Vein mosaic appears to be of low economic importance.

Main synonyms: Mosaïque des nervures (Fr.), Adernmosaik (Germ.), Mosaico delle nervature (Ital.).

Main symptoms: Pale green mosaic affecting mostly the tissues adjacent to the main veins or the smaller ones, producing often a vein banding effect. In the most sensitive varieties, areas of the leaf blade may become necrotic, but these necroses do not affect the veins as it is the case with vein necrosis. Symptom expression seems to depend on climatic conditions.

Agent: Unknown. Mycoplasma-like organisms were supposed to be the cause of vein mosaic, but this hypothesis has not been confirmed.

Transmission: By graft and vegetative propagation. No vector known.

Varietal susceptibility and sensitivity: *Vitis riparia* Gloire de Montpellier is especially sensitive and is used as indicator. LN 33 is also sensitive. Several *V. vinifera* cvs. show symptoms (Syrah, Servant, Viognier, Chardonnay, Alphonse Lavallée, Muscat de Hambourg, Pearl of Csaba). Chasselas, Pinot, and Gamay apparently show little or no symptoms.

Detection: Indexing with *V. riparia* Gloire de Montpellier.

Control: Use of indexed material. The disease can be eliminated by heat therapy.

2. Historical review

1966 **Vuittenez** *et al*.: Observation of a type of mosaic of grapevines which appears to be independent of fanleaf virus.

1973 **Legin and Vuittenez**: Description of vein mosaic. Comparison of symptoms of fleck, vein mosaic and vein necrosis.

1973 **Pop**: Vein mosaic in Romania.

1976 **Marinesku and Bondarchuk**: Vein mosaic in Moldova.

1973 **Saric and Hranuelli**: Vein mosaic in Croatia.

1973 **Samonina** *et al*.: Vein mosaic in URSS.

1978 **Krake and Woodham**: Description in Australia of a systemic mottling syndrome which is expressed during summer on the leaves of some varieties, in the absence of any detectable virus. Symptoms are very similar to those of vein mosaic in Europe.

1979 **Abracheva**: Vein mosaic in Bulgaria.

1980 **Milkus** *et al*.: Vein mosaic in Ukraine.

1982 **Vuittenez and Stocky**: Electron microscope study of thin-sectioned tissues of leaves from *Vitis riparia* and *Vitis vinifera* cv. Ehrenfelser showing symptoms of vein mosaic. A number of cytological modifications primarily involving chloroplasts were observed along with the presence of bundles of filamentous structures resembling closterovirus particles. No claim is made that these putative viruses are connected with the disease.

1983 **Woodham and Krake**: Comparison of summer mottle and vein mosaic.

1985 **Kuniyuki**: Vein mosaic in Brazil.

1993 **Golino**: Vein mosaic in California.

2004 **Bonfiglioli:** Vein mosaic in New Zealand (unpublished).

3. References

Credi R., A.R. Babini and A. Canova, 1985. Occurrence of grapevine vein necrosis and grapevine vein mosaic in the Emilia-Romagna region (northern Italy). *Phytopathologia Mediterranea* **24**, 17-23.

Golino D.A., 1993. Potential interaction between rootstocks and grapevine latent viruses. *American Journal of Enology and Viticulture* **44**, 148-152.

Krake L.R. and R.C. Woodham, 1978. Grapevine summer mottle: a new graft-transmissible disease. *Vitis* **17**, 266-270.

Legin R. and A. Vuittenez, 1973. Comparaison des symptômes et transmission par greffage d'une mosaïque nervaire de *Vitis vinifera*, de la marbrure de *V. rupestris* et d'une affection nécrotique des nervures de l'hybride *Rup.-Berl.* 110 R. *Rivista di Patologia Vegetale*, **Ser. IV**, **9**, 57-63.
Kuniyuki H., 1985. Adverse effect of light and of high temperature on symptom expression of grapevine vein mosaic in Sao Paulo. *Summa Phytopathologica* **11**, 48-49
Marinesku V.G. and V.V. Bondarchuk, 1976. La mosaique des nervures, maladie à virus de la vigne. *Vinogradr. Vinodel. Moldavii* **31**, 41-42.
Pop I.V., 1973. Grapevine vein mosaic. *Rivista di Patologia Vegetale*, **S. IV**, **9,** 243-250
Samonina I.N., B.N. Milkus, A.V. Krylov and V.V. Krylova, 1973. A grapevine virus disease in the Primorye territory, URSS. *Rivista di Patologia Vegetale* **S IV 9**, 68-72.
Saric A. and Hranuelli T., 1977. Investiation on grapevine viruses in the SR Croatia. *Proceedings of the Conference on Excoriosis and Virus Diseases of Grapevine, Mostar 1977*, 149-141.
Vuittenez A., R. Legin and J. Kuszala, 1966. Observations sur une Mosaïque de la Vigne, probablement indépendante du virus du Court-noué. *Annales des Epiphyties* **17**, Numéro hors série, 67-73.
Vuittenez A. and G. Stocky, 1982. Ultrstructure de vignes infecteés par deux maladies de type viral: la mosaique des nervures, ou la “feuille rouge”. *Proceedings 7th Meeting of IGCV, Niagara Falls 1980*, 191-204.
Woodham R.C. and L.R. Krake, 1983. A comparison of grapevine summer mottle and vein mosaic diseases. *Vitis* **22**, 247-252.

SUMMER MOTTLE

Summer mottle, an Australian disease, resembles in some respects the European vein mosaic and the Greek Roditis leaf discolouration (see under Minor virus diseases). Symptoms of vein mosaic develop under mild weather conditions and fade during hot weather, whereas the opposite occurs with summer mottle. Roditis leaf discolouration and summer mottle have similarities suggesting that they may be the same disease.

1. Description

Main synonyms: None.

Main symptoms: Pale green to yellowish dicolourations of the tissues adjacent to the main or secondary veins, producing a feathering or banding effect. These symptoms appear in summer and persist through the autumn. Bunches of infected cvs Sideritis and Cabernet sauvignon are fewer, poorly developed and with small berries.

Agent: Unknown, suspected to be a virus or a viroid.

Transmission: No vector is known. Spread is through infected propagative material but is has also been observed between adjacent vines

Varietal susceptibility: No grapevine tested was immune to infection. *V. rupestris* and LN33 are infected symptomlessly. However, several European grape cultivars show symptoms.

Detection: Graft transmission to a number of cvs., e.g. Cabernet franc, Cabernet sauvignon, Mission, Mataro. Symptoms show on vegetative growth that develops at temperatures in excess of 30 °C.

Control: Use of disease-free propagating material obtained by culture of fragmented shoot apices.

2. Historical review

1978 **Krake and Woodham**: Description of summer mottle in Australia. Evidence that the disease is graft-transmissible.

1982 **Barlass** *et al*.: Elimination of the disease agent by culturing fragmented shoot apices.

1983 **Woodham and Krake**: Comparative graft transmission trials demonstrate that summer mottle

differs from vein mosaic. Possible viroidal etiology put forward.

1999 **Krake** *et al.*: Suggestion that summer mottle and Roditis leaf discolouration are the same disease

3. References

Barlass M., K.G.M. Skene, R.C. Woodham and L.R. Krake, 1982. Regeneration of virus-free grapevines using *in vitro* apical culture. *Annals of Applied Biology* **101**, 291-295.

Krake L.R. and R.C. Woodham, 1978. Grapevine summer mottle: a new graft-transmissible disease. *Vitis* **17**, 266-270.

Krake L.R., N.S. Scott, M.A. Rezaian and R.H. Taylor, 1999. Graft-transmissible Diseases of Grapevines, 70-74. CSIRO Publishing, Collingwood, Australia.

Woodham R.C. and L.R. Krake, 1983. A comparison of grapevine summer mottle and vein mosaic diseases. *Vitis* **22**, 247-252.

VEIN NECROSIS

Although vein necrosis is currently regarded as a disease in its own right, recently an association exceeding 95% has been experimentally observed between *Grapevine rupestris stem pitting-associated virus* (GRSPaV) and vines of *V. rupestris* x *V. berlandieri* 110 Richter (110R) with vein necrosis symptoms. This strongly supports the hypothesis that vein necrosis is a specificic reaction of the rootstock 110 R to GRSPaV infection.

1. Description

Vein necrosis has probably a worldwide distribution. So far, its economic importance has not been assessed, and the only *Vitis* species that is clearly affected is the rootstock 110 R.

Main synonyms: Nécrose des nervures (Fr.), Adernnekrose (Germ.), necrosi delle nervature (Ital.).

Main symptoms: On the rootstock 110 R., growth is much reduced and necrosis of the leaf veins appears, at first on the leaves at the base of the shoots, later on younger leaves as they develop. Necrotic reactions are best seen on the lower face of the leaf blade. Also the tendrils and many shoots can necrotize, especially under greenhouse conditions, and some infected plants may die.

Agent: Suspected to be a virus, most likely GRSPaV. Mycoplasma-like organisms have been observed in the phloem of symptomatic vines, but their etiological relationship with the disease has not been proven.

Transmission: By grafting and vegetative propagation. No vector known.

Varietal susceptibility and sensitivity: The rootstock 110 R is most sensitive. Little is known about sensitivity of other *Vitis* species, varieties or hybrids. Many grapevine varieties and rootstocks are infected symptomlessly.

Detection: By grafting on 110 R. RT-PCR with virus specific primers and Western blot with an antiserum to recombinant coat protein of GRSPaV allow sensitive and reliable detection of this virus in symptomatic 110 R plants.

Control: Use of indexed planting material. The agent of vein necrosis can be eliminated by heat therapy.

2. Historical review

1973 **Legin and Vuittenez**: Discovery and description of this virus-like disease while searching for indicators for fleck.

1978 **Milkus and Kalashyan**: Mycoplasma-like organisms found in phloem tissues of vines with vein necrosis. Cause-effect relationships between MLOs and the disease has never been ascertained.

1978 **Martelli** *et al.:* Vein necrosis in Italy and Bulgaria

1984 **Woodham R.C. and L R. Krake**: Vein necrosis in Australia

1985 **Savino** *et al*.: In southern Italy, the incidence of vein necrosis in visually selected stocks of table and wine grape varieties is on the average 71 %. Heat therapy reduced this proportion to 35.5 %, but did not eliminate the disease entirely.

1986 **Lehoczky** *et al*.: Vein necrosis in Hungary

1988 **Gursoy**: Vein necrosis in Turkey

1989 **Rumbos**: Vein necrosis in Greese

1992 **Martelli** *et al*.: Vein necrosis in Malta

1993 **Golino**: Vein necrosis in California

1994 **Khun:** Vein necrosis in Brazil

2004 **Bouyahia** *et al*.: An association exceeding 95% observed between GRSPaV and 110R vines showing vein necrosis symptoms in indexing trials. No veing necrosis observed in 110R top grafted on GRSPaV-free *V. rupestris*. Suggestion than vein necrosis is a specificic reaction of 110R to GRAPaV.

3. References

Bouyahia H., D. Boscia, V. Savino, P. La Notte, C. Pirolo, M.A. Castellano, A. Minafra and G.P. Martelli, 2004. Is Grapevine vein necrosis a reaction to *Grapevine rupestris stem pitting-associated virus*? *Journal of Plant Pathology* **86**, 301.

Golino D.A., 1993. Potential interaction between rootstocks and grapevine latent viruses. *American Journal of Enology and Viticulture* **44**, 148-152.

Gursoy Y.Z., 1988. Vein necrosis: new virus-like disease in Turkish vineyards. *Journal of Turkish Phytopathology* **17**, 43-45

Kuhn G.B., 1994. Vein necrosis a disease that is latent in most grapevine cultivars of the State of Rio grande do Sul. *Fitopatologia Brasileira* **19**, 79-83

Legin R. and A. Vuittenez, 1973. Comparaison des symptômes et transmission par greffage d'une mosaïque nervaire de *Vitis vinifera*, de la marbrure de *V. rupestris* et d'une affection nécrotique des nervures de l'hybride *Rup.-Berl.* 110 R. *Rivista di Patologia Vegetale*, **Ser. IV**, **9**, 57-63.

Lehozcky J., G. Farkas, J. Lazar, 1986. Detection of vein necrosis virus (GVNV) in the vines of cultivated grape varieties. *Kergazdasag* **18** (**4)**, 59-65.

Martelli G.P., V. Savino, P. Abracheva and B. Rosciglione, 1978. Necrosi delle nervature della vite in Italia e Bulgaria. *Informatore Fitopatologico* **28** (**10**), 3-5

Martelli G.P., H. Galea Souchet, D. Boscia and V. Savino, 1992. Viruses of grapevine in Malta. *Bulletin OEPP/EPPO Bulletin* **22**, 606-612.

Milkus B.N. and J.A. Kalashyan, 1978. Mycoplasma-like bodies in phloem tissue of grapevine affected by vein necrosis. *Izvestiya Akademii nauk Moldav. SSR*, ser. *Biol. i Chim Nauka* **1**, 29-30.

Rumbos I C., 1989. Vein necrosis, fleck and leafroll in *Vitis vinifera* and grapevine rootstocks in central Greece. *Phytoparasitica* **17**, 61

Savino V., D. Boscia and G.P. Martelli, 1985. Incidence of some graft-transmissible virus-like diseases of Grapevine in visually selected and heat-treated stocks from Southern Italy. *Phytopathologia Mediterranea* **24**, 204-207.

Woodham R.C. and L.R. Krake, 1984. Grapevine vein necrosis disease detected in rooststocks in Australia. *Journal of the Australian Institute of Agricultural Sciences* **50**, 58-60.

VIROID
(Yellow speckle)

VIROIDS

Viroids, the non coding genomes, are subviral pathogerns endowed with autonomous replication in their hosts. They are made up of a non encapsidated circular RNA of 246-375 nucleotides, a size much smaller than that the smallest viral genome. Like viruses, viroids are classified in families, genera and species. Two families are known, *Pospiviroideae* and *Avsunviroideae* whose significant discriminating traits are the presence of a central conserved region in the secondary structure and nuclear replication (*Pospiviroideae*) or a branched secondary structure lacking the central conserved region, presence of ribozymes, and plastidial replication (*Avsunviroideae*). Five grapevine-infecting viroids are known, all of which belong in the family *Pospiviroideae: Grapevine yellow speckle viroid 1* (GYSVd-1), *Grapevine yellow speckle viroid 2* (GYSVd-2), *Australian grapevine viroid* (AGVd), *Hop stunt viroid* grapevine strain (HSVd-g), *Citrus exocortis viroid* grapevine strain (CEVd-g). Only GYSVd-1 and GYSVd-2 are pathogenic, inducing a disease called yellow speckle.

References

Hadidi A., R. Flores, J.W. Randles and J.S. Semancik (eds.), 2003. Viroids. CSIRO Publishing, Collingwood, 370 pp.

YELLOW SPECKLE

1. Description

Main synonyms: Moucheture jaune (Fr.), picchiettatura gialla (Ital.), Gelbsprenkelung der Rebe (Germ.).

Main symptoms: Few to many minute chrome yellow spots or flecks scattered over the leaf surface, or gathering along the main veins to give a vein banding pattern. These symptoms appear in the height of summer on a limited number of mature leaves and persist for the rest of the vegetative season. The symptomatology varies depending on the cultivar, plant age, climatic conditions, and perhaps the type of infecting viroidal sequence variant. Very often, infected vines are symptomless or show symptoms erratically. Vein banding, a disease characterized by chrome yellow flecks localized along the main veins of mature leaves and progressing into the interveinal areas, thought to be elicited by a specific strain of GFLV, was demonstrated to be caused by a co-infection by yellow speckle viroids and GFLV. Sometimes, however, vein banding-like symptoms can be observed in vines infected only by yellow speckle viroids.

Agents: Two distinct viroids, GYSVd-1 and GYSVd -2 cause the disease individually or in combination. GYSVd 1 and GYSVd 2 are made up of 366 and 363 nucleotides (nt), respectively and both belong in the genus *Apscaviroid.* Both these viroids wer first isolated in Australia, respectively from a cv. Cabernet franc and a cv. Kyoto vine with yellow speckle symptoms. Neither of them is able to replicate in herbaceous hosts but both were succesfully inoculated to grapevine seedlings reproducing the yellow speckle syndrome. GYSVd-1 and GYSV-2 have a worldwide distribution

The three additional viroids that have been detected in grapevines, HSVd-g, CEVd-g, and AGVd, are not associated to any specific symptomatology.

AGVd, a member of the genus *Apscaviroid,* has a genome 369 nt in size. It was isolated in Australia from a grapevine that contained also other viroids and was distinguished from these because it replicated in cucumber and tomato. AGVd has been reported from Australia, the USA, and Tunisia.

HSVd-g, the type species of the genus *Hostuviroid*, has a genome 297 nt in size. It was first detected in Japan and transmitted to cucumber and grapevine seedlings in which, however, it did not induce symptoms. Interestingly, phylogenetic analysis of hop and grapevine isolates of HSVd has provided evidence that the viroid that causes hop stunt disease in Japan is a variant of HSVd-g. The suggestion is that HSVd moved from grapevine to hop probably 50-60 ago in the Nagano and/or Fukushima prefectures in which it is not uncommon to find hop gardens next to vineyards. HSVd-g has been recorded from Australia, Europe, north and south America, and may have a worldwide distribution.

CEVd-g, a member of the genus *Pospiviroid*, has a genome 369 nt in size. It was first recoverd in Spain from symptomless grapevines. Although CEVd is present in most, if not all citrus-growing countries, its grapevine strain so far has only been recorded from Australia and the USA, besides Spain.

Transmission: No vector is known. Natural dissemination takes place by mechanical inoculation through surface-contaminated cutting tools during management operations, grafting, and distribution of infected propagating material. This latter way of dissemination has been considered as more efficient and frequent than mechanical transmission. Experimental transmission through dodder is possible. Seed transmission has been demostrated for GYSVd-1, GYSVd-2, CEVd-g and AGVd.

Varietal susceptibility: All *Vitis* species, hybrids and cultivars appear to be susceptible. In the great majority of grapevine germplasm infection is latent.

Detection: Some viroids can be transmitted mechanically to herbaceous hosts but this is not an efficient detection method. Polyacrylamide gel electrophoresis has been used extensively before the advent of nucleic acid-based assays (hybridization and RT-PCR) which constitute far better detection and identification tools.

Control: Use of viroid-free propagative material obtained by meristem tip culture.

2. Historical review

1972 **Taylor and Woodham**: First description of yellow speckle as a graft transmissible disease separate from chromogenic disorders induced by grapevine fanleaf virus (GFLV).

1975 **Mink and Parsons**: Yellow speckle can be detected by growing vines for 2-3 weeks at 32 °C under continuous illumination.

1978 **Abracheva** *et al*.: A disease of cv. Rcatzitelli resembling yellow speckle reported from Bulgaria.

1982 **Barlass** *et al*.: Yellow speckle eliminated by *in vitro* apical culture.

1982 **Woodham and Krake**: Evidence of field spread of yellow speckle.

1983 **Krake and Woodham**: Evidence that the agent of yellow speckle is implicated in the etiology of vein banding, a disease formerly thought to be caused by a chromogenic strain of GFLV.

1983 **Woodham and Krake**: Artificial transmission of grapevine leafroll, yellow speckle and fleck through dodder. For yellow speckle, the authors consider the results as inconclusive, as the disease may have spread naturally.

1984 **Shikata** *et al*.: First recovery of a viroid from grapevines in Japan.

1985 **Sano** *et al*.: The Japanese grapevine viroid identified as a strain of hop stunt viroid.

1985 **Flores** *et al*.: Two new viroids, one of which identified as the agent of citrus exocortis, found in grapevine accessions from Europe and California.

1985 **Prota** *et al*.: A vein banding condition of cv. Cannonau not associated with the presence of GFLV reported from Italy.

1987 **Semancik** *et al*.: Evidence that viroids are widespread in grapevines. Three different viroids found in a number of accessions in a Californian varietal collection.

1987 **Garcia Arenal** *et al.*: Reconstruction of the secondary structure of CEVd-g

1988 **Szychowski** *et al*.: Successful mechanical transmission of viroids to grapevines.

1988 **Rezaian** *et al*.: Four viroids found in Australian grapevines. First identification of AGVd

1988 **Koltunow and Rezaian**: Identification and sequencing of grapevine yellow speckle viroid.

1988 **Duran-Vila** *et al*.: Improvement of meristem tip culture technique for the production of viroid-free grapevines.

1989 **Martelli**: Brief review of grapevine viroid situation supporting the idea that vein banding is primarily induced by viroidal rather than GFLV infection.

1989 **Koltunow and Rezaian**: Description and sequencing of grapevine viroid 1B (later renamed Grapevine yellow speckle viroid 2).

1989 **Koltunow** *et al*.: Evidence that two related viroids (GYSVd 1 and GYSVd 2) can cause yellow speckle disease independently.

1990 **Minafra** *et al*.: A survey of viroids of grapevine in Italy. The occurence is reported of HSVd, GYSVd-1 and GYSVd-2

1990 **Rezaian**: Complete nucleotide sequencing of AGVd. Molecular evidence that this viroid originated from recombination between five different viroids among which GYSVd-1 and GYSVd-2

1991a,b **Szychowski** *et al*.: Extensive comparative analysis of grapevine accessions from California and Europe reveal a similar pattern of viroid distribution.

1991 **Semancik and Szychowski**: There are two classes of grapevine viroids:
(i) apparent viroids, which can readily be isolated directly from grapevines;
(ii) enhanced viroids, which require amplification in an alternate host.

1991 **Rezaian** *et al*.: Structural analysis reveals that five distinct viroids infect commercial grapevine varieties. These viroids, according to an international agreement reached during the 10th Meeting of ICVG held in 1990 at Volos, Greece, are to be named as follows:
Hop stunt viroid grapevine strain (HSVd-g),
Citrus exocortis viroid grapevine strain (CEVd-g),
Grapevine yellow speckle viroid 1 (GYSVd 1),
Grapevine yellow speckle viroid 2 (GYSVd 2)
Australian grapevine viroid (AGVd).

1996 **Wang** *et al*.: First record of grapevine viroids in China.

1997 **Flores** *et al.:* Review of viroids.

1999 **Wan and Symons**: Transmission of GYSVd-1, GYSVd-2, CEVd-g and AGVd via grape seeds.

2001 **Sano** *et al*.: Suggestion that the viroid causing stunting in hop (HSVd) originated from grapevines, based on phylogenetical analysis of hop and grapevine isolates of this viroid.

2003 **Little and Rezaian**: Updated review of grapevine viroids.

2003 **Elleuch** *et al*.: First report of AGVd in the Mediterranean.

3. References

Abracheva P., G.P. Martelli, A. Quacquarelli and V. Savino, 1978. A possible virus disease of Rcatzitelli vines in Bulgaria. *Proceedings of the 6th Meeting of ICVG, Cordoba, Spain, 1976. Monografias INIA* **18,** 127-130.

Barlass M., K.G.M. Skene, R.C. Woodham and L.R. Krake, 1982. Regeneration of virus-free grapevines using *in vitro* apical culture. *Annals of Applied Biology* **101**, 291-295.

Duran-Vila N., J. Juarez and J.M. Arregui, 1988. Production of viroid-free grapevines by shoot tip culture. *American Journal of Enology and Viticulture* **39**, 217-220.

Elleuch A., M. Marrakchi, J.P. Perreault and H. Fakhfakh, 2003. First report of Australian grapevine viroid from the Mediterranean region. *Journal of Plant Pathology* **85**, 45-57.

Flores R., N. Duran-Vila, V. Pallas and J.S. Semancik, 1985. Detection of viroid and viroid-like RNAs from grapevine. *Journal of General Virology* **66**, 2095-2102.

Flores R., F. Di Serio and C. Hernadez, 1997. Viroids: the non coding genomes. *Seminars in Virology* **8**, 65-73.
Garcia Arenal F., V. Pallas and R. Flores, 1987. The sequence of a viroid from grapevine closely related to to severe isolates of citrus exocortis viroid. *Nucleic Acids Research* **15**, 4203-4210.
Koltunow A.M., L.R. Krake, S.D. Johnson and M.A. Rezaian, 1989. Two related viroids cause grapevine yellow speckle disease independently. *Journal of General Virology* **70**, 3411-3419.
Koltunow A.M. and M.A. Rezaian, 1988. Grapevine yellow speckle viroid: structural features of a new viroid group. *Nucleic Acids Research* **16**, 849-864.
Koltunow A.M. and M.A. Rezaian, 1989. Grapevine viroid 1B, a new member of the apple scar skin viroid group contains the left terminal region of tomato planta macho viroid. *Virology* **170**, 575-578.
Krake L.R. and R.C.Woodham, 1983. Grapevine yellow speckle agent implicated in the aetiology of vein banding disease. *Vitis* **22**, 40-50.
Little A. and M.A. Rezaian, 2003. Grapevine viroids. In: Viroids (A. Hadidi, R. Flores, J.W. Randles and J.S. Semancik (eds.), 195-206. CSIRO Publishing, Collingwood, 370 pp.
Martelli G.P., 1989. Infectious diseases of grapevines. Nature, detection, sanitation and situation in the Arab countries. *Arab Journal of Plant Protection* **7**, 210-219.
Minafra A., G.P. Martelli and V. Savino, 1990. Viroids of grapevines in Italy. *Vitis* **29**, 173-182.
Mink G.I. and J.L. Parsons, 1975. Rapid indexing procedures for detecting yellow speckle disease in grapevines. *Plant Disease Reporter* **59**, 869-872.
Prota U., R. Garau, M. Cugusi and M. Dore, 1985. Investigations on a vein banding disease of Grapevine in Sardinia. *Phytopathologia Mediterranea* **24**, 24-28.
Rezaian M.A., A.M. Koltunow and L.R. Krake, 1988. Isolation of three viroids and a circular RNA from grapevines. *Journal of General Virology* **69**, 413-422.
Rezaian M.A., 1990. Australian grapevine viroid - evidence for extensive recombination between viroids. *Nucleic Acids Research* **10**, 5587-5598.
Rezaian M.A., A.M. Koltunow, L.R. Krake and K.G. Skene, 1991. Grapevine viroids. *Proceedings 10th Meeting of ICVG, Volos, Greece, 1990*, 297.
Sano T., I. Uyeda, E. Shikata, T. Meshi, T. Ohno and Y. Okado, 1985. A viroid-like RNA isolated from grapevine has high sequence homology with hop stunt viroid. *Journal of General Virology* **66**, 333-338.
Sano T., R. Mimura and K. Ohshima, 2001. Phylogenetic analysis of hop and grapevine isolates of hop stunt viroid supports a grapevine origin for hop stunt disease. *Virus Genes* **22**, 53-59.
Semancik J.S., R. Rivera-Bustamante and A.C. Goheen, 1987. Widespread occurrence of viroid-like RNAs in grapevines. *American Journal of Enology and Viticulture* **38**, 35-40.
Semancik J.S. and J.A. Szychowski, 1991. Comparative properties of viroids of grapevine origin isolated from grapevines and alternate hosts. *Proceedings of the 10th Meeting of ICVG, Volos, Greece, 1990*, 270-278.
Shikata E., T. Sano and I. Uyeda, 1984. An infectious low molecular weight RNA was detected in grapevines by molecular hybridization with hop stunt viroid cDNA. *Proceedings of the Japanese Academy of Science* **60(B)**, 202-205.
Szychowski J.A., J.P. Doazan, P.Leclair, M. Garnier, R. Credi, A. Minafra, N. Duran-Vila, J.A. Wolpert and J.S. Semancik, 1991a. Relationships among grapevine viroids from sources maintained in California and Europe. *Proceedings of the 10th Meeting of ICVG, Volos, Greece, 1990*, 287-288.
Szychowski J.A., J.P. Doazan, P. Leclair, M. Garnier, R. Credi, A. Minafra, N. Duran-Vila, J.A. Wolpert and J.S. Semancik, 1991b. Relationship and patterns of distribution among grapevine viroids from California and Europe. *Vitis* **30**, 25-36.
Szychowski J.A., A.C. Goheen and J.S. Semancik, 1988. Mechanical transmission and rootstock reservoirs as factors in the widespread distribution of viroids in grapevines. *American Journal of Enology and Viticulture* **39**, 213-216.
Taylor R.H. and R.C. Woodham, 1972. Grapevine yellow speckle -- a newly recognized graft-transmissible disease of *Vitis. Australian Journal of Agricultural Research* **23**, 447-452.
Wan C.W. and R.H. Symons, 1999. Transmission of viroids via grape seeds. *Journal of Phytopathology* **147**, 285-291
Wang G.P., N. Hong, Z. Zhang, S. Zhang and X.Jiang, 1996. The field investigation of virus and viroid diseases of grapevine and stone fruit trees in Shandong and Liaoning province, China. *China Fruits* **4**, 39-41.
Woodham R.C. and L.R. Krake, 1982. Grapevine yellow speckle disease: studies on natural spread observed in the field. *Vitis* **21**, 337-345.
Woodham R.C. and L.R. Krake, 1983. Investigations on transmission of grapevine leafroll, yellow speckle and fleck diseases by dodder. *Phytopathologische Zeitschrift* **106**, 193-198.

YELLOWS

GRAPEVINE YELLOWS: GENERAL PROPERTIES

1. Description

Grapevine yellows (GYs) are a group of severe phytoplasma-induced diseases occurring worldwide on a number of *Vitis vinifera* cultivars. The different GYs cannot be differentiated on the basis of symptoms. The first GY to be recorded was Flavescence dorée in France in the 1950's. However, it was mainly in the 1990's that GYs could be differentiated, after their aetiology had been understood and molecular methods for the characterization of associated phytoplasmas had been developed. The main characteristics of GY diseases are important losses or damage to the yield, a severe decline of the vine, persistence of infection in dormant plant material, and transmission by specific leafhopper or planthopper vectors. The occurrence and spread of a particular GY mainly depend on the presence of efficient vectors in the vineyards or their close vicinity. However, vector species have not been identified for all GY diseases.

Main synonyms: Flavescence dorée-like disease, Vergilbungskrankheit, Golden flavescence, Flavescenza dorata, Amarilliamento.

Main diseases: Flavescence dorée, Flavescenza dorata, Bois noir, Vergilbungskrankheit, Schwarzholzkrankheit, Legno nero, Palatinate grapevine yellows, Australian grapevine yellows, North American grapevine yellows.

Main symptoms: Young shoots of affected *Vitis vinifera* are weak with short internodes and frequent necrosis of terminal buds. Downwards rolling of the leaves and sectorial discolorations of the blades, involving also the main veins, develop on leaves. Red-berried varieties show reddish to purple discolorations while white-berried varieties show golden to chlorotic discolorations. Leaf blades are crispy and brittle. Bunches wither in early summer or berries shrivel later in season, resulting in reduction of quantity and quality of the crop. Characteristic symptoms in the end of summer are a partial or total lack of lignification which may affect individual canes and shoots or the whole plant, depending on the particular disease and other conditions such as variety, climate and infection pressure. Rubbery canes fall downwards with a typical "weeping" aspect. Quite often, autumn fall of leaves occurs later on diseased than on healthy vines. Severely infected stocks decline rapidly.

Agents: Phytoplasmas were called Mycoplasma-like organisms (MLOs) from their discovery in 1967 until the International Committee of Systematic Bacteriology (ICSB) replaced this name with the term phytoplasma in 1993. They are wall-less, phloem-restricted bacteria that belong to the class Mollicutes.

Phytoplasma cells are vesicular rounded bodies, variable in shape and size (50-1000 nm in diameter) that circulate in phloem sieve tubes and can be seen in the electron microscope passing through pores of sieve plates. However, their movement is slow and their distribution in the plant is erratic. Their titre is usually very low in grapevine, though some sieve tubes may appear crowded with phytoplasma cells in the electron microscope. Nevertheless, all organs of the plant may be infected, including roots, canes, shoots, buds, inflorescence and berries, but not seeds.

Phytoplasmas have the smallest genome reported for procaryotic organisms (560 2,200 kbp). Nonetheless, their genome is poorly known because they cannot be cultivated. Phytoplasmas form a homogeneous phylogenetic clade subdivided into about 20 groups and subgroups, based mainly on sequence similarity of their rRNA genes and of a few other genes, such as the ribosomal protein genes or the elongation factor Tu, in addition to other criteria such as symptomatology, host range, and serology. In 1997, the term phytoplasma has become the genus name of these plant pathogenic agents under the provisional taxonomic status *Candidatus*. Several *Candidatus* phytoplasma species have been recently described.

GY agents have been identified in no less than 5 groups of phytoplasma clade. Flavescence dorée (FD) and Palatinate Grapevine Yellows (PGY) phytoplasmas belong to group 16SrV (or Elm yellows group). Stolbur phytoplasmas, associated to Bois noir (BN), Vergilbungskrankheit (=Schwarzholzkrankheit) or Legno nero and also one of the agents of Australian grapevine yellows (*Candidatus* Phytoplasma australiense) belong to group 16SrXII (or stolbur group). Phytoplasmas in the 16SrIII group (or X-disease group) are associated with grapevine yellows in North America and Israel. *Candidatus* Phytoplasma australasia, a phytoplasma belonging to group 16SrII (or peanut witches'

broom group) is a second agent of Australian grapevine yellows. Phytoplasmas in the 16SrI group (or aster yellows group) are associated with endemic GY diseases in several countries of Europe and in the USA. Double infections have been reported.

Transmission: Phytoplasmas are vectored by hemipters, mainly hoppers (cicadellids or cixiids) or psyllids. The three ascertained vectors of GY diseases are univoltine leafhopper or planthopper species. Phytoplasmas persist in their vectors but vertical transmission to the progeny of infected gravid females is not possible or scarce.

Phytoplasmas also persist in vine stocks during winter. Propagation material may be the infection source for long distance dissemination of GY diseases. Though the rate of transmission to plant material can be very low, such type of transport is risky when potential insect vector species occur on the site of planting.

Varietal susceptibility and sensitivity: Numerous *V. vinifera* cultivars have been reported to be sensitive or very sensitive to GYs in all countries where infection occurs. It is probable that the feeding preference of insect vectors, as well as their feeding activity, influence symptom expression and differential sensitivity of cultivars. Some cultivars such as Chardonnay, Pinot noir, Cabernet Sauvignon, Riesling and also numerous local varieties, are very sensitive to all GY diseases. The situation of cv Syrah is controversial. Full recovery and transient remission of symptoms have been observed in low and medium sensitive cultivars, which allows restoring the sanitary status of affected vineyards when the vector activity is controlled. These phenomena also depend on the disease complex (phytoplasma, vector and abundance of reservoirs).

Vitis riparia and American rootstock varieties and hybrids do not show typical symptoms of GY. Infection of rootstocks has been detected only in the case of Flavescence dorée but it cannot be excluded for other GY agents.

Other host plants: Most phytoplasmas are ubiquitous plant parasites that can be hosted by several sometimes tolerant plant species. Hence, numerous plants or weeds may be overt or discrete reservoirs from which acquisition of phytoplasma by vectors is possible according to the feeding preference of each species. However, when grapevine is not a preferred host for the vector, erratic transmission to grapevine may nevertheless take place.

Detection: GY syndrome is characteristic. Simultaneous presence of symptoms on leaves, shoots, canes, and bunches is strong evidence for phytoplasma infection. Individual symptoms can be confused with other diseases or disorders.

Phytoplasmas can be detected by graft transmission to sensitive vines. They can also be observed in sieve tubes by light microscopy, using DAPI staining, but the latter technique has never been successfull on field-grown grapevines. Detection can also be made by transmission electron microscopy of thin sections or by scanning electron microscopy. These methods are not specific for any phytoplasma and are too laborious for disease monitoring.

Polyclonal and monoclonal antisera have been raised to a few phytoplasmas, including the agents of FD and BN. ELISA detection is possible from vascular tissue of symptomatic grapevines. The best antigen source are leaf veins and petioles. Particular procedures for extraction of phytoplasma antigens from infected vines must be used to enhance the sensitivity of detection.

Outstanding progress in detection was achieved with DNA-based techniques. A range of primers that can be used for amplification with Polymerase Chain Reaction (PCR) of characteristic DNA fragments of phytoplasmas, are available in the literature. Most of these PCR primers have been designed on conserved regions of the rRNA gene and are "universal" for all known phytoplasmas. Others, designed on variable regions of the rDNA, on less conserved genes, or on random selected non-ribosomal DNA fragments, are group specific. The extraction from infected tissues of total DNA containing enough phytoplasma DNA of good quality and the elimination of inhibitors of the PCR reaction, are critical.

When no information on the particular phytoplasma type is available, PCR amplification with universal primers is preferred. Then, Random Fragment Length Polymorphism (RFLP) analysis of the amplicon can provide further characterization of the infecting phytoplasma. When the presence of a particular disease is suspected, more specific primers can be used.

Other molecular methods are being developed, using detection of PCR amplification products with DNA-DNA hybridization with a specific probe. Real-time PCR has also been successfully used.

Detection of phytoplasma DNA can be achieved from all plant organs or insect vectors. Generally, phytoplasmas are unevenly distributed in GY-affected vines. Detection in the upper parts of the vines is usually done from veins and petioles of the leaves of symptomatic shoots, but is also possible using young leaves shortly before symptom expression or phloem scrapings from lignified canes. Non-symptomatic grapevines that show irregular symptoms from one year to the next may also test positive. FD can be detected from leaves of non-symptomatic American roostocks.

However, even sensitive detection methods may not be fit for use in sanitary selection because of the uneven distribution of phytoplasmas in mother plants and their vegetative progeny.

Control: There are no direct curing methods of infected plants. Pruning or top-grafting are useless because roots and trunks are infected. Control of GY diseases depends on the knowledge of vector insect species, on the possibility to limit or eradicate their population and prevent their migration or movement in vineyards, and on the identification of reservoirs of inoculum such as infected grapevines, weeds or other crops.

In any case, efforts should address prevention by planting healthy propagation material and limitation of vector populations and their inoculative activity.

Production of sanitized propagation material is possible with hot water treatment (HWT), i.e., soaking of dormant material before or after grafting, into hot water (50 °C) for a sufficient length of time (minimum 30 mn).

Control methods of vector populations are being experimented with natural insecticides, cultural practices, and natural enemies.

Investigations are being conducted on sensitivity, tolerance and potential for recovery of varieties, on physiological changes and defence mechanisms induced by infection, and on elicitors of defence reactions to these phloem-restricted bacterial agents.

2. Historical review

1955 **Levadoux**: Description of a severe outbreak of "Flavescence dorée" on Baco 22A in southwestern France. The author suggests this disease to be due to adverse climatic and soil conditions, but does not rule out the possible involvement of a pathogen.

1956 **Branas** (a and b): Description of flavescence epidemics on Baco 22A and Chardonnay in France. The disease is thought to be caused by root damage.

1957 **Caudwell**: Characterization of a new type of flavescence, denoted Flavescence dorée (FD) in agreement with the name proposed by Levadoux (1955) because of the golden yellow metallic aspect of leaves. Symptoms (macroscopic and microscopic), evolution of the disease in space and time, hypotheses on its nature. The disease can be transmitted by grafting and is probably a virus disease.

1961 **Caudwell** (a): Studies on Bois noir (BN) and on its relationships with FD. BN is considered as a non epidemic form of FD.

1961 **Caudwell** (b): Description of recovery in grapevines affected with FD.

1961 **Schvester** *et al*. FD is transmitted by the leafhopper *S. littoralis* Ball, an insect that has been introduced recently from America.

1964 **Vidano**: *S. littoralis* Ball found in Italy in 1963. The biology of the insect is described.

1965 **Gärtel**: Description, under the name Flavescence dorée, of a disease occurring in the vineyards of the Mosel Valley and of the Rhine Valley.

1966 **Caudwell**: Attempts to inhibit the agent of FD *in vivo* by heat treatment. Immersing cuttings taken on FD-affected grapevines in water at 30°C prior to planting reduced the proportion of infected plants by about 83%.

1967 **Doi** *et al*.: Discovery of Mycoplasma or PLT group-like microorganisms in the phloem elements of plants showing dwarfing, witches' broom and yellowing.

1968 **Baggiolini**: *S. littoralis* Ball is present in Ticino (southern Switzerland).

1970 **Rafaila and Costache**: Yellows of grapevine with symptoms similar to those of FD found in 1967 for the first time in Romania, mainly on cv. Regina.

1971 **Caudwell** *et al.* (a): Mycoplasma-like organisms (MLOs) are observed in diseased grapevines and infective leafhoppers and in *Vicia faba* submitted to feeding inoculation with infective *S. littoralis*.

1971 **Caudwell** *et al*. (b): Evidence that FD and BN are two different diseases with similar symptoms. Potential existence of several different diseases: leafhoppers (*Euscelidius* sp. and *Euscelis* sp.) caught in the vicinity of vineyards could transmit a yellows disease to *Vicia faba* plants. Symptoms on *V. faba* are different from those obtained with feeding inoculation with infective *S. littoralis*. Inoculation of grapevine seedlings with *S. titanus* fed on the latter *V. faba* plants produced typical GY symptoms. This phytoplasma was later on identified as a Clover phyllody phytoplasma.

1973 **Belli** *et al*.: Presence of a disease similar to FD in the Oltrepò Pavese (northern Italy). The disease has been observed for the first time in 1968.

1973 **Tanne and Nitzany**: Occurrence of a yellows disease resembling FD in Israel.

1975 **Osler** *et al*.: *S. littoralis* is present in the same region of Oltrepò Pavese.

1977 **Rumbos** *et al*.: Rickettsia-like organisms observed in roots of grapevines with "Vergilbungskrankheit" in the Saar, Mosel and Rhine regions are considered as the causal pathogens of this disease. As similar organisms have been found in nematodes of the species *Xiphinema index*, the hypothesis is put forward that this nematode is the vector of the disease. So far, these findings have not been confirmed.

1979 **Caudwell and Larrue**: Spread of FD in France is related to sanitary status of planting material. Recommendation that mother plants should be grown in areas far away from FD-infected regions.

1980 **Caudwell**: Symptoms of grapevine yellows (Amarilliamento) reported in Chile on cv Elqui.

1982 **Caudwell** *et al*.: Production of antisera to FD-MLO raised to extracts of experimentally FD-infected plants (*Vicia faba*) and leafhoppers (*Euscelidius variegatus*) and first microscope observation of MLOs trapped with ISEM.

1982 **Magarey and Wachtel**: Description of a new disease of grapevine of the yellows type on the cv Rhine Riesling in South Australia. Provisory name "Rhine riesling problem". First record in 1975-76.

1983 **Caudwell**: Discussion on the origins of yellows diseases of plants, with special reference to grapevine. The author assumes that both FD and its vector were introduced from North America with varieties of *Vitis labrusca* between 1927 and 1950. Conversely, Bois noir, of which *S. titanus* (= *littoralis*) is not a vector, is probably of European origin.

1984 **Credi and Babini**: Grapevine yellows are reported in Emilia Romagna (Italy).

1985 **Belli** *et al.*: *S. titanus* found in 1984 in vineyards of northern Italy. An important FD-like disease is reported.

1985 **Granata**: Description of an epidemic yellows disease on cv Inzolia in Sicily.

1985 **Rumbos and Avgelis**: Observations of a FD-like disease in Greece with severe symptoms on cvs Razaki and Roditis.

1986 **Boudon-Padieu and Larrue**: ELISA detection of FD pathogen on infected reared experimental and wild natural leafhopper vectors (*E. variegatus* and *S. titanus,* respectively).

1986 **Carraro** *et al*.: Presence and distribution of a FD-like disease in the region Friuli-Venezia Giulia in Italy.

1986 **Conti**: A review of intracellular procaryotic phytopathogenic agents.

1986 **Martelli**: A review on the knowledge on grapevine diseases induced by phloem- or xylem-limited prokaryotes in Europe.

1986 **Mescalchin** *et al*.: Occurrence of FD-like symptoms in the valley of Sarca in Trentino, northern Italy.

1987 **Borgo** *et al*.: Description in Italy of the presence of FD or FD-like diseases, that are responsible for severe decline of vines. However, their etiology is unclear.

1987 **Credi** *et al*.: Presence of a FD-like disease in Emilia-Romagna, Italy.

1987 **Fortusini and Belli**: Description of the development of epidemics of FD-like diseases in northern Itay. Susceptibility and sensitivity of affected varieties (Chardonnay, Pinot bianco, Pinot nero) and comparison with other similar diseases.

1987 **Rui** *et al*.: Contribution to the knowledge of FD (or similar diseases) in the Veneto region, Italy. Chardonnay is the more affected variety. Survey for the presence of *S. titanus*, vector of FD, disease distribution, control measures.

1987 **Seljak**: Presence of *Scaphoideus titanus* in western Slovenia (Yugoslavia).

1987 **Vidano** *et al*.: Study on the distribution of *S. titanus*, vector of FD, in viticultural areas of northern Italy and of other Auchenorrhynchas susceptible to play a role in the transmission of yellows diseases in this region.

1988 **Credi and Callegari**: Survey of vineyards in Emilia-Romagna, Italy, for the presence of a FD-like disease. The results suggest that the disease is brought into the vineyards from outside local sources.

1988 **Egger and Grasselli**: Presence in Toscana, Italy, of a FD-like disease on Chardonnay.

1988 **Fortusini** *et al*.: New data on the spread of FD in three vineyards of Oltrepò pavese (northern Italy) from 1985 to 1987. Two of these vineyards were sprayed with insecticides in 1986 and 1987, resulting in a reduced diffusion of the disease, whereas an unsprayed vineyard was more affected.

1988 **Magarey** *et al*.: Observation of MLOs in phloem tissue of yellows-affected grapevines in Australia.

1988 **Quaroni** *et al*.: Observations, using the scanning electron microscope, of MLOs in phloem tissues of grapevines affected by "FD" in northern Italy.

1988 **Vidano** *et al*.: Survey of potential Auchenorryncha vectors of the pathogen agent of FD in Piemonte (Italy). In addition to *S. titanus*, *Hyalesthes obsoletus, Euscelidius variegatus* and *Euscelis incisus* are taken into consideration.

1989 **Borgo**: General information on the presence of FD-type diseases in northern Italy. *S. titanus* is not always associated to the disease.

1989 **Credi**: Description of a FD-like disease in Emilia Romagna and the reaction of 3 different cultivars. Recovery and crop loss are variable.

1989 **Rumbos**: Review of the knowledge on the etiology of grapevine yellows and observations with the scanning electron microscope of root and petiole tissues from diseased and unaffected plants of cv Riesling. The aetiology is not fully ascertained though the presence of MLO is probable.

1989 **Vidano** *et al*. (a and b): Identification of numerous species of Auchenorrhynchas in the vineyard ecosystem in Piemonte (northen Italy) and of ampelophilous species. Several weeds with symptoms of phyllody were found to contain MLO in electron microscope studies. Natural infection with MLOs of bait plants (*Catharanthus roseus* and *Vicia faba*) placed in vineyards in spring and summer. The authors recommend that research continues on techniques for the ecological control of weeds and of leafhoppers linked to them and on the aetiology of the different forms of "golden flavescence".

1990 **Caudwell**: Review on the epidemiology and characterization of FD and other GY diseases.

1990 **Caudwell** *et al*.: Grapevine graftwood shoots infected with FD can be disinfected by hot water treatment in the dormant stage. The recommended temperature / time combination is 50°C / 35-60 min. Treatment prior to storage is more efficient.

1990 **Credi** *et al*.: Bench grafting experiments of buds of indicator cvs. Chardonnay and Baco 22A grafted on donor yellows-diseased plants of cvs Pinot blanc and Sangiovese. Only part of the plants were infected. Symptoms also developed on plants obtained from buds taken on diseased Chardonnay and Sangiovese grafted on healthy Kober 5BB.

1990 **Granata and Russo**: An epidemic disease with FD-type symptoms develops in Sicily on cv. Inzolia.

1991 **Conti**: A yellows-type disease of cv. Chardonnay develops in Tuscany. *S. titanus* was not found in the area. Similar symptoms on Chardonnay could be obtained by insect inoculation (*Euscelis incisus*) and by cleft-grafting of tissues taken from yellows-infected elm.

1991 **Credi and Santucci**: Development of "Flavescenza dorata" in grapevine in Emilia-Romagna and rate of infestation in different systems of cultivation. The annual rate of symptomatic plants was never greater than 20 % over a 6-year period.

1991 **Deng and Hiruki**: A method to amplify 16S rRNA gene from culturable and nonculturable mollicutes. Specific primers can be used for MLOs. This is a prospect for investigation on MLOs associated to plant yellows.

1991 **Di Terlizzi** *et al*.: Presence of yellows-like symptoms in Apulian grapevines (central Italy).

1991 **Granata and Grimaldi**: MLOs are observed with the electron microscope on affected grapevines of cv. Inzolia in Sicily.

1991 **Marinesku** *et al*.: Occurrence of grapevine yellows in Moldavian SSR.

1991 **Refatti** *et al*.: The FD-like disease developing in Friuli-Venezia Giulia since the early 1980's was not decreased significantly in vineyards sprayed with insecticides though *S. titanus* was present in all vineyards checked.

1992 **Ahrens and Seemüller**: Oligonucleotides selected in the conserved parts of the 16S rRNA gene of MLOs can be used with polymerase chain reaction (PCR) to amplify a sequence of the gene in several plant pathogenic MLOs maintained on periwinkle (*Catharanthus roseus*). Restriction profiles after digestion with endonucleases permit the differenciation of MLOs associated to different plant diseases.

1992 **Boidron and Grenan**: Construction and testing in ENTAV, Le Grau du Roi (France) of a device for secure soaking of dormant buds and canes into hot water (50°C, 45mn).

1992 **Caudwell and Kuszala**: Detection with ELISA of FD-MLO in naturally FD-affected grapevines. Affected grapevines in the Rhône valley tested negative, suggesting an unrelated agent.

1992 **Credi and Santucci**: Of 628 attempts to transmit the agent of a yellows disease of grapevine from Sangiovese, Caveccia and Chardonnay vines to periwinkle by the dodder species *Cuscuta campestris*, 4 positive results (0.6%) were obtained. MLOs were visible in sections of petioles of periwinkle showing symptoms and subsequent graft transmission from periwinkle to periwinkle was successful.

1992 **Daire** *et al*.: First detection of FD-MLO DNA in grapevine extracts by DNA-DNA hybridization with DNA probes cloned from FD-MLO partially purified from experimentally infected plants (*Vicia faba*). The titre of MLO appears very low in grapevine. FD-MLO DNA can be distinguished from other MLO DNA with Dot-blot hybridization and Southern-blotting. It is more related to the agent of Elm yellows than to other yellows agents.

1992 **Davis** *et al*. (a and b): Characterization of Italian periwinkle virescence (IPVR) MLO (obtained on bait periwinkle plants exposed in yellows-affected vineyards in Italy) is possible with DNA-DNA hybridization and PCR. IPVR is related to aster yellows MLO.

1992 **Meignoz** *et al*.: Description of MLOs and associated disorders in the phloem of FD-affected LN33 experimentally inoculated with *S. titanus*. Senescent or degraded forms of MLOs identified inside degenerate sieve elements.

1992 **Osler** *et al*.: ELISA with FD-antibodies permit to detect related antigens in *S. titanus* leafhoppers. However, transmission by feeding to healthy grapevines succeeded only in 1 attempt out of 100, suggesting the presence of two different diseases at least in Veneto and Friuli-Venezia Giulia.

1992 **Quacquarelli and Barba**: Review of the distribution of flavescence dorée and other grapevine yellows in EEC viticultural countries.

1993 **Alma** *et al*.: Transmission experiments from grapevine to grapevine and to herbaceous hosts with *S. titanus* and other leafhopper species show that yellows disease present in northeastern Italy differs from flavescence dorée as it occurs in France.

1993 **Arnò** *et al*.: The survey in Piemonte of Chardonnay vineyards affected with a FD-like disease shows that no correlation can be made between the importance of the *S. titanus* population in vineyards and the rate of spread of the disease.

1993 **Arzone** *et al*. (a and b): Observations supporting the existence of different types of grapevine yellows in northern Italy. Attempts to characterize MLO DNA extracted from insects with molecular methods. One MLO strain transmitted with *Macrosteles quadripunctulatus* appears similar or close to aster yellows MLO.

1993 **Bertaccini** *et al*. (b): Evidence of an association of MLOs with grapevine yellows in Emilia Romagna. The MLO strains found in grapevine are related with aster yellows MLOs, but are different from known aster yellows cluster MLO strains.

1993 **Bianco** *et al*. (a): Differentiation with PCR-RFLP analysis between a MLO related to aster yellows in GY-diseased plants from Lombardia and a MLO related to elm yellows in an affected grapevine in Friuli-Venezia Giulia.

1993 **Boubals** (a): Report on a meeting of the French working group on FD. Evolution of the disease and of its vector in the various viticultural regions of France, results of research, detection (ELISA, genomic tests). FD can be readily distinguished from Bois noir.

1993 **Boubals** (b): A severe epidemic of grapevine yellows occurs in Golan (Israel). Typical symptoms on several cvs. No spontaneous recovery. *S. titanus* is not present.

1993 **Caudwell** *et al.*: FD can be transmitted by symptomless rootstocks. Hot water treatments suppress the transmission to Chardonnay indicators.

1993 **Chen** *et al*.: Construction of serological and molecular detection tools to MLO transmitted to periwinkle with dodder from a yellows-diseased grapevine in Friuli-Venezia Giulia (Italy) (later

called FDU, then GYU phytoplasma) and comparison of specificity and sensitivity of the latter tools to detect phytoplasmas in grapevines in New York and Italy. Detection in non symptomatic *V. riparia* in New York and failure of detection in some symptomatic grapevines in New-York and Italy. GYU was later on characterized by other authors as a phytoplasma belonging to the X-disease (16SrIII) group.

1993 **Daire** *et al*. (a and b): PCR-RFLP analysis of 16S rDNA from MLOs show that 2 different MLOs at least occur in yellows-affected grapevines in France. FD is related to elm yellows and BN is related to stolbur. FD detected in leaves of rootstock 3309C and is also present in samples from Veneto (Italy). BN (stolbur MLO) detected in several regions of Italy and in Israel. A third MLO related to X-disease of *Prunus* detected in a grapevine from New York (USA) and in a periwinkle carrying a grapevine MLO (FDI = FDU) transmitted through dodder in Udine (Italy).

1993 **Girolami and Egger**: Importance of contamination of vineyards and diffusion of Grapevine yellows in northern Italy. Experiments on the use of hot water treatment on planting material, on the effects of pollarding affected vines and of chemical sprays against vectors.

1993 **International Committee of Systematic Bacteriology (ICSB), Subcommittee on the Taxonomy of Mollicutes**: The trivial name MLO is replaced by the term phytoplasma as a consequence of the demonstration by diverse studies that the phytoplasmas represent a monophyletic clade of organisms more closely related to mollicutes than to walled bacteria.

1993 **Kuszala** *et al*.: FD-ELISA method was used on tissues of yellows-affected grapevines from diverse countries. Positive assays obtained only on samples from France and Veneto.

1993 **Maixner** (a, b, c and d): Grapevine yellows (Vergilbungskrankheit) are common in the Moselle and Rhine valley. A MLO has been transmitted to periwinkle with dodder. *S. titanus* is not present. Computer analysis for spatial patterns of diffusion show a non-random distribution and suggest transmission from other vines or from weeds.

1993 **Osler** *et al*. (a and b): Various attempts to transmit FD-like disease in different regions of northern Italy, using insects, graft and dodder. In northeastern Italy, healthy plants protected with plastic screens did not develop symptoms and diseased plants protected with screens showed transient recovery.

1993 **Prince** *et al*.: Diversity of MLOs associated with grapevine yellows and transmitted to periwinkle. Detection in grapevines from Virginia (USA) of MLO related to X-disease. Classification of grapevine MLOs into three RFLP groups: elm yellows (FD from France), aster yellows and X-disease.

1994 **Carraro** *et al*.: Six-year transmission trials of different types of yellows with *S. titanus* to test plants of cvs Perera and Chardonnay in Veneto and Friuli-Venezia Giulia (Italy). Transmission has been obtained only from vines of Veneto. *S. titanus* is present in the Friuli-Venezia Giulia region but no transmission assay has been successful. So, at least two different phytoplasmas are infecting grapevines in Veneto: FD *sensu stricto* (transmitted by *S. titanus*) and a second one, probably transmitted by another insect.

1994 **Credi** (a and b): Observation of MLO in yellows-affected grapevines in northern Italy. Description of pathological changes in phloem of leaves and identification of senescent forms of MLO inside degenerate sieve elements. MLO appear to be in very low titre.

1994 **Daire**: PhD thesis on detection and differentiation with DNA-based methods of the MLO agents of GY diseases in France. Only FD and BN have been identified in naturally affected grapevines. FD belongs to the elm yellows group but is different from elm phytoplasmas. BN belongs to the stolbur group. Specific probes cloned and specific primers designed for PCR amplification of phytoplasma DNA.

1994 **Di Terlizzi** *et al*.: Important outbreak of a yellows disease on local varieties in Apulia (southeastern Italy) and infection of periwinkle as bait plants and with dodder transmission. Electron microscopic observation of MLO in periwinkle and grapevine.

1994 **Maixner**: Demonstration that *Hyalesthes obsoletus* (Auchenorrhyncha: Cixiidae) is a vector of German grapevine yellows (Vergilbungskrankheit).

1994 **Parente** *et al*.: Presence of grapevine yellows in northern Portugal and electron microscopic visualization of MLOs in the phloem tissue of petioles of affected plants.

1994 **Prince** *et al*.: MLOs associated to grapevine yellows in Virginia belong to 2 different groups : X-disease group (16SrIII) and aster yellows group (16SrI). Double infection is reported. Related MLOs were also detected in wild grapevines.

1995 **Arzone** *et al*.: Emphasis on the possible role of weeds as reservoir for MLO in vineyards. Ten weeds were found harboring MLOs with transmission electron microscopy.

1995 **Del Serrone** *et al*. (a and b): Grapevine yellows in Latium (southwestern Italy) are not associated with *S. titanus* which has not been found. Molecular detection of aster yellows-related phytoplasma.

1995 **Egger** *et al*.: Survey of yellows symptoms in an ampelographic collection of 1281 cultivars in Conegliano (Veneto, Italy), with the aim of identifying sources of tolerance or resistance to yellows diseases.

1995 **Fortusini** *et al*.: Six-year survey of evolution of yellows symptoms in a 6-12 year-old vineyard of cv Chardonnay that was never sprayed with insecticides. Consideration on possible resistance and research on interaction of phytoplasma with nepovirus infection.

1995 **Laviña** *et al*.: Identification of BN (stolbur phytoplasma) in Spain.

1995 **Maixner** *et al*. (a): Specific detection with PCR of stolbur phytoplasma in grapevines affected with Vergilbungskrankheit, in the vector *H. obsoletus* and in weeds growing in the vineyard in Germany.

1995 **Maixner** *et al* (b): Detection of a new phytoplasma type related to FD in cv Scheurebe showing symptoms of yellows in Palatinate (Germany).

1995 **Padovan** *et al*. (a and b): Detection of a phytoplasma closer to aster yellows phytoplasma than to elm yellows phytoplasmas in GY-affected vines in Australia

1995 **Sancassani and Posenato**: Simultaneous presence of FD and of other yellows type in vineyards of Veneto. The importance of proper identification of disease type for control measures is emphasized.

1996 **Albanese** *et al*.: Presence and distribution of GY in Sicily. PCR detection of phytoplasma with universal primers.

1996 **Alma** *et al*.: Grapevines from Piemonte (northern Italy) contained several different phytoplasmas. The most frequent belonged to group 16SrI-G (later designated as 16SrXII or stolbur group). One grapevine out of 16 contained a 16SrV (= elm yellows) phytoplasma together with a 16SrI-G phytoplasma.

1996 **Boudon-Padieu** (a and b): Reviews on knowledge and research on grapevine yellows.

1996 **Del Serrone and Barba** (a and b): Monitoring of detection of phytoplasma in the organs of grapevine according to the vegetative state. Detection is also possible during winter on wood scrapings.

1996 **Haidar**: First report of symptoms of yellows on grapevines in Lebanon.

1996 **Koruza**: Dispersal of grapevine yellows in Slovenia, probably of Bois noir type.

1996 **Murari** *et al*.: Four different phytoplasmas (FD, aster yellows, stolbur and apple proliferation) can be detected, sometimes in mixed infection, in grapevines with yellows symptoms in Soave (Veneto, Italy).

1996 **Padovan** *et al*.: The phytoplasma associated with Australian grapevine yellows is close to but different from stolbur phytoplasma causing BN.

1996 **Rüdel**: Review on the history and diversity of Vergilbungskrankheit of grapevine in Germany.

1997 **Batlle** *et al*.: Identification of Flavescence dorée in Spain.

1997 **Belli** *et al*.: History and control of GY diseases in Italy.

1997 **Bosco** *et al*.: Survey of leahoppers in vineyards of Piemonte, northern Italy. Among 32 species identified, 10 are confirmed phytoplasma vectors. Presence of *S. titanus* reported for the first time in this region.

1997 **Daire** *et al*. (a): Only stolbur and FD phytoplasmas were detected in samples of yellows-affected grapevines from numerous regions of France and from Italy, Spain and Israel. Aster yellows and X-disease types were never detected. No double infection has been found to occur.

1997 **Davis** *et al*. (b): Prospects on detection and identification of grapevine phytoplasmas with new molecular tools and consequence on future epidemiology studies.

1997 **Del Serrone** : A review in Italian on the knowledge on etiology, spread, vectors and detection of the agents of Grapevine yellows.

1997 **Garau** *et al*.: Recurrent and severe yellows symptoms observed since the 1980's in Sardinia (Itlay) on several cultivars. No epidemic outbreak has been observed. *S. titanus* is not present. Positive reaction with a DNA probe specific to aster yellows phytoplasmas.

1997 **International Committee of Systematic Bacteriology (ICSB), Subcommittee on the Taxonomy of Mollicutes**: The taxonomy of phytoplasmas will refer to their molecular phylogeny. The term phytoplasma will become the genus name of plant pathogenic mycoplasmas under the provisional taxonomic status *Candidatus*. Subclades are considered to represent the equivalent of distinct species.

1997 **Kölber** *et al*.: Symptoms of grapevine yellows observed in Hungary in the early 1970's. Severe symptoms with high incidence on seven cultivars are reported from four grapevine-growing regions surveyed for 5 years (1993-1996). Phytoplasma belonging to the stolbur subgroup have been identified.

1997 **Maixner and Reinert** (a): Hot water treatment (HWT) of 50°C for 60 min applied to dormant mature canes eliminated Vergilbungskrankheit phytoplasma with a small loss in survival of the cuttings.

1997 **Maixner** *et al*. (a): Description of available methods and strategies for detection of phytoplasmas in grapevine.

1997 **Maixner** *et al*. (b): Survey of possible auxiliaries for the biological control of leafhoppers and planthoppers in vineyards.

1997 **Murari** *et al*.: Use of Hot water treatment (HWT) to eliminate phytoplasmas (FD and AY) from 3 cultivars of grapevine. No positive detection with PCR on the HW-treated vegetative progeny of mature canes of symptomatic plants.

1997 **Tanne and Orenstein** (a and b): Successful heterografting transmission of phytoplasma from symptomatic grapevine to periwinkle and easy subsequent identification of phytoplasma type. AY and X-disease related phytoplasmas have been transmitted and detected.

1998 **Aldini** *et al*.: Survey of hoppers in vineyards of the province of Piacenza (Emilia Romagna, Italy). Among 29 species of Auchenorrhynchas from the vine canopy and weeds of the border, 10 species were known vectors of phytoplasmas. *S. titanus* is not reported.

1998 **Borgo**: Description and colour photographs of symptoms of grapevine yellows and knowledge on their aetiology and vectors.

1998 **Boudon-Padieu and Maixner**: Updating in French and English of present knowledge on grapevine yellows: etiology, transmission, biology and control. The possibilities of control

depend on the knowledge of the biology of phytopathogenic agents and of their vectors. Insecticide sprays against *S. titanus*, vector of FD, are compulsory in France.

1998 **Lee** *et al*.: Phylogenetic studies of phytoplasmas associated to numerous plant diseases. On the basis of RFLP of PCR-amplified 16S rRNA gene, phytoplasmas can be classified into 14 groups and 38 subgroups.

1998 **Maixner and Reinert**: Updating in German of the research made in different countries on grapevine yellows diseases, with a particular reference to the work done in Germany.

1998 **Reinert W. and M. Maixner**: A review of thermotherapy to cure phytoplasma infected material.

1998 **Refatti** *et al*.: Summary of the complex situation of GY in northeastern Italy. Survey with PCR of phytoplasmas infecting grapevines in Friuli-Venezia Giulia and Trento province (Italy) and in Slovenia, have shown that only stolbur group phytoplasma was consistently found. FD-related phytoplasmas (elm yellows group) have been detected in grapevines from Treviso and Verona and transmitted from vine to vine using *S. titanus*. In the Veneto region only stolbur-group phytoplasma was recorded in some areas and both stolbur and elm yellows group phytoplasmas in other areas. In addition a phytoplasma (FDU=GYU) transmitted from GY-affected vines to *Catharanthus roseus* by means of dodder in Friuli-Venezia Giulia, has been identified as a member of the X-disease group.

1998 **Seemüller** *et al*.: A comprehensive review of the classification of phytoplasmas in the world, according to the most recent studies on molecular structure of rDNA, nucleic acid hybridization and serological comparisons. Phytoplasmas for which 16S rDNA sequence is available have been classified into 20 major groups and subgroups. Grapevine phytoplasmas classify into different groups.

1999 **Borgo** *et al*.: Unsatisfactory results on the use of hot water treatments to eliminate phytoplasmas from grapevine wood.

1999 **Boudon-Padieu**: Review on recent progress in the knowledge on grapevine yellows, methods of detection of phytoplasmas in grapevine tissues and in insect vectors, epidemiology of these diseases, distribution in the world.

1999 **Firrao** *et al*.: Monitoring grapevine yellows in North-eastern Italy and attempts to rationalize routine laboratory testing for the differentiation between FD and stolbur phytoplasmas. Sensitivity of assays must be good because of the low titre of phytoplasmas in affected plants.

1999 **Lherminier** *et al*.: First report of the use of oligonucleotides for *in situ* hybridization with transmission electron microscopy to localize phytoplasma in plant cells. Probes were antisense to stolbur specific sequences in the 16S rDNA and used on stolbur-infected periwinkle. Similar attemp with FD phytoplasma were not successful.

2000 **Batlle** *et al*.: A review of the situation of GY in Spain. GY affect mainly the northern provinces. Only FD and BN have been identified. FD is restricted to the north of Cataloña, though *S. titanus* is more widely distributed. BN is very frequent but *H. obsoletus* is rarely found in vineyards. Search for alternative vectors.

2000 **Boudon-Padieu** (b): Chapter in a Handbook on viral and bacterial diseases of the grapevine. History, symptoms, epidemiology and etiology of GYs in the world.

2000 **Carraro** *et al*.: A history of GYs in north-eastern Italy.

2000 **Frausin** *et al*.: Evaluation on the efficiency and security of hot water treatment used to eradicate phytoplasmas from propagation material. No negative effect was observed on scion buds but rootstock cuttings were more sensitive to negative effects of the treatment.

2000 **Guadagnini** *et al*.: Report of positive detection of aster-yellows phytoplasma in grapevine fed with *Metcalfa pruinosa* and in the body of the insects used for transmission.

2000 **Moretti and Anaclerio**: Evaluation of the effects of hot water treatment on the viability of grapevine cuttings of different varieties with different temperature / time combinations. Plant variety and cutting diameter influence the rate of surviving cuttings.

2000 **Zahavi** *et al*.: Survey of GY in Israel. Influence of rootstock on the rate of GY symptoms in the same vineyard and same grapevine variety. A high rate of recovery is observed from one year to the next. The phytoplasma agents are not specified.

2001 **Bertaccini** *et al*.: Use of immersion in hot water (HWT) or in chemicals to suppress phytoplasmas from grapevine propagation material in Italy. HWT (50°C/40 mn) gave acceptable survival but none of the conditions experimented provided a total elimination of phytoplasmas. The latter was difficult to evaluate because of the non homogenous distribution of phytoplasmas in canes.

2001 **Bertamini and Nedunchezhian**: Study of the effect of phytoplasma infection of field-grown plants of cv Chardonnay affected with Bois noir (stolbur phytoplasma) on the physiological response of plants: photosynthesis, sugar metabolism, nitrate and nitrite reductase.

2001 **Clair** *et al*.: *Metcalfa pruinosa* specimen reared in the laboratory may acquire FD and clover phyllody (aster yellows group) phytoplasmas by feeding on infected *Vicia faba* but feeding transmission to several plant species has not been obtained. Phytoplasmas seemed to disappear from the insect body after the transfer of insects to healthy plants, suggesting that they did not multiply in the body of the insects.

2001 **Klein** *et al*.: In Golan Heights (Israel) *Hyalesthes obsoletus, Neoaliturus* sp., *Circulifer* sp. *Macrosteles quadripunctulatus* and *Orosius orientalis* were found on weeds in vineyards or trapped on sticky traps. Phytoplasmas were detected in all five species, which are all known as vector of phytoplasmas.

2001 **Marzachi** *et al*. (a): Presence of FD, BN and aster yelllows in vineyards of southeastern Piemonte (Italy).

2001 **Orenstein** *et al*.: A 2-year survey in Golan Heights, Israel, confirmed the presence of three phytoplasmas associated to GY: stolbur (70%), aster yellows (11 %) and X-disease groups phytoplasmas. Dual infection may occur (13 %). Primers fitted for specific detection of these 3 phytoplasmas permit cheaper and quicker diagnosis.

2001 **Quartau** *et al*.: *Scaphoideus titanus* is present in Portugal.

2001 **Seljak and Petrovic**: Overview on phytoplasma diseases of grapevine and fruit trees in Slovenia. FD has not been identified, although its vector *S. titanus* is widespread in western vineyards. *Hyalesthes obsoletus* has been found but not in vineyards.

2001 **Tanne** *et al*.: The presence of phytoplasmas in liquid medium on which insect vectors have been fed can account for potential vectorship of the species. Experimental evaluation of the method and application to field-trapped individuals of suspected vector species.

2001 **Waite** *et al*.: Use of hot water treatment in commercial nurseries in Australia to eradicate diverse pests and pathogen agents from propagation material.

2002 **Crocker** *et al*.: Recommandations for the organisation of nursery in Australia and handling of hot water treatment to avoid dehydration of cuttings during treatment.

2002 **Frosini** *et al*.: Development of a new technique with DNA chips to detect phytoplasmas in grapevine.

2002 **Moretti** *et al*.: Report of experiments combining temperature and time of treatment with hot water on 5 grapevine cultivars to cure planting material from phytoplasmas.

2002 **Osler and Refatti**: The situation of GYs in northern Italy.

2002 **Seljak:** A review of non-European hoppers introduced in Slovenia.

2003 **Boudon-Padieu**: Updating of knowledge and research on grapevine yellows worldwide.

2003 **Boudon-Padieu** *et al*.: Compared efficiency, rapidity and sensitivity of methods for use in routine diagnosis of grapevine phytoplasmas.

2003 **Chabbouh** *et al*.: Identification of grapevine yellows symptoms in Tunisia and attempts to identify pathogen agent and vector. An aster yellows phytoplasma is suspected.

2003 **Clair** *et al*.: Development of a sensitive PCR procedure for dual identification of FD and BN phytoplasmas, fitted to routine detection.

2003 **Crocker** *et al*.: Measurements of basal respiration rate of grapevine dormant wood as an indicator of the best period for application of hot water treatment.

2003 **Gajardo** *et al*.: Identification of aster yellows (16SrI-B and C) and of ash yellows (16Sr-VII) related phytoplasmas associated to yellows of grapevine in Chile.

2003 **Ge and Maixner** (a): Transmission to feeding medium is more efficient than transmission to natural host plants and to grapevine for *Hyalesthes obsoletus* and *Oncopsis alni*, two nonpreferentially ampelophagous vectors of grapevine phytoplasmas. Discussion on benefits and limits of artificial feeding medium to assess the transmission capability of phytoplasma by insects.

2003 **D'Ascenzo** *et al*.: Important presence of GY in Abruzzo (central Italy). BN (stolbur phytoplasma) has an incidence of about 30 %. Other phytoplasmas are reported, in particular a clover phyllody type (16SrI-C) which is quite frequent.

2003 **Duduk** *et al*. (a and b): FD phytoplasma (16S rV-C) and *S. titanus* found associated to grapevine yellows with a high incidence in vineyards of Rastina (South Serbia).

2003 **Kuzmanovic** *et al*.: Report of severe symptoms of yellows on numerous grapevine varieties in Serbia and observation of organisms resembling phytoplasmas in sieve tubes of affected shoots collected in the Zupa area. Apart from FD phytoplasma reported by Duduk *et al.*, stolbur phytoplasmas are suspected to occur because of long-lasting record of stolbur disease on many host plants in Serbia.

2003 **Lessio** *et al*.: Flight activity of *Scaphoideus titanus* and *Hyalesthes obsoletus* and their infection status towards FD and BN (stolbur) phytoplasma, respectively.

2003 **Marzachi** *et al*.: Improvement of detection of FD and BN in field-grown grapevines with real-time PCR.

2003 **Myrta** *et al*.: Report of stolbur phytoplasmas in grapevine affected with yellows in Albania.

2003 **Orenstein** *et al*.: Survey of potential vectors of phytoplasmas in vineyards of the Golan Heights. *Neoaliturus fenestratus, Hyalesthes obsoletus* and *Circulifer haematoceps* abundant and positive for stolbur and aster yellows phytoplasmas. *Megophthalmus scabripennis* positive for aster yellows phytoplasma. Study of the spatial and temporal dispersion of the four species.

2003 **Osler** *et al*.: Grapevines affected with yellows are found free of phytoplasmas after recovery. Recovery is a progressive phenonenon developing over 3 years in the case of BN. Consequently roguing of affected vines should be avoided when possible and especially if vectors are controlled.

2003 **Tassart-Subirats** *et al*.: Data on 15-year studies on efficiency and effect on propagation material of hot water treatment.

2004 **Leitner**: The situation of Grapevine yellows in Austria is now surveyed by means of molecular detection assays. No important damage has been reported.

2004 **Milkus** *et al*.: Important outbreak of grapevine yellows on cv Chardonnay and identification of a stolbur phytoplasma in diseased plants.

2004 **M'hirsi** *et al*.: Report of aster yellows phytoplasmas in grapevine affected with yellows in Tunisia.

GRAPEVINE YELLOWS: INDIVIDUAL DISEASES

A. FLAVESCENCE DORÉE

1. Description

Flavescence dorée (FD) was the first Grapevine yellows (GY) disease to be reported. It is highly epidemic and extremely dangerous because of the biology and ethology of its leafhopper vector, *Scaphoideus titanus* Ball (= *S. littoralis* Ball). In France, it occurs in all southern vine-growing regions, Corsica, and Savoie. In addition, isolated infected vines have been identified in northern vineyards of Burgundy and Alsace. It was described in a limited area in north-eastern Cataluña (Spain). It is widespread in all northern provinces of Italy and an outbreak was recently reported from southern Serbia.

Main symptoms: It is believed that vines that show symptoms for the first time in a vegetative season had been infected in the previous summer. Symptoms develop on leaves and shoots in June and July to become oustanding in August and autumn. Leaves persist longer on affected plants. Lignification of the canes is usually incomplete. Most of the time, symptoms affect the whole plant. Diseased vines have a patchy distribution in the plot, indicating a vine-to-vine transmission, with an incidence that increases rapidly from one year to the next. Crop losses may be very high.

Affected vines of most varieties may recover in the second year when they are protected against re-inoculation with insecticide treatments. If the plants are inoculated after recovery, symptoms may be limited to a few shoots. However, extremely sensitive varieties do not recover, decline progressively and die.

Infected rootstocks show little or no symptoms. However, rooted cuttings from infected canes of a few rootstock varieties can develop "vinifera-like" symptoms on the wood and leaves, show a general asymmetric bent posture and necrosis of terminal bud.

Agents: FD was first regarded as a physiological disorder, then as a virus disease. The associated phytoplasma (= MLO) was observed in phloem tissue of affected plants and in insect vectors in 1971 and later classified in the Elm yellows group (16SrV). After the discovery of other GY diseases, the term "FD *sensu stricto*" was applied to diseases and phytoplasmas that are transmitted by *S. titanus.* Several isolates have been characterized with molecular criteria. Isolates F70, FD88, FD92 and FD2000 were experimentally transmitted to broadbean (*Vicia faba* L.) using *S. titanus* individuals collected in infected vineyards of south-western France. These isolates could be distinguished by Western-blot analysis using FD antisera and monoclonal antibodies (Mabs). Two isolates denoted FD-D and FD-C, were characterized in Italy and shown to be transmitted also by *S. titanus*. Molecular comparisons have shown that all these isolates are more closely related among them than with other phytoplasma strains in the same group. Moreover, FD88, FD92 and FD-D could not be distinguished from one another.

Transmission: The FD agent is transmitted in the persistent mode by the leafhopper *Scaphoideus titanus* Ball (= *S. littoralis* Ball) (Homoptera, Cicadellidae). FD is endemic only in regions where *S. titanus* is well established. This leafhopper is a neartic species specialized on *Vitis* sp. introduced into Europe at the beginning of the 20th century, that has colonized a wide climatic area. It is also present in regions from which FD has not been reported in France, Switzerland, north of Spain and Portugal, southern Italy, and western Slovenia. Vineyards in these areas are under the threat of an FD outbreak that could occur if FD-infected planting material is introduced. *S. titanus* is a univoltine species that overwinters at the egg stage and develops from May to September on grapevine leaves with 5 aerial apterous larval instars followed by alate nymphs that feed on the leaf veins and petioles and on green shoots. Eggs are laid in summer on two-year old wood and trunk. Phytoplasma acquisition by all insect instars (larvae and nymphs) may occur from infected vines at any time from the beginning of hatching (usually in the beginning of May) throughout the growing season. Feeding transmission starts after a 4-week latency in the body of the vector. Hence, transmission is possible from early June (about one month after the beginning of hatching) until the death of adults.

Transmission occurs also by vegetative propagation and grafting. Infected buds or graftwood may be collected from symptomless parts of infected mother vines or from recently infected vines that have not yet developed symptoms. Infected rootstocks are important means of dissemination because they are symptomless. Though the rate of transmission by bench grafting can be very low, this way of spreading is significant when infected grafted plants are planted in vineyards hosting the vector. First symptoms may

appear on young vines as late as four years after grafting. The low rate of transmission by grafting and the long delay in symptom expression make the detection of infected vines in planting material difficult, and the risk of disease spreading important.

Varietal susceptibility and sensitivity: All varieties grown in the various FD-affected regions in France, Italy and Spain are susceptible with various degrees of sensitivity. Nielluccio and Garganega are very sensitive varieties that usually do not recover after infection. Alicante Bouschet, Grenache, Cabernet Sauvignon, Sauvignon blanc, Chardonnay, Ugni blanc (Trebbiano) and Prosecco are sensitive varieties that may recover when they are protected from new inoculations. Other varieties, such as Merlot, appear more tolerant, although heavily infected vines can be observed. Symptoms are rare in Syrah. *Vitis riparia* can be infected but shows little symptoms. The same is true for American rootstocks which can therefore be dangerous sources of infection and dissemination of the disease.

Other host plants: No host plants other than *Vitis* sp. have been found carrying FD phytoplasma until recently. In 2003 a phytoplasma resembling the FD-C isolate was found in wild Clematis in Veneto (Italy).

Detection: FD symptoms can be confused with those of other GYs and also with other diseases or disorders. The presence of *S. titanus* in an affected vineyard is an important indication that may lead to suspect a FD infection. Nevertheless, Bois noir (BN) is also frequent in regions inhabited by this leafhopper.

Detection with laboratory methods is possible on insect vectors and infected vines. Polyclonal antisera and Mabs have been raised to FD phytoplasma. Antigen extraction from vascular tissue of symptomatic grapevines requires the use of high Tris molarity and strong detergents in the extraction buffer. An indirect DAS-ELISA using coating of wells with rabbit polyclonal antisera and detection with a cocktail of several Mabs, has been used as the official method for large scale survey of FD in France from 1993 to 2003.

Molecular detection by PCR of selected phytoplasma DNA fragments, has become the preferred detection method because it is easy to perform and was improved in reliability and sensitivity. Nested PCR and RFLP analysis of selected fragments of the 16S rDNA permit the characterization of any phytoplasma and especially to differentiate FD from BN. Recently, sensitive amplification with nested PCR of the DNA fragment FD9, which is specific for 16SrV-group phytoplasmas allowed the reliable detection of FD phytoplasma in grapevine. Simultaneous amplification in a multiplex procedure of both FD9 and Stol11, a DNA fragment specific to BN (stolbur) phytoplasma can be used for the survey and monitoring of these two GY diseases. Sequence or RFLP analysis of the FD9 DNA fragment permit to readily differentiate all the known FD isolates.

Other DNA-based methods, such as real-time PCR or identification of PCR-amplified product with DNA-DNA hybridization using specific probes, are currently under development.

Control: FD is a quarantine organism in the EC. In France and Italy, control measures are compulsory according to legal regulations. Indirect control is obtained by insecticide treatments against *S. titanus*. Natural insecticides can be used to preventively limit vector populations but their efficiency is limited in epidemic outbreaks. Under these circumstances only chemical insecticides are efficient for eradication of the disease. The first treatment is applied 30 days after first instar emergence at the beginning of the period of potential transmission. Two additional treatments are applied during summer. The second treatment, at the beginning of July, aims at killing newly hatched insects, whereas the third treatment, at the beginning of August, is directed against winged adults migrating from nearby vineyards or wild vines. Monitoring natural enemies of *S. titanus* in New York State (USA), its area of origin, has allowed the identification of potential auxiliaries for biological control. Their rearing is still under development.

In spite of the possibility of recovery, roguing of diseased vines is advisable when the epidemic pressure is high. Roguing is compulsory in France.

Planting material must not be collected from mother vines in areas or vineyards affected by the disease. In France and Italy budwood can be taken only from mother plants growing in plots that have shown no GY symptoms for the last two growing seasons. Material from mother plants that have developed symptoms in the following growing season, must be destroyed. Soaking of dormant material in hot water (HW) is recommended. Standard conditions (50°C for 45 min) proved highly efficient for sanitizing infected rootstocks and grapevine cultivars. Planting of HW treated material is especially important in areas where the vector is present.

2. Historical review

1955 **Levadoux**: Description of an outbreak of "Flavescence dorée" on Baco 22A in southwestern France. The aetiology is unknown.

1956 **Branas** (a and b): The new disease is thought to be caused by root damage.

1957 **Caudwell**: The disease is denoted Flavescence dorée (FD) in agreement with the name proposed by Levadoux (1955) because of the golden yellow metallic aspect of the leaves. Description of macroscopic and microscopic symptoms, evolution of the disease in space and time. The disease can be transmitted by grafting and has probably a viral aetiology.

1960 **Bonfils and Schvester**: Relationships of leafhoppers with FD of grapevine in western France.

1960 **Caudwell and Poitou**: Study of the interaction between fanleaf and FD.

1961 **Caudwell**: Study of the phenomenon of recovery of FD-affected vines. Spontaneous recovery occurs after a 1-2 year crisis period. Recovered vines may be infected again but the symptoms are lighter.

1961 **Schvester** *et al*.: Demonstration that FD is transmitted by the leafhopper *S. littoralis* Ball, an insect recently introduced from North America.

1962 **Schvester** *et al.* (a): Control of FD by insecticide treatments against the vector, *S. littoralis.* Use of 4-5 treatments with DDT or parathion and removal or destruction of pruning wood older that two years. First report that abandoned or wild vines may be a source of infection.

1962 **Schvester** *et al*. (b): Biology of *S. littoralis*.

1963 **Schvester** *et al*.: Field tests for insecticide control of *S. littoralis*.

1964 **Caudwell**: PhD thesis on FD, considered as a virus disease. Description and study of recovery phenomenon and of localised symptoms.

1964 **Vidano**: *S. littoralis* recorded from in Italy in 1963. Description of the insect, biology and feeding damage and of the symptoms of FD in France on Baco 22A.

1966 **Caudwell**: Attempts to inhibit the agent of FD *in vivo* by heat treatment. Immersion in lukewarm water (30°C) for 72 h of cuttings from FD-affected grapevines reduced the proportion of infected plants by about 83 % as compared with untreated control.

1966 **Vidano**: Study of the ecology and biology of *S. littoralis* in its area of origin in North America.

1967 **Carle and Moutous**: Study on possible secondary or alternative vectors of FD or Bois noir (BN). No positive results of transmission trials with 15 species of Hemiptera (mainly Cicadellidae) other than *S. littoralis.*

1968 **Baggiolini** *et al*.: First report of *S. littoralis* from Ticino (southern Switzerland).

1969 **Caudwell** *et al*.: Studies on the survival of *S. littoralis* on plants other than the grapevine and transmission trials of FD to other host plants.

1970 **Caudwell** *et al*.: Successful transmission of FD to herbaceous hosts by increasing the feeding access period of the vector *S. littoralis.*

1971 **Boubals and Caudwell**: FD epidemics observed in Corsica. *S. littoralis* is present.

1971 **Caudwell** *et al*. (a). Study of the role in the aetiology of FD of mycoplasmalike organisms (MLO) observed in insect vectors and in inoculated grapevine and *V. faba* plants.

1972 **Caudwell** *et al*. (a): Possibility to limit the populations of *S. littoralis* in Corsican vineyards with winter treatment of dormant eggs with oleoparathion.

1972 **Caudwell** *et al*. (c): Transmission of FD from *Vicia faba* to *V. faba* by leafhoppers of the genera *Euscelis* and *Euscelidius* and from *V. faba* to grapevine by *S. littoralis*.

1972 **Caudwell** *et al.* (d): Different damage caused by leafhoppers in vineyards and specific control of *S. littoralis*.

1973 **Belli** *et al*.: A disease similar to FD observed in vineyards of Oltrepò Pavese since 1968.

1974 **Caudwell** *et al*.: Research on liquid media to preserve and cultivate MLO agents of FD. Use of the infectivity test to evaluate MLO survival or multiplication.

1975 **Osler** *et al*.: *S. littoralis* found in vineyards of Oltrepò pavese affected with a FD-type disease.

1977 **Caudwell and Larrue**: Rearing of colonies of healthy and MLO-infected leafhoppers.

1977 **Moutous** *et al*.: Results of ovicide treatments against *S. littoralis*.

1978 **Caudwell** *et al*.: Successful transmission with *S. littoralis* of the Corsican GY, thus identified as the same disease as FD.

1979 **Caudwell and Larrue**: The problem of FD in France in relation with sanitary selection of grapevine planting material.

1982 **Caudwell** *et al*.: Use of serology for detecting FD MLOs by immunosorbent electron microscopy. Antisera raised to MLOs extracted from *E. variegatus* are used to trap MLOs in extracts from *V. faba*.

1984 **Belli** *et al*.: Presence of *S. titanus* (= *S. littoralis*) in vineyards of the Veneto (northern Italy) and spread of FD in this region.

1985 **Anonymous**: An important outbreak of FD observed in South France since the beginning of the 1980's. The situation is critical.

1985 **Belli** *et al*. (a): FD, which was reported in Italy for the first time in 1973, is now spreading northeast in the Veneto region. The vector *S. titanus* is abundantly present.

1985 **Belli** *et al*. (b): Problems of identification of FD in Veneto (Italy) and correlation with the presence of the vector.

1986 **Bagard and Felici**: The situation of FD in Corsica is very serious.

1986 **Boudon-Padieu and Larrue**: ELISA detection of FD MLO is possible in leafhopper vectors reared in the laboratory and in *S. littoralis* individuals trapped in FD-affected vineyards. Positive insects were found in South-eastern France.

1986 **Kuszala**: Injection of MLO-enriched extracts into the body of *Euscelidius variegatus* is used for evaluating the infectivity of the extracts. Males are better vectors than females.

1987 **Agulhon and Laurent**: Biology and spread of *Scaphoideus titanus* (= *S. littoralis*) in vineyards of the south of France.

1987 **Borgo** (a and b): Study on the susceptibility and tolerance of grapevine cultivars in Veneto.

1987 **Boudon-Padieu** *et al.* (a and b): Development of serological assays (ELISA, Immunofluorescence and Western-blotting) for the detection and characterization of FD-antigens in infected leahopper vectors.

1987 **Caudwell** *et al.:* Present knowledge on the biology, aetiology and diagnosis of FD MLO.

1987 **Pavan** *et al*.: Dynamics of the populations of *S. titanus* in Veneto.

1987 **Planas**: Report on field trials to control FD and its vector in South France.

1987 **Seljak**: Presence of *S. titanus* in Slovenia (western Yugoslavia).

1989 **Anonymous**: Compared efficiency of various insecticides in the control of *S. titanus.*

1989 **Boudon-Padieu** *et al*. (a and b): Polyclonal antisera raised to FD MLO maintained in the laboratory permit detection in infective *S. titanus* individuals from affected vineyards. Description of the infection cycle of the MLO in the body of the experimental vector *E. variegatus*.

1989 **Du Fretay** *et al*.: Satisfactory control of the vector of FD in 1988 in South France.

1989 **Fortusini** *et al*.: Successful transmission of FD to grapevine cuttings using *S. titanus* in Italy.

1989 **Laurent and Agulhon**: 1989. Comprehensive review of the situation and evolution of FD and the vector leafhopper in French wine-growing regions.

1989 **Lherminier** *et al*.: *In situ* detection of FD MLO in salivary glands of infective *Euscelidius variegatus* leafhoppers with immunofluorescence.

1989 **Schwartz**: PhD thesis on the production, screening and characterization of monoclonal antibodies to the FD-MLO.

1990 **Boudon-Padieu** *et al*.: Serological differentiation between FD-MLO and Phy-MLO, an agent causing phyllody in *V. faba* plants, transmitted in the laboratory by *Euscelidius variegatus* leafhoppers.

1990 **Caudwell** *et al*.: Hot water treatment to disinfect grapevine wood from FD-MLO.

1990 **Lherminier** *et al*. (a and b): The use of immunolabeling in the electron microscope to detect and localize MLO in plants and insects with specific polyclonal antibodies.

1991 **Arzone** *et al*.: Electron microscopic observation of MLO in sieve elements of Chardonnay and Perera grapevines showing FD symptoms, in clover (*T. repens*) inoculated with *S. titanus* fed on infected grapevines and in salivary glands of the leafhopper.

1991 **Cazenove and Planas**: Attempts to obtain a satisfactory control of *S. titanus* with natural insecticides used in biological agriculture.

1992 **Anonymous**: Recommendations for control of FD in biological wine-growing. Combination of winter treatments with white oil and removing of pruning wood to suppress eggs.

1992 **Caudwell and Kuszala**: ELISA detection of FD MLO in affected grapevines. The method requires extraction of proteins with a strong detergent. DAS ELISA is developed with polyclonal rabbit antiserum as coating antibodies and a cocktail of mouse monoclonal antibodies as detecting antibodies.

1992 **Daire** *et al*.: Random cloning of FD-MLO DNA and selection of specific probes for detection of FD MLO with DNA-DNA hybridization. Detection in field-infected grapevines is possible only on DNA extracted from a MLO-enriched fraction.

1992 **Jermini** *et al*.: In spite of the presence in Ticino (Switzerland) of *S. titanus* in vineyards and nurseries, FD does not seem to occur.

1992 **Lozzia**: A review of the presence, biology and control of *S. titanus* in Italy.

1992 **Meignoz** *et al*.: Electron microscopic study of the cytopathogenic effects of FD-MLO in experimentally infected cuttings of LN33.

1992 **Osler** *et al*.: *S. titanus* fed on yellows-diseased grapevines in northern Italy (Friuli-Venezia Giulia), test positive to FD-antibodies raised in France.

1993 **Caudwell** *et al*.: Positive indexing of rootstocks showing latent FD infection and erratic distribution of the pathogen in the material. Sanitation of rootstocks with hot water treatment (50°C for 45 mn).

1993 **Daire** *et al*. (a and b): Diversity among MLOs inducing GY diseases in France and other countries, shown with PCR-RFLP analysis of rDNA. FD shows the same pattern as elm yellows MLO. BN is related to stolbur MLO. FD MLO was detected in samples from France and Veneto (Italy).

1993 **Jermini** *et al*.: Assessment of the optimal number and disposition of sticky traps to evaluate the importance of *S. titanus* populations in the vineyard.

1993 **Lefol**: PhD thesis on recognition between the FD-MLO and the organs of the experimental leafhopper vector *Euscelidius variegatus*.

1993 **Lefol** *et al*.: Development of the "double-dot" method and a derived procedure in the transmission electron microscope to identify the sites of attachment of the FD-MLO on insect organs in vector and non-vector insect species.

1993 **Maixner** *et al*.: Study of *S. titanus* in New York and its possible relationship to an American GY. *S. titanus* transmitted a yellows disease to 29% of *Vicia faba* plants. FD antibodies raised in France tested positive on 13% of American *S. titanus* individuals.

1993 **Seddas** *et al*. (a and b): Immunoaffinity purification of FD-MLO from infected experimental vectors.

1994 **Carraro** *et al*.: Demonstration with transmission trials using *S. titanus*, ELISA and PCR analyses, that FD *sensu stricto* is present in Veneto and not in Friuli-Venezia Giulia, though *S. titanus* is also present in the vineyards of the latter region.

1994 **Caudwell** *et al*.: Identification of latent FD infection in several rootstock varieties, including 3309 Couderc and Fercal. The rate of graft transmission to scion depends on the infection status of mother vines and could reach 80 %.

1994 **Farmer and Boudon-Padieu**: Cloning of FD-MLO DNA, construction of an expression library and screening with FD antibodies allowed the selection of three inserts carrying information for FD membrane proteins.

1994 **Lefol** *et al*.: Route and multiplication of the FD-MLO in the body of experimentally infected *Euscelidius variegatus*. All main organs were infected, except for germinal cells.

1994 **Lherminier** *et al*.: Use of ELISA and immunolabeling by transmission electron microscopy for studying the distribution and movement of FD-MLO in the experimental host plant *Vicia faba*.

1994 **Seddas**: PhD thesis on the production and use of monoclonal antibodies to identify the main antigens of FD-MLO and obtain highly purified fractions of the infectious agent from vector insects and herbaceous host plants.

1995 **Bertaccini** *et al*.: Presence of phytoplasmas of two types, sometimes in double infections, in severely GY-affected grapevines in Liguria (North-western Italy). One type is related to elm yellows phytoplasma and the other to IPVR phytoplasma, shown later on to belong to the stolbur group.

1995 **Seddas** *et al*.: Immunoaffinity purified FD phytoplasmas appear as whole cells in ISEM. Experimental vectors (*E. variegatus*) injected with purified fractions of FD phytoplasma supported its multiplication and were able to feed-inoculate *V. faba* seedlings.

1996 **Alma** *et al*.: In Piemonte, several phytoplasmas were identified in yellows-affected grapevines. A 16SrV (= elm yellows) phytoplasma was detected in a double infection with a 16SrI-G phytoplasma. Phytoplasmas of the latter group (later renamed 16SrXII = stolbur) were the more numerous.

1996 **Bianco** *et al*. (a and b): Elm yellows-related (16SrV) phytoplasmas are present only in the Vicenza and Arezzo provinces of northern Italy. Two different RFLP patterns can be distinguished, suggesting the existence of two strains of FD phytoplasma, one of which is similar to the French strain.

1996 **Borgo**: The first occurrence of FD *sensu stricto* in the province of Treviso (northern Italy) was reported in the 1980's. Infection is rapidly spreading to the east.

1996 **Jermini and Baillod**: Combination of visual observation of instar larvae and trapping of adults on sticky traps to monitor the populations of *S. titanus* in Switzerland.

1996 **Kuszala**: Specific ELISA procedures to detect FD or BN phytoplasmas in extracts from diseased grapevines from the field.

1996 **Lherminier and Boudon-Padieu**: Use of transmission electron microscopy with *in situ* immunolabeling to detect FD phytoplasma in grapevine and herbaceous host plants.

1996 **Posenato** *et al*. (a and b): Situation of FD and *S. titanus* in north-eastern Italy where vines are trained in the pergola system. Survey of hemipters in the vineyard and presence of other known phytoplasma vector species.

1996 **Seddas** *et al*.: Monoclonal antibodies raised to immunoaffinity purified FD phytoplasmas. Several different peptides from membrane proteins are identified by Western-blot. Serological relationships with elm yellows phytoplasma is confirmed

1997 **Alma** *et al*.: A phytoplasma of the 16SrI (aster yellows) group is detected in eggs, nymphs and adults of *S. titanus* reared on healthy plants. The biological significance of this finding is unknown.

1997 **Batlle** *et al*.: First report of FD outbreak in northern Cataluña (Spain).

1997 **Bosco** *et al*.: Monitoring of leafhoppers in vineyards in Italy. Numerous species identified. The possible role of six species in the transmission of GY is discussed.

1997 **Caudwell** *et al*.: Verification of hot water treatment conditions to suppress FD phytoplasma infection in dormant wood of grapevine. In the same conditions, the eggs of *S. titanus* laid in the bark were killed.

1997 **Clerc** *et al*.: First report of *S. titanus* in the canton of Geneva (Switzerland).

1997 **Daire** *et al*.: Development of specific PCR primers for the detection of FD or BN phytoplasmas. The amplified FD9 fragment is specific and variable among 16SrV (elm yellows) group phytoplasmas. Three different RFLP patterns at least are shown in FD isolates from France, Spain and Italy.

1997 **Marcone** *et al*.: RFLP studies of 16SrV phytoplasmas. FD is not present in southern Italy.

1997 **Pavan** *et al*. (a and b): Evolution of FD in the Treviso province (Veneto, Italy). First outbreak in the 1980's on cv Perera. Increase and spread to other cultivars, especially Prosecco in the period 1993-1996. Control recommendations. Transmission by grafting is studied. The possibility that direct inoculations have occurred in nursery is discussed.

1997 **Rousseau**: A review of different ways to reduce the populations of *S. titanus* in biological viticulture.

1997 **Vindimian** *et al*.: In spite of the presence and rapid spread of *S. titanus* in Trentino (Italy), FD has not been identified.

1999 **Martini** *et al*.: Demonstration that two isolates of FD *sensu stricto* (FD-D and FD-C) are spreading in Veneto (Italy).

1999 **Mori** *et al*.: Insecticide control of *S. titanus* in Italy, according to the severity of the FD epidemics.

2000 **Belli** *et al*.: Important outbreak of FD in Lombardia (northern Italy).

2000 **Bianco** *et al*. (a and b): Demonstration of curing effect of hot water treatment on FD-affected plant material.

2000 **Boudon-Padieu** (a): Description, biology, spread, FD-transmission and control of *S. titanus*.

2000 **Clair** *et al*.: Design of internal nucleotides on the specific DNA fragment FD9 to be used as primers in nested-PCR for improving sensitivity of detection of elm yellows (16SrV) phytoplasmas in FD-affected grapevine or in elms affected with yellows in France.

2000 **Cravedi and Aldini**: Biology of *S. titanus* in Oltrepò pavese (Italy), a region affected by a severe outbreak of FD since 1999.

2000 **Morone** *et al*.: Occurrence of FD in Piemonte (northern Italy) since 1998.

2000 **Roure**: The situation of FD in France. Compulsory control (insecticide sprays and roguing of affected vines) on 300 000 ha.

2000 **Scattini** *et al*.: Important spread of FD in Lombardia (Italy) in cv Sangiovese.

2001 **Angelini** *et al*.: Phylogenetic comparison of FD isolates from France and Italy among them and other 16SrV (elm yellows) strains. One isolate from France (FD92 = FD88) and one from Italy (FD-D) are widespread and identical.

2001 **Bianco** *et al*.: *S. titanus* in northern Italy can transmit different grapevine isolates of 16SrV (elm yellows) phytoplasmas.

2001 **Credi** *et al*.: Detection of FD in grapevine samples from the provinces of Piacenza, Parma, Reggio Emilia and Modena in Emilia Romagna (Italy).

2001 **Davis and Dally**: A new 16S rDNA sequence of FD is produced and it is proposed that FD phytoplasmas are placed in two distinct subgroups. However, further work has shown that the 1994 original sequence was erroneous (see Angelini *et al*., 2003a).

2001 **Harrison** *et al*.: An elm yellows (16SrV) group phytoplasma close to the Italian isolate FD-C is detected in Virginia creeper plants (*Parthenocissus quinquefolia*) in southern Florida (USA). It is the first time that a phytoplasma resembling a FD phytoplasma is found in a plant species other than *Vitis* sp.

2001 **Marzachi** *et al*. (b): Development of a PCR strategy for large scale detection of FD phytoplasma in plants and insects.

2001 **Pasquini** *et al*.: Harmonization of procedures for diagnosis of FD in Italy.

2001 **Quartau** *et al*.: Presence of *S. titanus* in Portugal.

2002 **Alma**: A review of the distribution and biology of *S. titanus* in Italy.

2002 **Bianco** *et al*.: Development of a specific TaqMan® assay for detection of FD phytoplasmas.

2002 **Borgo and Angelini**: Spread of FD in Italy and the situation of mother vines and cultural practice.

2002 **Boudon-Padieu**: Present knowledge on the epidemiology, aetiology and diagnosis of FD.

2002 **Credi** *et al*. (b): Presence of FD in the Marche region (central Italy).

2002 **Martini** *et al*.: Further comparisons between FD phytoplasma isolates from France and Italy.

2002 **Mori** *et al*.: Positive transmission of the two Italian FD isolates (FD-D and FD-C) by *S. titanus.*

2002 **Posenato** *et al*.: Efficiency of various insecticides to destroy nymphs of *S. titanus* and *Metcalfa pruinosa*.

2002 **Viggiani**: Presence of *S. titanus* in the Basilicata region (southern Italy).

2003 **Angelini** *et al*.: Use of Heteroduplex Mobility Assay and full sequencing on two genomic DNA fragments (ribosomal and non ribosomal) to further study the relationships between FD isolates and related 16SrV (elm yellows) group phytoplasmas.

2003 **Bianco** *et al*. (b): Presence of FD-D and FD-C isolates of FD phytoplasma in Lombardia (northern Italy).

2003 **Botti and Bertaccini**: Molecular variability between FD phytoplasma isolates using the 16S rRNA gene, the ribosomal protein operon and the FD9 DNA fragment. Distinction between epidemic and non epidemic isolates.

2003 **Bressan** *et al*.: An attempt to identify a pattern of seasonal transmission of FD, taking into account the transmission efficiency of *S. titanus*, the pattern of symptom expression by infected grapevines, the emergence of nymphs of *S. titanus* and the importance of vector population and diseased grapevines.

2003 **Cavallini** *et al*.: Presence of FD together with BN in the area of Modena (north central Italy).

2003 **Clair** *et al*.: A multiplex nested-PCR procedure for easy simultaneous diagnosis of FD and BN. The method is now the official method registered in the Official Journal of the French Republic to be used by laboratories in the frame of compulsory control of FD in vineyards.

2003 **Constable and Boudon-Padieu**: Isolation of FD phytoplasma chromosome in Pulse Field Gel Electrophoresis and first physical map for two FD isolates.

2003 **De Sousa** *et al*.: Identification of FD-D phytoplasma in *S. titanus* specimen trapped in Portugal. No description of FD-affected grapevines.

2003 **Duduk** *et al*. (a and b). Identification of FD in southern Serbia and presence of *S. titanus*. The phytoplasma isolate is similar to FD-C.

2003 **Malausa** *et al*.: Search for natural enemies of *S. titanus* in New York with the scope of their introduction in France as biological control auxiliaries.

2003 **Nusillard** *et al*. Results of a 2-year study in North America of the natural enemies of *S. titanus*.

2003 **Santinelli** *et al*.: Presence of *S. titanus* in Umbria (central Italy).

2003 **Torres** *et al*. The situation of FD in Spain. Confirmation that only FD-D is present.

2004 **Angelini** *et al*.: A phytoplasma identical to FD-C isolate is found in wild Clematis in the vicinity of a FD-C affected vineyard in Veneto (Italy).

2004 **Lessio and Alma**: Study of the distribution of *S. titanus* within a vineyard and use of chromatic sticky traps. Abundance is greater in normal- than in low-density planted vineyards. *S. titanus* is monophagous. Leafhoppers are not able to spread significantly outside a vineyard. Females are less likely to fly far away than males.

B. BOIS NOIR (VERGILBUNGSKRANKHEIT, LEGNO NERO)

1. Description

Bois noir (BN) and related diseases are Grapevine yellows (GY) known in Europe and Asia Minor. The first observations in Eastern France date back to the early 1940's. BN was formally described in 1961 in comparison with Flavescence dorée (FD), because symptoms were similar. It was assumed that the two diseases were different because BN occurred in regions where the vector of FD was not present and experimental transmission with *S. titanus* was not successful. Because the vector insect, *Hyalesthes obsoletus*, does not live on vines, affected plants are usually not grouped into patches as with FD, except for situations where a high percentage of affected plants is observed. Nevertheless, distribution is non-random and spread follows a main direction or is preferentially along the border of the plot. BN has been identified in all wine-growing regions of western and eastern Europe, in Israel, Lebanon and recently in the Ukraine.

Main synonyms: The syndrome named Vergilbungskrankheit (VK) (1971) or Schwarzholzkrankheit (SHK) (2003) in Germany, Legno nero (LN) in Italy, Bois noir in Spain, has been occasionally described under the name of Flavescence dorée-like disease. Moreover, it has been sometimes confused with FD in the 1970's and 1980's. It is only since the 1990's that the aetiology was established and that it was shown that the agents of these diseases in the different countries were similar or closely related. Furthermore, the same vector insect species, *H. obsoletus,* has been identified in all countries, except for Spain where it appears to be very rare.

Main symptoms: All the main symptoms typical of GY can be found in BN / VK / LN - infected grapevines. In addition to leaf discoloration, growth abnormalities can be observed on canes and roots. Usually, only a few canes per plant show typical symptoms with either an uneven or a total lack of lignification. On white-berried varieties, yellow banding develops along the veins which may undergo necrosis. On red-berried varieties, sectorial reddening of blades develops in summer and progressively invades the whole leaf. When berries develop they remain immature, greenish and eventually fall down. Remaining berries are tasteless and sour. Internodes often show longitudinal rows of brown pustules along the green bark of unripe wood. Severely affected vines decline and may die after a few years. Some vines may recover or express irregular symptoms in successive years.

Agents: The phytoplasmas associated to these diseases belong to the stolbur group (16SrXII), a group that was for some time considered by some to be the I-G subgroup of the larger Aster yellows group (16SrI). Although stolbur phytoplasmas are ubiquitous pathogens, known to infect solanaceous crops as well as many weeds and bushes, only a limited number of strains have been identified. Hence the different names of BN disease appear to be more geographically than genetically significant.

Transmission: Vergilbungskrankheit (= Schwarzholzkrankheit) was the first disease for which the vector was identified. The known vector insect of stolbur of tomato, *H. obsoletus* (Homoptera, Cixiidae) can transmit stolbur phytoplasma to grapevine, but this occurs during feed probing as the insect does not keep feeding on grapevine. Hence, vine-to-vine transmission does not occur. The role of *H. obsoletus* has been confirmed in France, in Italy and Israel. In Spain, where the species is rare, its role in BN epidemiology must be verified. Alternative vectors have been suspected but not demonstrated. *H. obsoletus* is a univoltine polyphagous species that overwinters as larval instars that live on the roots of host plants. Nymph emerge in spring and transmission occurs during adult mating flights. Overall, the presence of insects on vines may last a couple of months. Eggs are laid during summer on the ground at the base of the stem of host plants. Main host plants of the insect vector are common weeds such as *Convolvulus arvensis*, *Ranunculus* sp., *Urtica dioica, Cardaria draba* and *Calystegia sepium.* However, only *C. arvensis* and *U. dioica* were found consistently infected with stolbur phytoplasma, distinct isolates of which were identified in these hosts. From 10 to 80% of trapped populations of the vector may test positive for the presence of stolbur phytoplasma.

Transmission by grafting is possible but only at a low rate. Since acquisition by the vector from infected vines does not seem possible, the significance of graft transmission on the spread of the disease is probably very low.

Varietal susceptibility and sensitivity: In the different affected regions and countries, numerous cultivars of *V. vinifera* were found susceptible to the stolbur phytoplasma, cv Chardonnay being the most sensitive. The increasing incidence of BN has been related to the increase of surfaces planted with Chardonnay in the last decade in all countries. Infection of rootstock varieties has not been reported. In all varieties there is a proportion of affected grapevines that undergo transitory recovery or remission, while other plants in the same plot are tolerant or immune to infection.

Other host plants: Stolbur phytoplasma is widespread, and has a wide host range. In addition to *C. arvensis*, *U. dioica, Ranunculus* sp., *C. draba* and *C. sepium,* shrubs and trees of *Prunus* spp., solanaceaous crops (tomato, tobacco, pepper, egg plant) and lavender (*Lavandula* spp.) may be significant reservoirs.

Detection: The use of monoclonal antibodies raised to stolbur phytoplasma did not show enough sensitivity for routine ELISA detection in field-grown infected grapevines. Detection is achieved mainly with PCR assays or PCR-RFLP analyses of DNA from infected host plants and insect vectors. Most often, nested PCR is necessary for sensitive detection from infected grapevines. Universal primers were first used to detect both BN and FD in areas where the two diseases may coexist. Subsequent RFLP analyses of amplified phytoplasma rDNA permit the characterization of pathogens. Stolbur specific primers have also been designed, either on variable regions of the rRNA gene or on selected specific non-ribosomal

DNA fragments. Combination of RFLP profiles of two DNA fragments allow the identification of three types of stolbur phytoplasmas associated to VK in Germany and hosted by different weeds. For direct differentiation between FD and BN/VK phytoplasmas, the multiplex nested-PCR assay cited in the FD chapter can be used.

Control: As with other GY diseases, no direct control is possible. Chemical sprays against *H. obsoletus* are not efficient, because of the complex biological cycle and multiple host plants of the insect species. Superficial soil cultivation in summer or winter ploughing are methods intended to damage the larval instars and reduce vector populations. Natural enemies are being investigated.

Recovery and remission of symptoms for several consecutive years are frequent in vines affected by BN. Hence, roguing should be avoided, except for declining vines. Though pruning does not cure infected vines, suppression of affected branches may improve harvest quality and help in progressive recovery.

2. Historical review

1961 **Caudwell**: Study on BN and its relationships to FD. BN is considered as a non epidemic form of FD.

1965 **Gärtel**: Description of VK under the name of Flavescence dorée. The disease occurs in the Moselle valley and the Rhine valley.

1968 **Leclant**: Presence of *Hyalesthes obsoletus* a cixiid planthopper in the south of France. The species has been described as the vector of stolbur "virus" by Suchov in USSR in 1948.

1969 **Leclant and Lacote**: Study of the ability to transmit stolbur to herbaceous plants by *H. obsoletus* in the south of France.

1971 **Caudwell** *et al*. (b): BN is distinct from FD based on non transmissibility by *S. littoralis,* absence of recovery, and different susceptibility and sensitivity of grapevine cultivars.

1971 **Mendgen**: 1971. Description of symptoms of VK, history, cytological and electron microscope study of tissues of affected grapevine. Description of structures that were probably closteroviruses, unknown at that time.

1972 **Caudwell** *et al*. (b): Epidemiological observations of BN lead to the assumption that an aerial vector is involved. Some grapevines show symptoms repeatedly in successive years, while others seem more tolerant and do not show symptoms.

1977 **Rumbos** *et al*.: Rickettsia-like organisms detected in phloem and xylem of roots of grapevines affected with VK in West Germany and in nematodes of the species *Xiphinema index* feeding on roots of these grapevines.

1978 **Nienhaus** *et al*.: Rickettsia-like organisms from VK-affected grapevines are cultured in chick embryos. Findings never confirmed.

1978 **Rumbos** *et al*.: Rickettsia-like organisms found in roots of VK-affected grapevines in the Saar, Mosel and Rhine valleys are considered as the causal agents of the disease and it is hypothesized that the nematode *Xiphinema index* is the vector of the disease. These findings have never been confirmed.

1988 **Credi and Callegari**: Survey of vineyards in Emilia-Romagna, Italy, for the presence of a FD-like disease. The results suggest that the disease is brought into the vineyards from outside local sources.

1989 **Borgo**: General information on the presence of FD-type diseases in northern Italy. *S. titanus* is not always associated with the disease.

1992 **Cazelles** *et al*.: GY symptoms are present in Switzerland (Suisse romande and Ticino) but they are not associated with *S. titanus*.

1992 **Fos** *et al*.: A monoclonal antibody raised to stolbur mycoplasma-like organism is used for ELISA detection of the agent in herbaceous host plants and insects. *H. obsoletus* is confirmed as a vector of stolbur disease plants in France.

1993 **Bertaccini** *et al*. (b): Evidence of an association of MLOs with grapevine yellows in Emilia-Romagna, Italy. The MLO strains found in grapevine are related with aster yellows MLOs, but are different from known strains of MLOs of the aster yellows cluster.

1993 **Bianco** *et al*. (a): Differentiation by PCR-RFLP of a MLO related to aster yellows in GY-diseased plants from Lombardia and a MLO related to elm yellows in an affected grapevine in Friuli-Venezia Giulia (Italy).

1993 **Cazelles and Kuszala**: Negative results with FD-ELISA on all tested GY-affected plants from Switzerland suggest that the GY present is BN rather than FD.

1993 **Daire** *et al*. (a and b): PCR-RFLP analysis of 16Sr DNA of MLOs show that the MLO associated with BN is different from the FD MLO and similar to the MLO associated with stolbur disease. BN MLO is detected in grapevines from France, from several regions of Italy, and from Israel.

1993 **Davis and Prince**: According to a different terminology, MLO associated to GY in Italy are related to aster yellows MLO.

1993 **Davis** *et al*. (a and b): PCR amplification of MLO DNA shows that MLOs associated with GY in several regions of northern Italy are related to the Italian periwinkle virescence (IPVR) MLO. The latter MLO was shown later to belong to the stolbur group.

1993 **Maixner** (b, c and d) Transmission of a yellows to periwinkle with dodder in Germany. It is suggested that vectors with preference for other host plants act as vectors for VK. Computer analysis for spatial patterns of spread shows a non-random distribution and suggests preferential transmission from other vines or from weeds.

1994 **Maixner** : Demonstration that *H. obsoletus* is a vector of VK in Germany.

1994 **Maixner** *et al*.: PCR-RFLP analysis of MLO-DNA detected in VK-affected grapevines in Germany show that this MLO is related to stolbur.

1994 **Minucci** *et al*.: The agent of a GY disease in the Italian Riviera is detected with a probe specific for Eastern aster yellows. PCR-RFLP analysis confirms relationship to aster yellows phytoplasmas.

1995 **Bertaccini** *et al*.: One of the two phytoplasmas detected in yellows-diseased grapevines in Liguria is related to IPVR phytoplasma, clustered by the authors into aster yellows group but shown later to belong to the stolbur group.

1995 **Laviña** *et al*.: First detection of BN (stolbur phytoplasma) in Spain.

1995 **Maixner** *et al*. (a): Development of stolbur-specific primers on phytoplasma rDNA and use for detection of stolbur phytoplasma in grapevines affected with VK and in the vector *H. obsoletus*. Several weeds are host plants of the stolbur phytoplasma.

1996 **Alma** *et al*.: Grapevines from Piemonte (northern Italy) contain several different phytoplasmas, the most frequent belonging to group 16SrI, subgroup I-G (later renamed as 16SrXII or stolbur group).

1996 **Bianco** *et al*. (b): Presence of phytoplasmas in the group 16SrI, subgroup I-G (later named group 16SrXII (stolbur) in the provinces of Vicenza, Brescia and Pavia (northern Italy).

1996 **Borgo**: Presence of BN in mixed infections with FD in the province of Treviso (Veneto, Italy) where FD is prevalent.

1996 **Boudon-Padieu** (b): History, aetiology and transmission of BN in France. *H. obsoletus* identified as the vector. Biology of the insect. Reservoirs and possible role of other vectors remain to be elucidated.

1996 **Koruza**: Survey of GY in three regions of Slovenia shows that the disease is of BN type. Estimated crop damage ranges from 20 to 40 %.

1996 **Kuszala**: Detection in ELISA using a monoclonal antibody to stolbur phytoplasma of BN-associated antigens in diseased grapevines in France. First detection of BN agent in diseased grapevines in Switzerland with the same procedure.

1996 **Maixner**: The situation of VK in Germany: symptoms, vector transmission and possible control measures.

1996 **Marcone** *et al*.: Phytoplasmas associated to GY in Campania (southern Italy) are genetically uniform and belong to the stolbur group, as well as phytoplasmas transmitted by Credi to periwinkle in Emila Romagna and previously classified in the aster yellows group.

1996 **Weber**: PhD thesis on the biology of the cixiid *H. obsoletus* and its role as the vector of VK.

1997 **Albanese** *et al*.: Important spread of GY symptoms on several grapevine varieties in Umbria (central Italy). Characterization of a phytoplasma belonging to group 16SrI, subgroup I-G (identified later as belonging to the stolbur group or 16SrXII).

1997 **Daire** *et al*. (a and b)*:* The identification with PCR-RFLP of rDNA of phytoplasma detected in European and Israeli grapevines affected by GY has shown that BN occurs in all regions. Search for variability among BN phytoplasmas with RFLP analysis of the specific non ribosomal DNA was unsuccessful.

1997 **Davis** *et al*. (c): Identification of stolbur phytoplasma (16SrXII) as agents of GYs in Greece and Israel.

1997 **Kölber** *et al*.: Occurrence of GY diseases in Hungary and identification of stolbur phytoplasma in affected grapevines.

1997 **Laviña** *et al*.: Prevalence of BN (stolbur phytoplasma) in Navarra and Cataluña (north eastern Spain). Preferential spread along the rows.

1997 **Maixner and Reinert** (a): Trials on elimination of VK infection from vine wood in Germany, using hot water treatment with conditions recommended in France. Results were satisfactory.

1997 **Maixner and Reinert** (b): Spatio-temporal analysis of the distribution of VK in 4 vineyards in the Moselle an Rhine valleys over a 2-3 year period showed a high incidence, a strong annual increase, a high proportion of previously infected vines that did not show symptoms for 2 years at least and, conversely, a high proportion of vines in which symptoms re-occurred after one season or more.

1997 **Osler** *et al*. (a and b): BN is poorly transmitted by bench-grafting. The maximum delay of symptom expression in young plants is 2 years.

1997 **Vindimian**: LN but not FD is present in Trentino (northern Italy) in spite of the presence and active spread of *S. titanus*.

1997 **Weber** *et al*.: Monitoring of field populations of *H. obsoletus* in Germany.

1998 **Maixner and Reinert**: A review of the research and present knowledge on VK and other GY diseases.

1998 **Refatti** *et al*.: Consistent association of stolbur phytoplasma with GY diseases in the Italian provinces of Fiuli-Venezia Giulia and Trento and in Slovenia.

1998 **Sforza**: PhD thesis on the epidemiology of BN in France, search for vectors, biology of *H. obsoletus* and possible control measures. Ploughing in winter of soils infested by *C. arvensis* is recommended to expose instar larvae and kill them with frost.

1998 **Sforza and Boudon-Padieu**: Description of *H. obsoletus* as a vector of BN.

1998 **Sforza and Bourgoin**: Anatomy of reproductory organs and mating of *H. obsoletus*.

1998 **Sforza** *et al*.: Epidemiology of BN in France. Confirmation of the role of *H. obsoletus* as a vector to grapevine. Acquisition may occur at larval stages since emerging 5th instars were infective. Identification of main reservoir weeds, among which hoary cress, formerly reported in western Europe.

1998 **Škoric** *et al*.: First detection of stolbur phytoplasma in grapevines in Croatia. Identification of two infected symptomless weeds in the vineyard.

1998 **Weber and Maixner** (a): Procedures for the survey of infection status of populations of *H. obsoletus* related to VK infection. Up to 34% of insects were infected with stolbur phytoplasma. PCR detection is reliable when testing together 25 insects among which only one is infected. Females are more often infected than males.

1998 **Weber and Maixner** (b): Ethology of *H. obsoletus* and possibility to control the insect in vineyards.

1999 **Seljak and Petrovic**: A review of the Slovenian situation of GY diseases. High rate of BN / LN infection in the different vine-growing regions**.**

1999 **Sforza** *et al*.: Ethological onservations and morphological descriptions of adults and larvae of *H. obsoletus*. First launching of colonies of the insect under controlled conditions.

2000 **Bourquin** *et al*.: Use of PCR to confirm the presence of stolbur phytoplasma in GY-affected grapevines in Switzerland.

2000 **Braccini and Pavan**: Report of survey of Auchenorrynchas in vineyards of Toscana (central Italy). *H. obsoletus* and *Metcalfa pruinosa* were found positive for BN phytoplasma (16SrXII-A).

2000 **Braccini** *et al*.: Widespread presence of LN in Toscana (central Italy). No other grapevine phytoplasma was detected.

2000 **Darimont and Maixner**: Comparison of the transmission efficiency of phytoplasma to their host plants and to grapevine by *H. obsoletus* and *Oncopsis alni*, the vector of Palatinate grapevine yellows (PGY), the second GY disease in Germany. The rate of infected *H. obsoletus* can be high because of the presence of reservoir weeds in the vineyard. Transmission to natural host plants is higher than for grapevine with both insects.

2000 **Larrue** *et al*.: Several vineyards affected by BN in Burgundy (France) monitored for over 15 years and assessed for symptom severity. Evidence secured for the occurrence of tolerance (no symptom at all for 15 years) and temporary remission (no symptoms for a few years) .

2000 **Maixner and Reinert**: Collection of *H. obsoletus* in vineyards is efficient with sticky traps placed at the soil level. Up to 30 % of the insects were infected and the highest rate was in vineyards with high populations of *Convolvulus arvensis.*

2000 **Maixner** *et al*.: VK disease dramatically increased in incidence in the Moselle and Rhine valleys during the 1990's. The study confirms a high rate of infected *H. obsoletus,* the ability to recover of cvs Riesling and Pinot in spite of systemic symptoms, and a high proportion of vines that escaped infection during the 3-5 year period of monitoring.

2000 **Marcone** *et al*.: Only stolbur phytoplasma detected in grapevines showing GY symptoms, regardless of the cultivar in Campania (southern Italy). The same pathogen detected in weeds and other crops.

2000 **Šeruga** *et al*.: BN reported only in north-western and eastern vineyards of Croatia. No other phytoplasma found in the South of the country.

2000 **Varga** *et al*.: In a large survey of vineyards in 8 Hungarian counties conducted in 1998, different phytoplasmas were identified in a number of cultivars. Phytoplasmas in the 16SrXII group (stolbur) were the most frequent.

2001 **Bertamini and Nedunchezhian**: Evaluation of effects of BN disease (stolbur phytoplasma) in field-grown grapevines, on pigments, chlorophyll fluorescence and photosynthetic activities suggest that Photo System II is affected. The authors conclude that phytoplasma infection induces non specific, general stress responses and rapid senescence**.**

2001 **Curkovic Perica** *et al*.: The situation of GY diseases in Croatia shows that only BN is present in the northern and eastern vineyards.

2001 **Darimont and Maixner**: Importance of the presence and infectivity of *H. obsoletus* to the German viticulture.

2001 **Gatineau** *et al*.: Anoder cixiid planthopper, *Pentastiridius* sp. is a natural vector of stolbur phytoplasma to sugarbeet in Bourgogne (France).

2002 **Alma** *et al*.: Demonstration that *H. obsoletus* is the vector of LN in Italy. Role of stinging nettle (*U. dioica*) as a reservoir of stolbur phytoplasma and as a host for the insect.

2002 **Gugerli** *et al*.: Only BN identified in Switzerland on cvs Chardonnay, Merlot and Pinot noir.

2002 **Maixner** *et al*.: The highest risk of phytoplasma contamination for grapevines coincides with the flight activity of adults of *H. obsoletus*. Indicators based on climatic parameters permit to predict the flight period.

2003 **Bertaccini** *et al*.: Importance of outbreaks of BN in the province of Modena (Italy) and monitoring of potential insect vectors in addition to *H. obsoletus*, which is widespread in the province.

2003 **Choueiri** *et al*.: Incidence of BN in a small area of the Bekaa valley (Lebanon) on cvs Chardonnay and Alicante Bouschet. All affected grapevines and two naturally infected periwinkles contained the same stolbur isolate, very similar to European isolates. The presence of *H. obsoletus* in Lebanon is recorded.

2003 **Cicotti** *et al*.: Observation of the occurrence of BN in Trentino in eight Chardonnay vineyards on more than 11,000 plants over 12 years. Same conclusions about tolerance and transient recovery of grapevines, reached by other authors.

2003 **Kölber** *et al*.: Survey of GY from 1997 to 2002 on 21 cultivars in 12 Hungarian counties. BN is the main disease and cvs Chardonnay and Zweigelt appear to be the more sensitive among white- and red-berried varieties, respectively. Severity of symptoms vary from one year to the other.

2003 **Langer** *et al*.: Comparison of infection risk by VK in organic and conventional vineyards in Germany. In spite of a similar abundance of *H. obsoletus* and the presence in organic vineyards of several weeds known as host plants carrying larvae on the roots, the incidence of VK was significantly higher in conventional vineyards. Attempt to bring up the larvae to the surface of the soil by ploughing so that they are killed by frost in winter is under evaluation.

2003 **Laviña** *et al*.: Assessment of the best period for detection of BN in affected grapevines. Samples were taken on all organs of 10 affected grapevines, every month for one year except in winter. Detection in December was the more constant.

2003 **Mescalchin and Mattedi**: A description of the development of VK in Trentino (northern Italy)**.**

2003 **Morandell**: Detection of VK in south Austria.

2003 **Myrta** *et al*.: First detection in Albania of BN phytoplasma in grapevines of different age and varieties.

2003 **Orenstein** *et al*.: Survey of potential vectors of phytoplasmas in vineyards of the Golan Heights. *Neoaliturus fenestratus*, *H. obsoletus* and *Circulifer haematoceps* were widespread and positive for stolbur or aster yellows phytoplasmas, while *Megophthalmus scabripennis* was positive for aster yellows phytoplasma. Study of the spatial and temporal dispersion of the four species.

2003 **Petrovic** *et al*.: Importance of a GY epidemics in the Drava region (Slovenia) in 2001 and 2002, together with high populations of *H. obsoletus* and frequence of *C. arvensis* and *U. dioica*.

2003 **Sabaté** *et al*.: Search for vectors of stolbur phytoplasma in Cataluña (Spain) where *H. obsoletus* is rare. Trapping of insects on sticky traps or with D-Vac suction. Living insects checked for transmissibility of phytoplasma by feeding on artificial medium. Several hemipters have been found to deliver stolbur phytoplasma to the medium. Transmission to plants is not reported.

2003 **Šeruga** *et al*. (a): Investigation on the variability of stolbur (16SrXII) phytoplasmas from extracts of different grapevines in Croatia, using 4 fragments of phytoplasma DNA showed that all isolates are similar.

2003 **Šeruga** *et al*. (b): First identification of BN infection in the Macedonian republic.

2004 **Gilge** *et al*.: Important epidemics of "Schwarzholzkrankheit" (SHK = VK) in Franken (Bayern, Germany). Symptoms were recorded on 26% of 30-year old Scheurebe grapevines and 96% of tested individuals of *H. obsoletus* were positive for stolbur phytoplasma.

2004 **Langer and Maixner**: Three different types of stolbur phytoplasma isolates found in grapevines, *H. obsoletus* and weeds in different areas in Germany. According to the data of field survey, specific association of each isolate with a different weed is discussed.

2004 **Milkus** *et al*.: Important expression of BN in cv Chardonnay in the Ukraine.

C. PALATINATE GRAPEVINE YELLOWS

1. Description

Palatinate grapevine yellows (PGY) is a disease occurring in Germany in Pfalz and Moselle regions (west of Germany) mainly on cv Scheurebe. The disease was identified in 1995. It is associated to phytoplasmas in the Elm yellows (16SrV) group. It is not epidemic and occurs most often in old vines in vineyards along creeks or rivers where alders (*Alnus glutinosa* L) are present.

Main synonyms: FD-Pfalz was a first name because the agent was shown to be related to the FD phytoplasma.

Main symptoms: Symptoms are similar to those of other GY diseases and may affect the whole plant. However, affected plants are not numerous, occur most often at the border of plots, and rarely in groups.

Agents: The agent is an EY (16SrV) group phytoplasma. Three isolates (PGY-A, -B and C) have been identified. PGY phytoplasma is similar to the Alder yellows phytoplasma that is widespread in black alder in Germany. It is different from FD phytoplasma. Alder is considered as the source of PGY infection.

Transmission: Transmission was obtained with the leafhopper *Oncopsis alni* Schrank (Hemiptera, Cicadellidae) trapped on alders and caged on *V. vinifera* seedlings that later developed GY symptoms. *O. alni* is highly monophagous and specimen do not survive long on grapevine. Another alder insect, the psyllid *Psylla alni*, was found carrying the alder phytoplasma at a higher rate than *O. alni* but failed to transmit both to alder and grapevine. Attempts to transmit PGY phytoplasma from grapevine to grapevine using reared *S. titanus* leafhoppers have failed. The latter results have not been published.

Varietal susceptibility and sensitivity: PGY occurs in limited areas, mainly on cv Scheurebe.

Other host plants: Alder trees (*Alnus glutinosa* L.)

Detection: Universal primers and RFLP analysis of amplicons can be used to identify a 16SrV phytoplasma. More specific characterization can be obtained with EY-group specific primers fAY/rEY that amplify a 16S rDNA fragment or with FD9 primers that amplifiy the non ribosomal FD9 DNA fragment. RFLP of FD9 fragment permit to distinguish PGY phytoplasmas from FD phytoplasmas and from other phytoplasmas in the same group (see the Flavescence dorée chapter).

Control: No possibility of control because of erratic transmission by the vector.

2. Historical review

1995 **Maixner** *et al*. (b): Detection of a new EY-related phytoplasma in GY-affected cv Scheurebe in Germany. It is different from FD phytoplasma but molecular and serological data show a close relationship.

1997 **Reinert and Maixner**: 1997. Identification of the PGY-associated phytoplasma with phytoplasmas infecting alder in the vicinity of affected vineyards. Same RFLP profiles of P1-P7 rDNA amplicons obtained from yellows affected grapevines, alder, *Oncopsis alni* and *Psylla alni* specimen, both insect species trapped on alder.

1999 **Maixner and Reinert**: Demonstration that *O. alni* (Auchenorrhyncha, Cicadellidae) (but not *P. alni*) is able to transmit the alder yellows phytoplasma to healthy seedlings of alder. The alder phytoplasma resembles ALY, a phytoplasma isolate transmitted from alder to periwinkle in Italy.

1999 **Reinert**: PhD thesis on detection, molecular characterisation and epidemiology of PGY. Variability analysis and sequencing of the FD9 DNA fragment and homology of the sequence to a part of the *SecY* gene.

2000 **Darimont and Maixner**: Comparison of the transmission efficiency of phytoplasma to their host plants and to grapevine by *O. alni* and *H. obsoletus*, the vector of BN / VK. The proportion of infective leafhoppers is lower with *O. alni*. The risk of infection by PGY is lower than for VK because reservoir plants are fewer and outside vineyards.

2000 **Maixner** *et al*. (b): Transmission to *V. vinifera* seedlings of the PGY phytoplasma using specimen of *O. alni* trapped on alders. The strong adaptation of *O. alni* to alder prevents a frequent inoculation to grapevine even if the infestation of the leafhopper population is high. As much as 5 % of leafhoppers from Palatinate and 15 % from Moselle tested positive.

2000 **Reinert and Maixner**: All the 3 strains of PGY were detected both in alder trees and in specimen of *O. alni*. Characterization of the three PGY strains showed that they were closer to FD than to strain EY1 from American elm. Extensive survey of yellows-affected grapevines in several areas of Germany did not show the presence of other EY group phytoplasmas.

2001 **Angelini** *et al*.: Comparison between Elm yellows group (16SrV) phytoplasmas including PGY strains, 4 Italian and French strains of FD and elm and alder phytoplasmas. The PGY strains are closest to the ALY phytoplasma from alder in Italy and to one strain of FD.

2003 **Angelini** *et al*.: Further comparison between elm yellows group (16SrV) phytoplasmas, using Heteroduplex mobility assay and sequencing of rDNA and FD9 fragment. The differences in vector specificity between PGY and FD phytoplasmas are not supported by molecular data.

D. NORTH AMERICAN GRAPEVINE YELLOWS

1. Description

Grapevine yellows (GY) were first reported in New York State (USA) in 1977. In 1991, populations of *S. titanus* living mostly on wild *Vitis riparia* around affected vineyards were found to carry an agent that was serologically related to that of FD. However, the latter findings were not confirmed. In 1993, a phytoplasma belonging to the X-disease group (16SrIII) was detected in affected grapevines in New York. In the same period, a serious outbreak of GY occurred in Virginia, which was associated with two different phytoplasmas in group 16SrIII and 16SrI (aster yellows), respectively.

Main synonyms: Leaf curl and berry shrivel (LCBS), American grapevine yellows.

Main diseases: Virginia grapevine yellows I (VGYI), Virginia grapevine yellows III (VGYIII)

Main symptoms: North American Grapevine Yellows (NAGY) is a lethal disease causing yellowing of the leaves, die back of shoot tips and abortion of developing fruit. Infected grapevines often die within months from the onset of symptoms and significant losses of vines have been observed. In New York, affected vines often do not survive winter frost because they lack reserves.

Agents: The 16SrIII phytoplasma detected in NY has not been further characterized. The Virginia Grapevine Yellows (VGY) has been associated with the VGYIII phytoplasma (a strain of X-disease or 16SrIII, subgroup III-B) and with the VGYI phytoplasma (a strain of aster yellows or 16SrI, subgroup I-A).

Transmission: No vector insects have been identified for VGY phytoplasmas. However, the survey of vineyards and transmission assays to *V. vinifera* cuttings, faba bean plants and feeding solutions, as well as direct PCR assays from insects, allowed the identification of a few candidate vectors of the aster yellows phytoplasma, among which *Agallia constricta*. X-disease phytoplasma was detected in native *Vitis* sp. and aster yellows was detected from numerous weeds and shrubs within and around the vineyard. No transmission by vine planting material reported.

Varietal susceptibility and sensitivity: In New York, the disease was first observed on cv De Chaunac, then on White Riesling. In Virginia, it is very severe on Chardonnay vines but was observed on other varieties including Riesling, Sauvignon blanc and Cabernet franc.

Other host plants: Both phytoplasmas are widespread in the USA in weeds and cultivated species. X-disease phytoplasma was detected in native *Vitis* sp. and an aster yellows phytoplasma was detected in numerous weeds and shrubs within and around the vineyards.

Detection: With molecular assays using universal or group-specific PCR primers. The X-disease phytoplasma occurring in New York was also detected with monoclonal antibodies and with probes for dot-blot hybridization.

Control: There are no control methods since vectors and reservoirs of the associated phytoplasmas are still undetermined.

2. Historical review

1977 **Uyemoto** *et al*.: Description of a disease of the yellows type affecting the variety De Chaunac in vineyards of New York State denoted Leaf curl and berry shrivel (LCBS). It appeared to be spreading and was perhaps insect borne.

1985 **Pearson** *et al*.: Occurrence of FD-like symptoms on White Riesling grapevines in New York. Symptoms, very similar to those of LCBS, observed in 1983. Symptoms may occur for several years in succession in the same vines.

1991 **Maixner and Pearson**: First data on the study on *S. titanus*, present in New York and its possible relationship with a GY disease.

1993 **Chen** *et al*.: Two MLOs were transmitted from affected grapevines to periwinkles in Udine (Italy) (= FDI or FDU or GYU) and New York. Extracts of periwinkles were used to raise two monoclonal antibodies and to design oligonucletides that were used as probes in DNA-DNA hybridisation or as PCR primers. ELISA and immunfluorescence were positive from periwinkle. Probes and primers yielded positive reactions using DNA extracted from grapevine. Data showed that the Italian and American MLO were related. Detection was positive in symptomless wild *Vitis riparia* growing near vineyards in New York and in some symptomatic grapevines. However, other grapevines with strong symptoms tested negative. The latter observation suggests that another non-related MLO might have been present. The FDI MLO was identified in a parallel work as a member of the X-disease group.

1993 **Daire** *et al*. (a): A Riesling plant from New York and a periwinkle carrying the FDI MLO described above, tested positive for a MLO in the X-disease group with PCR-RFLP of 16S rDNA.

1993 **Maixner** *et al*.: Monitoring of *S. titanus* in New York and transmission assays of a possible infectious agent. Larvae are more frequent on wild *Vitis riparia* at the border of the vineyards. Adults migrate from *V. riparia* to *V. vinifera*.

1993 **Prince** *et al*.: Molecular comparisons between MLOs transmitted to periwinkle from grapevine or detected in a few naturally affected grapevines, show that the FDU (= FDI) strain from Italy and a MLO detected in a grapevine in Virginia (USA) are both related to X-disease.

1993 **Wolf** *et al*.: A GY disease observed in Virginia since 1983 affects large areas with a low incidence and a low spread rate. The relatedness of the associated MLO to X-disease MLO is confirmed.

1998 **Davis** *et al*.: Two phytoplasmas are detected in yellows diseased grapevines in Virginia. Confirmation that a X-disease (16SrIII) group phytoplasma is involved and classification of the latter phytoplasma into a new subgroup, III-I. The second phytoplasma, also detected in wild *V. riparia* vines, is a member of the aster yellows (16SrI) group, subgroup I-A.

2003 **Beanland and Wolf**: Search for possible insect vectors and reservoirs of NAGY phytoplasmas in Virginia. *Agallia constricta* is a suspected vector of VGYI (aster yellows phytoplasma). Other species tested positive and transmitted to feeding solutions. Both VGYI and VGYIII were found in several weeds and shrubs around and inside the vineyards.

E. AUSTRALIAN GRAPEVINE YELLOWS

1. Description

Grapevine yellows were first reported from Australia in 1976 and called Australian grapevine yellows (AGY) in 1983. The association of AGY with phytoplasmas was confirmed as early as 1988. Early and recent surveys have shown that AGY are found in most viticultural regions of Australia, with a higher incidence in warmer inland districts of New South Wales and South Australia. The use of PCR has shown the association with AGY of three different phytoplasmas. In addition, two syndromes with particular symptoms (Restricted Growth and Late Season Leaf Curl) have been found in some cases, consistently associated with AGY symptoms and AGY phytoplasmas but their aetiology is not clear. Conversely, there are reported cases where they were not associated with AGY disease or phytoplasmas.

Main diseases: AGY (*sensu stricto*); Buckland Valley Grapevine Yellows (BVGY), a GY disease found in Victoria (Australia); Restricted Growth (RG), Late Season Leaf Curl (LSLC).

Main symptoms: All symptoms typical for GY can be found on AGY-diseased plants. Affected vines carry one or more shoots with irregular veinal of interveinal yellowing and downward rolling of the leaves that overlay one another in a shingled fashion. The yellow leaf tissue can become necrotic. Shoots may display abortion of bunches or berry shrivel later in the season and death of terminal buds, followed by the progressive death of the shoots, one node after the other. In this particular disease, leaves tend to fall early. Stems of affected shoots develop a blue, waxy appearance and remain rubbery. Mapping of diseased plants show that grapevines appear to be a terminal host of AGY, suggesting that the source is from an alternative host.

Restricted Growth (RG)-affected grapevines show retarded growth resulting in shortened shoots and smaller leaves. Some plants also display uneven bud development resulting in canes and cordons that are bare in places with little or no bunch development.

Late Season Leaf Curl (LSLC)-affected grapevines show symptoms in late summer with tightly downward rolled leaves that often remain green, overlay one another like shingles and become leathery and brittle.

Agents : AGY disease (*sensu stricto*) is associated with two phytoplasmas: the AGY phytoplasma, which is the more frequent and the Tomato big bud (TBB) phytoplasma. The AGY phytoplasma has been designated as *Candidatus* species "*Candidatus* Phytoplasma australiense". It belongs to the stolbur group (16SrXII) but is distinct from the BN and VK phytoplasmas. The 16S rRNA gene has a high sequence similarity (more than 99.5%) with the phytoplasmas associated to Papaya die back (PDB) in Australia and to *Phormium* yellow leaf (PYL) in New Zealand, respectively. It has been suggested that all three phytoplasmas are strains of the same phytoplasma species. The TBB phytoplasma has been designated as *Candidatus* species "*Candidatus* Phytoplasma australasia". It belongs to the peanut witches' broom group (16SrII) and has a broad plant host range in Australia.

BVGY phytoplasma has not been clustered in an established phytoplasma group. The sequence similarity of the 16S rRNA gene shows that it is close to members of the aster yellows group (16SrI), clover phyllody phytoplasma (16SrI-C) being the closest .

Transmission: No vectors have been identified for any AGY disease. The AGY phytoplasma was detected in the common leafhopper *Orosius argentatus* (Evans) but transmission to grapevine has not been reported. The planthopper *Oliarus atkinsoni* Myers (Hemiptera, Cixiidae) is known as the vector of PYL disease in New Zealand but the species has not been reported from Australia. The TBB phytoplasma is transmitted to other crops by *O. argentatus*. Recent studies have shown that the latter phytoplasma can be acquired from infected grapevine by *O. argentatus* and subsequently transmitted to faba bean but the ability to transmit to grapevine was not confirmed. The BVGY phytoplasma has no suspected insect vector. However, this phytoplasma is associated with GY disease in vineyards in the same restricted grape-growing areas that were established with planting material from different sources, suggesting that the disease is the result of an aerial transmission and that the phytoplasma was not present in the original planting material.

Varietal susceptibility and sensitivity: Chardonnay and Riesling appear to be most often affected, but phytoplasmas were also detected in other red- and white-berried varieties, such as Shiraz or Semillon. It is possible that AGY diseases have become prevalent in Australia in the last years with the increasing planting of Chardonnay.

Remission of AGY, RG and LSLC diseases has been observed. A "heat curing" effect of AGY disease by hot weather has been observed, suggesting that this contributes to the decline in phytoplasma numbers and to the remission of symptoms. However, once vines are infected by AGY, RG or LSLC, they are at greater risk of displaying symptoms again in the following years, indicating persistence of the disease.

Other host plants: As mentioned above, AGY phytoplasmas are common in several crops in Australia. Several observations suggest that aerial transmission prevails. Hence, reservoirs must be important but the epidemiology is not fully understood.

Detection: Detection is obtained with PCR. All generic "universal" primers may be used, followed by RFLP analysis or sequencing. Specific primers have been designed on the 16S rRNA gene for detection of AGY phytoplasma (*Ca*. Phytoplasma australiense) either in single-step or nested PCR following a first amplification with universal primers. Similarly, a specific primer in the intergenic 16S-23S spacer region has been designed for detection of TBB phytoplasma (*Ca*. Phytoplasma australasia). Detection can be from shoots, branches, trunks and roots throughout the year and infection is persistent from year to year. Sampling simultaneously from shoots, branches, and trunks in October is more reliable.

Control: There are no methods to control AGY diseases in the vineyard. Sanitation with hot water treatment is being developed in Australia.

2. Historical review

1982 **Magarey and Wachtel**: Description of a new disease of the yellows type in cv Rhine Riesling in South Australia.

1983 **Magarey** *et al*.: The "Rhine Riesling problem" denoted "Australian Grapevine Yellows".

1985 **Magarey and Wachtel**: Review of the AGY problem. Reduction of symptom expression in vines injected with tetracycline. Phloem fluorescence of diseased vines in the UV microscope.

1986 **Magarey**: Comprehensive review of GY diseases in the world.

1986 **Magarey and Wachtel**: GY symptoms are found in most viticultural areas of Australia. The incidence of disease may be temporarily high in some vineyards of Chardonnay.

1988 **Magarey**: The situation of GY in Australia.

1988 **Magarey** *et al*.: MLOs, 140-510 nm in diameter, found in sieve tubes of diseased vines are associated with AGY symptoms.

1989 **Osmelak** *et al*.: *Orosius argentatus*, vector of TBB in tomato crops, is found in high numbers together with two other potential MLO vectors in vineyards of Victoria (Australia).

1995 **Bonfiglioli** *et al*. (a and b): Positive detection of phytoplasma with PCR in AGY-affected grapevines and tentative survey of phytoplasmas in Australia.

1995 **Padovan** *et al*. (a and b): The phytoplasma associated with AGY is related to an aster yellows type phytoplasma associated with GY in Italy (later on identified as the stolbur phytoplasma).

1996 **Padovan** *et al*.: Further comparison of AGY phytoplasma with overseas GY phytoplasmas show that it is closely related to, but different from the stolbur phytoplasma associated with BN in France, Spain and Israel.

1997 **Bonfiglioli** *et al*.: Assumption from field observations and monitoring that AGY, RG and LSLC are associated. LSLC would be followed by AGY on the following year and AGY would be followed by RG in subsequent years.

1997 **Davis** *et al*.: Description of the AGY phytoplasma and designation of a new taxon, *Candidatus* Phytoplasma australiense.

1997 **Wilson** *et al*.: Description of AGY symptoms.

1998 **Constable** *et al*.: Detection of phytoplasmas associated with AGY, RG, and LSLC.

1998 **Kelly** *et al*.: No vector for AGY found. Hence, insecticide sprays are useless for controlling the disease.

1998 **Liefting** *et al*.: Close relationships between phytoplasmas associated with AGY, Papaya dieback and Phormium yellow leaf diseases.

1999 **Beanland** *et al*.: AGY phytoplasma detected in the body of *Orosius argentatus* leafhoppers.

1999 **Constable and Symons**: AGY phytoplasma is detected in most symptomatic grapevines but also TBB phytoplasma and a third uncharacterised phytoplasma, later called BVGY phytoplasma. Uneven distribution of phytoplasmas in infected plants. Spring and summer are optimal for detection.

1999 **Gibb** *et al*.: The AGY phytoplasma is consistently present in the majority of symptomatic grapevines. It is occasionnally detected in symptomless vines and in vines with LSLC or RG symptoms. The TBB phytoplasma is detected occasionnally in vines with AGY symptoms and also in LSLC-affected vines.

2000 **Constable** *et al*.: Identification of a new phytoplasma in Chardonnay grapevines in Victoria (Australia).

2000 **Habili** *et al*.: Comparison of visual assessment and diagnostic assays. The problem of symptomlessly infected vines.

2001 **Beanland** *et al*.: TBB phytoplasmas can be acquired from diseased grapevine by *Orosius argentatus* and subsequently transmitted to faba bean.

2001 **Waite** *et al*.: Use of hot water treatment in commercial nurseries of Australia.

2002 **Constable**: PhD thesis on the biology and epidemiology of AGY phytoplasmas.

2002 **Constable** *et al*.: Study of the phylogenetic relationships of the BVGY phytoplasma with aster yellows and stolbur phytoplasmas. BVGY might form a new AY subgroup of AY *(*16Sr*)* group or even a new phytoplasma group.

2002 **Constable** *et al*.: BVGY phytoplasma is associated to GY symptoms that may show remission then reoccurrence but also appear on vines that were not affected previously, resulting in increasing cumulative incidence. Detection of BVGY in another plot in the same area, established from a different source of plant material indicate that BVGY disease occurs as a result of aerial transmission.

2002 **Crocker** *et al*.: The management of the area for plant material in the nursery with the scope of hot water treatment.

2003 **Constable** *et al*. (a and b): Biology and epidemiology of AGYs. The AGY and the TBB phytoplasmas may persistently affect grapevines throughout the year and between years. Symptomatic shoots from AGY affected vines are reliable for detection in summer (January). At other times of the year, detection is more reliable from samples taken from branches and trunks.

2004 **Constable and Symons**: Study with Heteroduplex mobility assay (HMA) of the elongation factor Tu (*Tuf*) gene of the AGY and the BVGY phytoplasmas. Two isolates of AGY and Papaya dieback (PDB) phytoplasma did not show variability between them but showed some variability when compared to a reference AGY phytoplasma. No variability was observed amongst BVGY phytoplasma isolates.

2004 **Constable** *et al*.: Survey of AGY, RG and LSLC symptoms for 3 to 6 years in Chardonnay and Shiraz vineyards. In Chardonnay, the diseases are characterized by remission in some plants, recurrence in other vines and new occurrence in previously unaffected vines. The total cumulative incidence for AGY could be as high as 90%. Statistical analysis showed that RG and LSLC diseases were not always associated with AGY. However, TBB phytoplasma may have a role in the aetiology of LSLC. There is no information of transmission of AGY by planting material. The incidence of AGY in a plot of cv Shiraz that had been treated with hot water suggests that AGY phytoplasmas are introduced to vineyards by aerial transmission.

F. OTHER GRAPEVINE YELLOWS

1. Description

Besides the cases reported above, three different situations must be described. The first is the detection in countries other than the USA, of phytoplasmas belonging to the aster yellows group (16SrI) in yellows-affected grapevines, sometimes as a second phytoplasma in co-infection with FD or BN phytoplasmas and sometimes also in symptomless grapevines. These aster yellows phytoplasmas belong to subgroups I-B or I-C (clover phyllody) which are ubiquitous in Europe. They must not be confused with the 16SrI-G phytoplasma of earlier reports, which was the first designation for stolbur phytoplasma in some laboratories, later designated 16SrXII. It seems that aster yellows phytoplasmas have no important significance in European grapevine yellows. However, they seem to have some relevance in Israel and were recently reported from Tunisia. The second situation is the significant occurrence of X-disease group (16SrIII) phytoplasmas in countries other than the USA, namely Israel. The third situation is represented by poorly characterized GYs recorded from new countries.

Transmission: Aster yellows and, to a lesser extent, X-disease group phytoplasmas, are very frequent in many host plant species and several insect species are known as vectors or potential vectors in different countries.

Varietal susceptibility and sensitivity: Chardonnay, a variety widely grown in all countries and very sensitive to all GY agents, is often reported in connection with these cases. Other varieties are cited in the different situations.

2. Historical review

Europe

1996 **Alma** *et al*.: Survey of phytoplasmas infecting grapevine in northern Italy. In three instances, a 16SrI-B phytoplasma was found in mixed infection with a stolbur phytoplasma (at that time designated 16SrI-G).

1997 **Saric** *et al*.: Detection of phytoplasma in the aster yellows group in GY affected plants in Slovenia and Croatia. The subgroup of aster yellows was not determined but primers specific for stolbur tested negative.

2001 **Alma** *et al*.: Experimental transmission of the Chrysanthemum yellows phytoplasma (16SrI-B) to grapevine by four leafhopper species, including *S. titanus*. Similar transmission of clover phyllody (16SrI-C) MLO by *S. titanus* had been obtained in 1971 in France (cf. Caudwell *et al*. 1971b).

2003 **D'Ascenzo** *et al*.: A 16SrI-C phytoplasma was found associated with GY in relevant percentages in the same vineyards as stolbur (BN) phytoplasma in Abruzzo region (eastern central Italy).

Israel

1997 **Tanne and Orenstein**: Grapevine phytoplasmas in Israel were transmitted to periwinkle with heterografting and identified in the periwinkle as 16SrIII and 16SrI phytoplasmas.

2000 **Tanne** *et al*.: Monitoring of potential phytoplasma vectors in vineyards in Israel and molecular detection of phytoplasmas in their body. *Neoaliturus* sp*., Orosius orientalis*, *Macrosteles sexnotatus*, *Circulifer* spp. and *Anaceratagalia laevis* were all found carrying an aster yellows phytoplasma. In addition, a X-disease phytoplasma was detected in some *Neoaliturus* specimen.

2001 **Klein** *et al*.: Further survey of GY vectors in the Golan Heights. *H. obsoletus* was found in addition to the preceding 5 species.

2003 **Orenstein** *et al*.: Survey over several years of potential vectors of phytoplasmas in vineyards of the Golan Heights showed that *Neoaliturus fenestratus, H. obsoletus* and *Circulifer haematoceps* were all three abundant and positive for stolbur and aster yellows phytoplasmas. *Megophthalmus scabripennis* was positive for aster yellows phytoplasma. The spatial and temporal dispersion of the four species was analysed.

Tunisia

2003 **Chabbouh** *et al*.: First results on the monitoring of GY diseases in Tunisia in imported table grape varieties. Trapping of hemipters and identification of numerous potential phytoplasma vectors. Transmission to periwinkle of yellows diseases using collected insects. Detection with PCR show erratic identification of a 16SrI-B phytoplasma.

2003 **M'hirsi** *et al*.: Formal identification of a 16SrI-B phytoplasma in GY-affected grapevines in Tunisia.

South America

1980 **Caudwell**: Description of a disease of the yellows type in Chile, called "Amarilliamento de Elqui". In addition to similarities of symptoms with FD, some affected vines showed a sudden fall of leaves in summer.

2003 **Gajardo** *et al*.: Identification in yellows-affected vines of varieties Petit Syrah, Merlot and Carmenere, of phytoplasmas belonging to group 16SrI, subgroups I-B and I-C and also to group 16SrVIII (Ash yellows) in mixed infection with I-B. Stolbur phytoplasma (16SrXII) was also detected.

GRAPEVINE YELLOWS: REFERENCES

Agulhon R. and J. C. Laurent, 1987. Informations sur l'évolution de la cicadelle *Scaphoideus titanus*. *Progrès agricole et viticole* **104**, 340-341.

Ahrens U. and E. Seemüller, 1992. Detection of DNA of plant pathogenic mycoplasmalike organisms by a polymerase chain reaction that amplifies a sequence of the 16S rRNA gene. *Phytopathology* **82**, 828-832.

Albanese G., R.E. Davis, G. Granata, E.L. Dally, T. Santuccio, M. Tessitori, 1996. DNA-based analyses to detect and identify phytoplasmas in yellows-diseased grapevines in Sicily. Petria 6, 65-75.

Albanese G., G. Granata, S. Collodoro, E. Egger, P. Baioletti and M. D'Arcangelo, 1997. Individuazione e caratterizzazione molecolare di fitoplasmi in piante di vite con sintomi di giallume in Umbria. *Rivista di Viticoltura e di Enologia* **50** (4), 3-9.

Aldini R.N., M.C. Guardiani and P. Cravedi, 1998. Rilievi faunistici sugli Omotteri Auchenorrinchi in vigneti della provincia di Piacenza. *Bolletino di Zoologia Agraria e di Bachicoltura* **30** (1), 61-68.

Alma A, 2002. Diffusione di *Scaphoideus titanus* Ball in Italia. *Atti Giornate Fitopatologiche 2002*, 51-53.

Alma A., A. Arzone and D. Bosco, 1993. Grapevine MLO transmission by insects. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 84-85.

Alma A., R. E. Davis, M. Vibio, A. Danielli, D. Bosco, A. Arzone and A. Bertaccini, 1996. Mixed infection of grapevines in northern Italy by phytoplasmas including 16S rRNA RFLP subgroup 16SrI-B strains previously unreported in this host. *Plant Disease* **80**, 418-421.

Alma A., D. Bosco, A. Danielli, A. Bertaccini, M. Vibio and A. Arzone, 1997. Identification of phytoplasmas in eggs, nymphs and adults of *Scaphoideus titanus* Ball reared on healthy plants. *Insect Molecular Biology* **6**, 115-121.

Alma A., S. Palermo, G. Boccardo and M. Conti, 2001. Transmission of Chrysanthemum yellows, a subgroup 16SrI-B phytoplasma, to grapevine by four leafhopper species. *Journal of Plant Pathology* **83**, 181-187.

Alma A., G. Soldi, R. Tedeschi and C. Marzachi, 2002. Ruolo di *Hyalesthes obsoletus* Signoret (Homoptera: Cixiidae) nella trasmissione del Legno nero della vite in Italia. *Atti II Incontro Nazionale sulle Malattie da Fitoplasmi, Roma 2002,* 57-58.

Altabella N., A. Laviña and A. Battle, 2002. Study of the transmission of Stolbur phytoplasma by *Macrosteles quadripunctulatus* to different plant species. *Abstracts 11th International Auchenorrhyncha Congress, Potsdam 2002*, 70.

Angelini E., D. Clair, M. Borgo, A. Bertaccini and E. Boudon-Padieu, 2001. Flavescence dorée in France and Italy - Occurrence of closely related phytoplasma isolates and their near relationships to Palatinate grapevine yellows and an alder yellows phytoplasma. *Vitis* **40**, 79-86.

Angelini E., E. Negrisolo, D. Clair, M. Borgo and E. Boudon-Padieu, 2003a. Phylogenetic relationships among Flavescence dorée isolates and related phytoplasmas determined by Heteroduplex Mobility Assay and sequences of ribosomal and non-ribosomal DNA. *Plant Pathology* **52**, 663-672.

Angelini E., F. Squizzato, L. Gianluca and M. Borgo, 2003b. Identification of a grapevine FD-C phytoplasma and two deletion mutants in Clematis. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 60-61. http://www.agr.uniba.it/ICVG2003/

Angelini E., F. Squizzato, L. Gianluca and M. Borgo, 2004. Detection of a phytoplasma associated with grapevine Flavescence dorée in *Clematis vitalba*. *European Journal of Plant Pathology* **110**, 193-201.

Anonymous, 1985. La flavescence dorée dans l'Aude en 1985. *Progrès agricole et viticole* **102**, 569-573.

Anonymous, 1989. Etude de l'efficacité de divers insecticides sur la cicadelle *Scaphoideus titanus* vectrice de la Flavescence dorée. *Progrès agricole et viticole* **106**, 163-169.

Anonymous, 1992. La lutte contre la flavescence dorée de la vigne dans le cadre de l'agriculture biologique. *Progrès agricole et viticole* **109**, 523-526.

Arnò C., A. Alma, D. Bosco and A. Arzone, 1993. Investigations on spatial distribution and symptom fluctuation of Flavescence dorée in 'Chardonnay' vineyards. *Petria* **3**, 81-91.

Arzone A., A. Alma, A. Patetta and D. Bosco, 1991. Grapevine golden flavescence MLOs in plant and vector. *Proceedings 10th Meeting of ICVG, Volos 1990,* 184-192.

Arzone A., A. Alma, C. Arnò and D. Bosco, 1992. Ricerca su flavescence dorée e auchenorrinchi probabili vettori del suo agente patogeno. *Quaderni Piemonte Agricoltura* **16** (3 suppl.), 90-93.

Arzone A., A. Bertaccini, R.E. Davis, A. Alma, D. Bosco, M. Vibio and J. P. Prince, 1993a. Molecular detection of MLOs associated with grapevine yellows disease in Piemonte, Italy. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 86-87.

Arzone A., P. Cravedi and F. Pavan, 1993b. Epidemiologia della malattia. *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 39-47.

Arzone A., A. Alma, D. Bosco and A. Patetta, 1995. MLO-infected weeds in the vineyards of north-western Italy. *Journal of Phytopathology* **143**, 257-260.

Bagard A, 1987. La flavescence dorée dans le vignoble corse. *Atti del Convegno sulla Flavescenza Dorata della vite, Vicenza-Verona, Italy, 1987,* 69-90.

Bagard M. and G. Felici, 1986. La flavescence dorée, une menace permanente pour le vignoble corse. *Phytoma - La Défense des Végétaux* **379**, 25-27.

Baggiolini M., V. Canevascini, R. Caccia, Y. Tencalla and G. Sobrio, 1968. Présence dans le vignoble du tessin d'une cicadelle néarctique nouvelle pour la Suisse, *Scaphoideus littoralis* Ball. (Homoptera, Jassidae), vecteur possible de la Flavescence dorée. *Mitteilungen Schweizerische Entomologische Gesellschaft* **60**, 270-275.

Batlle A. and A. Laviña, 1997. Identification of grapevine yellows phytoplasmas in the northern Spain. *Proceedings 12th Meeting of ICVG, Lisboa 1997,* 69-70.

Batlle A., A. Laviña, C. Kuszala, D. Clair, J. Larrue and E. Boudon-Padieu, 1997. Detection of flavescence dorée phytoplasma in grapevine in northern Spain. *Vitis* **36**, 211-212.

Batlle A., M.A. Martinez and A. Laviña, 2000. Occurrence, distribution and epidemiology of Grapevine Yellows in Spain. *European Journal of Plant Pathology* **106**, 811-816.

Beanland L., M. Kelly, R. Faggian, J. MacFarlane and D. Glenn, 1999. In search of an insect vector of Australian grapevine yellows. Species composition and abundance of potential vectors. *The Australian Grapegrower and Winemaker* **430**, 41-46.

Beanland L., L. Pollock and M. Rankin, 2001. Studies of Australian grapevine yellows. *The Australian Grapegrower and Winemaker* **449a,** 114-118.

Beanland L. and T. Wolf, 2003. Possible insect vectors of North American grapevine yellows phytoplasma in Virginia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 64-65. http://www.agr.uniba.it/ICVG2003

Belli G., A. Fortusini, R. Osler and A. Amici, 1973. Presence of a “Flavescence dorée” type disease in vineyards of Oltrepò Pavese. *Rivista di Patologia Vegetale* (S.V) **9** (suppl.), 50-56.

Belli G., D. Rui, A. Fortusini, L. Pizzoli and G. Torresin, 1984. Presenza dell'insetto vettore (*Scaphoideus titanus*) e ulteriore diffusione della Flavescenza dorata nei vigneti del Veneto. *Vignevini* **11**, 23-27.

Belli G., A. Fortusini and D. Rui, 1985a. Recent spread of Flavescence dorée and its vector in vineyards of Northern Italy. *Phytopathologia Mediterranea* **24**, 189-191.

Belli, G., D. Rui, A. Fortusini, G. Torresin, L. Pizzoli, P. A. Bianco and S. Carraro, 1985b. La flavescenza dorata della vite e le sue manifestazioni nel Veneto. *Atti del Convegno "Problemi Attuali di Patologia Viticola", Vicenza 1985,* 13-25.

Belli G., P.A. Bianco and A. Fortusini, 1993. Osservazioni e richerche sulla flavescenza dorata della vite in Lombardia e zone limitrofe. *Extended Abstracts, Convegno "La flavescenza dorata ed altri giallumi della vite, stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 55-57.

Belli G., R. Credi and E. Refatti, 1994. Recenti sviluppi nelle conoscenze sulla flavescenza dorata ed altri giallumi della vite. *Atti Giornate Fitopatologiche 1994,* **2**, 295-306.

Belli G., A. Fortusini, P.A. Bianco, G. Torresin, S. Carraro and L. Pizzoli, 1997. Flavescenza dorata e altri giallumi della vite. *L'Informatore agrario* **53** (19), 69-73.

Belli G., P.A. Bianco, P. Casati and G. Scattini, 2000. Gravi e diffuse manifestazioni di flavescenza dorata della vite in Lombardia. *L'Informatore agrario* **56** (30), 56-59.

Bertaccini, A., A. Arzone, A. Alma, D. Bosco and M. Vibio, 1993a. Detection of mycoplasma-like organisms in *Scaphoideus titanus* Ball reared on flavescence dorée infected grapevine by dot hybridizations using DNA probes. *Phytopathologia Mediterranea* **32**, 20-24.

Bertaccini, A., R.E. Davis, M. Vibio, J.P. Prince and R. Credi, 1993b. Detection and characterization of mycoplasmalike organism (MLO) DNA in naturally infected grapevine cultivars in Emilia-Romagna, Italy : Polymerase Chain Reaction and restriction analyses. *Extended Abstracts 11th Meeting of ICVG, Montreux 1993,* 88-89.

Bertaccini A., M. Vibio and E. Stefani, 1995. Detection and molecular characterization of phytoplasmas infecting grapevine in Liguria (Italy). *Phytopathologia Mediterranea* **34**, 137-141.

Bertaccini A., M. Vibio, D. A. Schaff, E. Murari, M. Martini and A. Danielli, 1997. Geographical distribution of elm yellows-related phytoplasmas in grapevine flavescence dorée outbreaks in Veneto (Italy). *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 57-58.

Bertaccini A., M. Borgo, M. Pondrelli, E. Murari, S. Sartori and A. Bonetti, 2000. Efficiency of molecular tests to control phytoplasma elimination. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000,* 116-117.

Bertaccini A., M. Borgo, L. Bertotto, A. Bonetti, S. Botti, S. Sartori, M. Pondrelli and E. Murari, 2001. Termoterapia e chemioterapia per eliminare i fitoplasmi da materiali di moltiplicazione della vite. *L'Informatore agrario* **57** (42), 137-144.

Bertaccini A., N. Mori, S. Botti, A. Castiglioni, G. Cavallini and A. Malossi, 2003. Survey on Bois noir phytoplasmas spreading in vineyards of Modena province (Italy). *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 104-105. http://www.agr.uniba.it/ICVG2003/

Bertamini M. and N. Nedunchezhian, 2001. Effects of phytoplasma (stolbur-subgroup (Bois noir-BN)) on photosynthetic pigments, saccharides, ribulose 1,5-bisphosphate carboxylase, nitrate and nitrite reductases, and photosynthetic activities in field-grown grapevine (*Vitis vinifera* L. cv. Chardonnay) leaves. *Photosynthetica* **39** (1), 119-122.

Bianco, P.A., R. E. Davis, J. P. Prince, I. M. Lee, D. E. Gundersen, A. Fortusini and G. Belli, 1993a. Double and single infections by aster yellows and elm yellows MLOs in grapevines with symptoms characteristic of Flavescence dorée. *Rivista di Patologia Vegetale* (S.V) **3**, 69-82.

Bianco, P.A., R. E. Davis, J. P. Prince, I. M. Lee, B. D. Mogen and G. Belli, 1993b. PCR detection of a mycoplasma-like organism (MLO) in Flavescence dorée diseased grapevines from Lombardia, Italy. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 90-91.

Bianco P.A., R. E. Davis, J. P. Prince, A. Fortusini, P. Casati and G. Belli, 1994. Elm yellows and aster yellows MLOs associated with a grapevine disease very similar to Flavescence dorée in northern Italy. *IOM Letters* **3**, 251-252.

Bianco P.A., P. Casati, R. E. Davis and G. Scattini, 1996a. Two different phytoplasmas belonging to group 16SrV may occur in grapevines affected by Flavescence dorée disease. *IOM Letters* **4**, 192-193.

Bianco P.A., R.E. Davis, P. Casati and A. Fortusini, 1996b. Prevalence of aster yellows (AY) and elm yellows (EY) group phytoplasmas in symptomatic grapevines in three areas of northern Italy. *Vitis* **35**, 195-199.

Bianco P.A., A. Alma, P. Casati, G. Scattini, A. Arzone and G. Belli, 1997. Experimental transmission of 16SrV phytoplasmas by *Scaphoideus titanus* Ball. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 59-60.

Bianco P.A., A. Fortusini, G. Scattini, P. Casati, S. Carraro and G. C. Torresin, 2000a. Prove di risanamento di materiale viticolo affetto da Flavescenza dorata mediante termoterapia. *Informatore Fitopatologico* **50** (4), 43-49.

Bianco P.A., G. Scattini, P. Casati and A. Fortusini, 2000b. Thermotherapy of grapevine cuttings for flavescence dorée eradication, *Extended abstracts 13th Meeting of ICVG, Adelaide 2000,* 162-163.

Bianco P. A., A. Alma, P. Casati, G. Scattini and A. Arzone, 2001. Transmission of 16SrV phytoplasmas by *Scaphoideus titanus* Ball in northern Italy. *Plant Protection Science*, **37** (2) 49-56.

Bianco P.A., P. Casati, N. Marziliano and G. Belli, 2002. Detection of phytoplasmas associated to grapevine Flavescence dorée disease by a specific 5' nuclease assay (TaqMan®). *IOM Letters* **7**, 209.

Bianco P.A., A. Frosini, P. Casati and G. De Bellis, 2003a. Identification of phytoplasmas infecting grapevine by ligase reaction and universal array. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 55. http://www.agr.uniba.it/ICVG2003/

Bianco P.A., F. Quaglino, P. Casati and M. Calvi, 2003b. Genetic variability and distribution of grapevine phytoplasmas of group 16Sr-V in Lombardia (northern Italy). *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 84. http://www.agr.uniba.it/ICVG2003/

Boidron, R. and S. Grenan, 1992. Appareil à eau chaude pour le traitement des bois contre la flavescence dorée. *Progrès agricole et viticole* **109**, 271-273.

Bonfiglioli R.G., P.A. Magarey and R.H. Symons, 1995a. PCR analysis confirms an expanded symptomatology for Australian grapevine yellows. *Australian Journal of Grape and Wine Research* **1**, 71-75.

Bonfiglioli R.G., L.F. Schliefert, R.J. Gibson, P.A. Magarey, M.F. Wachtel, K.S. Gibb and R.H. Symons, 1995b. Preliminary survey of the distribution of phytoplasma associated with Australian grapevine yellows. *The Australian Grapegrower and Winemaker* **32** (378a), 98.

Bonfiglioli R.G., C.T. Carey, L.F. Schliefert, A.J. Kinnear and R.H. Symons, 1997. Description and progression of symptoms associated with grapevine yellows disease in young Chardonnay vines in the Sunraysia district. *The Australian Grapegrower and Winemaker* **400**, 11-15.

Bonfils J. and D. Schvester, 1960. Les Cicadelles (Homoptera, Auchenorrhyncha) dans leurs rapports avec la vigne dans le Sud-Ouest de la France. *Annales des Epiphyties* **11**, 325-336.

Borgo M., 1987a. Evoluzione della malattia "flavescenza dorata" rilevata su alcuni vitigni sensibili nel Veneto. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 103-119.

Borgo M., 1987b. Primi risultati di saggi biologici e di ricerca di varietà tolleranti alla malattia "flavescenza dorata" della vite mediante prove di sovrinnesto. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 121-139.

Borgo, M., 1989. Présence de dépérissements du type "flavescence dorée" sur la vigne en Italie. *In:* R. Cavalloro (Editor), Influence of Environmental Factors on the Control of Grape Pests, Diseases and Weeds. *Proceedings of the Meeting of EC Experts' Group, Thessaloniki, October 1987.* A.A. Balkema, Rotterdam, Netherlands. 285-294.

Borgo M., 1996. Fitoplasmosi della vite in provincia di Treviso. Diffusione di legno nero e flavescenza dorata. *L'Informatore agrario* **52** (20), 72-75.

Borgo M., 1998. Riconoscimento di viti affette da malattie da fitoplasmi. *L'Informatore agrario* **54** (24), 51-63.

Borgo M. and E. Angelini, 2002. Diffusione della Flavescenza dorata della vite in Italia e relazioni con vitigni, pratiche agronomiche e materiali di propagazione. *Atti Giornate Fitopatologiche 2002*, 35-50.

Borgo M., E. Egger and L. Corino, 1987. Presenza e diffusione in Italia della "flavescenza dorata", malattia responsabile di gravi deperimenti su vitigni europei. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 209-236.

Borgo M., E. Murari, S. Sartori, A. Zanzotto, P. Sancassani and A. Bertaccini, 1999. Termoterapia per eliminare i fitoplasmi da vite. *L'Informatore agrario* **24**, 47-51.

Bosco D., A. Alma and A. Arzone, 1997. Studies on population dynamics and spatial distribution of leafhoppers in vineyards (Homoptera, Cicadellidae). *Annals of Applied Biology* **130**, 1-11.

Boselli M, 1999. Spatial distribution and severity of grapevine yellows on Albarola and Vermentino grapevine (*Vitis vinifera* L.) cultivars in eastern Liguria (northern Italy). *Advances in Horticultural Science* **13**, 41-45.

Botti S. and A. Bertaccini, 2003. Molecular variability in flavescence dorée phytoplasmas as marker for the disease outbreaks in vineyards. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 62-63. http://www.agr.uniba.it/ICVG2003/

Boubals D., 1993a. Situation actuelle des maladies à mycoplasmes (Flavescence dorée et autres jaunisses de la vigne) dans le vignoble français. *Progrès agricole et viticole* **110**, 540-543.

Boubals D., 1993b. Une grave épidémie de jaunisse de la vigne sur le Golan (Israël). *Progrès agricole et viticole* **110**, 361-364.

Boubals D. and A. Caudwell, 1971. Une épidémie de jaunisse dans le vignoble corse : probablement la Flavescence dorée. *Progrès agricole et viticole* **88**, 355-364.

Boudon-Padieu E., 1996a. Jaunisses à mycoplasmes de la vigne. Diagnostic, épidémiologie, et développement des recherches. *Comptes rendus des Séances de l'Académie d'Agriculture de France* **82**, 5-20.

Boudon-Padieu, E, 1996b. Le Bois noir. Des inconnues sont levées, mais d'autres demeurent. *Phytoma - La Défense des Végétaux* **488** (Nov 1996), 10-13.

Boudon-Padieu E., 1999. Grapevine phytoplasmas. *First Internet conference on phytopathogenic mollicutes,* http://www.Uniud.it/phytoplasma/pap/boud8290.Html

Boudon-Padieu E., 2000a. La cicadelle vectrice de la Flavescence dorée, *Scaphoideus titanus* Ball, 1932. *In:* Ravageurs de la vigne. Editions Féret, Bordeaux, France, 110-120.

Boudon-Padieu E., 2000b. Les jaunisses à phytoplasmes de la vigne. *In:* Les Maladies à virus, bactériennes et à phytoplasmes de la Vigne, Editions Féret, Bordeaux, France, 121-167.

Boudon-Padieu E., 2000c. Recent advances on grapevine yellows, detection, etiology, epidemiology and control strategies. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 87-88.

Boudon-Padieu E., 2002a. Flavescence dorée of the grapevine, knowledge and new developments in epidemiology, etiology and diagnosis. *Atti Giornate Fitopatologiche 2002*, 15-34.

Boudon-Padieu E., 2003. The situation of grapevine yellows and current research directions, distribution, diversity, vectors, spreading and control. *Extended abstracts 14th Meeting of ICVG, Locorotondo 2003,* 47-53. http://www.agr.uniba.it/ICVG2003/

Boudon-Padieu E. and J. Larrue, 1986. Diagnostic rapide de la Flavescence dorée de la vigne par le test ELISA sur la cicadelle vectrice. Application à des populations naturelles de *Scaphoideus littoralis*. Confirmation de la présence de la Flavescence dorée dans les Bouches du Rhône. *Progrès agricole et viticole* **103**, 524-526.

Boudon-Padieu E. and M. Maixner, 1998. Grapevine Yellows, current knowledge and control methods / Jaunisses de la vigne, état des connaissances et des méthodes de lutte. *OIV Bulletin / Bulletin de l'OIV* **71**, 572-606.

Boudon-Padieu E., Y. Schwartz, J. Larrue and A. Caudwell, 1987a. ELISA and immunoblotting detection of grapevine Flavescence dorée-MLO induced antigens in individual vector leafhoppers. *Bulletin OEPP/EPPO Bulletin* **17**, 305.

Boudon-Padieu E., T. Terwisscha Van Scheltinga, J. Lherminier and A. Caudwell, 1987b. ELISA and immunofluorescence (IF) detection of the MLO agent of grapevine flavescence dorée on individual leafhopper vectors. *Israel Journal of Medical Science* **23**, 506.

Boudon-Padieu E., J. Larrue, A. Caudwell, 1989a. ELISA and Dot-Blot detection of Flavescence dorée MLO in individual leafhopper vectors during latency and inoculative state. *Current Microbiology* **19**, 357-364.

Boudon-Padieu E., Y. Schwartz, R. Meignoz, J. Lherminier, J. Larrue and A. Caudwell, 1989b. Immunoenzymatic detection of the MLO pathogen agent of grapevine flavescence dorée. Correlation with its visualization. *Proceedings 9th Meeting of ICVG, Kiryat Anavim 1987,* 185-195.

Boudon-Padieu E., J. Larrue and A. Caudwell, 1990. Serological detection and characterization of grapevine flavescence dorée MLO and of other plant MLOs. *IOM Letters* **1**, 217-218.

Boudon-Padieu E., X. Daire, D. Clair, A. Laviña, A. Batlle, W. Reinert and M. Maixner, 1997. Differentiation of grapevine phytoplasmas in the elm yellows and the stolbur group with the use of RFLP of non-ribosomal DNA. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 55-56.

Boudon-Padieu E., A. Béjat, D. Clair, J. Larrue, M. Borgo, L. Bertotto and E. Angelini, 2003. Grapevine yellows: comparison of different procedures for DNA extraction and amplification for routine diagnosis of phytoplasmas in grapevine. *Vitis* **42***,* 141-149.

Bourquin L., A. Schmid, J. De Meyer, O. Cazelles, M. E. Ramel and P. Gugerli, 2000. Confirmation of the presence of stolbur-type yellows in Swiss vineyards by molecular diagnosis of grapevine. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 111-112.

Bovey R., 1992. Le rôle des porte-greffe dans la dissémination des maladies à virus et affections similaires de la vigne. *Revue suisse de viticulture, arboriculture et horticulture* **24**, 321-324.

Braccini P. and F. Pavan, 2000. Indagine sulla presenza di auchenorrinchi in vigneti della Toscana centrale. *Petria* **10**, 181-182.

Braccini P., A. Sfalanga, M. Pondrelli, M. Martini and A. Bertaccini, 2000. Diffusione di fitoplasmi in vigneti della Toscana centrale. *Petria* **10**, 177-178.

Branas J., 1956a. La "Maladie" du 22A. *Progrès agricole et viticole* **77**, 289-297.

Branas J., 1956b. La "Maladie" du Chardonnay et les épidémies de flavescence. *Progrès agricole et viticole* **77**, 319-325.

Bressan A., S. Spiazzi, C. Capuzzo, V. Girolami, E. Boudon-Padieu, 2003. Seasonal probability of Flavescence dorée phytoplasma transmission in relation to abundances of leafhopper vectors and source for acquisition. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 107-108. http://www.agr.uniba.it/ICVG2003/

Carraro L., R. Osler, N. Loi, E. Refatti and V. Girolami, 1986. Diffusione nella regione Friuli-Venezia Giulia di una grave malattia della vite assimilabile alla Flavescenza dorata. *Un vigneto chiamato Friuli* **4** (5), 4-9.

Carraro L. and F. Pavan, 1988. La flavescenza dorata della vite in Friuli. I primi risultati delle ricerche nel 1987. *Un vigneto chiamato Friuli* **6** (4), 6-10.

Carraro L., N. Loi, C. Kuszala, D. Clair, E. Boudon-Padieu and E. Refatti, 1994. On the ability-inability of *Scaphoideus titanus* Ball to transmit different grapevine yellows agents. *Vitis* **33**, 231-234.

Carraro L., R. Osler and E. Refatti, 2000. Storia dei giallumi della vite nei Friuli-Venezia Giulia. *Atti del Convegno "Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia", Gorizia 1999,* 23-27.

Carle P. and G. Moutous, 1967. Recherches sur d'éventuels vecteurs de la Flavescence dorée. *Annales des Epiphyties* **18** (Numéro hors série "Etudes de virologie"), 151-156.

Caudwell A., 1957. Deux années d'études sur la Flavescence dorée, nouvelle maladie grave de la Vigne. *Annales d'Amélioration des Plantes* **4**, 359-393.

Caudwell A., 1961a. Etude sur la maladie du Bois noir de la Vigne, ses rapports avec la Flavescence dorée. *Annales des Epiphyties* **12**, 241-262.

Caudwell A., 1961b. Les phénomènes de rétablissement chez la Flavescence dorée de la vigne. *Annales des Epiphyties* **12**, 347-354.

Caudwell A., 1964. Identification d'une nouvelle maladie de la vigne, la Flavescence dorée. Etude des phénomènes de localisation des symptômes et de rétablissement. *Annales des Epiphyties* **15** (Numéro hors série I), 249-251.

Caudwell A., 1966. L'inhibition in vivo du virus de la Flavescence dorée par la chaleur. *Annales des Epiphyties* **17** (Numéro hors série "Etudes de virologie"), 61-66.

Caudwell A., 1968. Der heutige Stand der Flavescence dorée Forschung. *Vitis* **7**, 141-150.

Caudwell A., 1980. L'Amarilliamento de Elqui, nouvelle jaunisse de la vigne au Chili. *Proceedings 7th Meeting of ICVG, Niagara Falls 1980*, 9-13.

Caudwell A., 1983. L'origine des jaunisses à mycoplasmes (MLO) des plantes et l'exemple des jaunisses de la vigne. *Agronomie* **3**, 103-111.

Caudwell A, 1988. Grapevine yellows diseases. *In:* Pearson R. C. and A. C. Goheen (Editors): Compendium of Grape Diseases. American Phytopathological Society Press, St.Paul, Minnesota, USA, 45-47.

Caudwell A, 1989. Les maladies bactériennes et à mycoplasmes de la vigne. La flavescence dorée et les jaunisses de la vigne en Europe. *In:* R. Cavalloro (Editor), Plant-Protection Problems and Prospects of Integrated Control in Viticulture. *Proceedings of the CEC/IOBC International Symposium, Lisboa-Vila Real 1988,* 451-457.

Caudwell A, 1990. Epidemiology and characterization of Flavescence dorée (FD) and other grapevine yellows. *Agronomie* **10**, 655-663.

Caudwell A, 1993. Advances in grapevine yellows research since 1990. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 79-83.

Caudwell A. and N. Poitou, 1960. Interaction entre "Court-noué" et "Flavescence dorée". *Comptes rendus des séances de l'Académie d'Agriculture de France* **46**, 958-963.

Caudwell A. and J.C. Bachelier, 1963. Premiers résultats de transmission de la Flavescence dorée à des plantes herbacées. *Comptes rendus des séances de l'Académie d'Agriculture de France* **49**, 144-148.

Caudwell A. and D. Schvester, 1970. Flavescence dorée. *In*: Frazier (Ed.) : Virus Diseases of Small Fruits and Grapevines (A Handbook), University of California, Division of Agricultural Sciences, Berkeley, 201-207.

Caudwell A. and J. Larrue, 1977. La production de cicadelles saines et infectieuses pour les épreuves d'infectivé chez les jaunisses à Mollicutes des végétaux. *Annales de Zoologie et d'Ecologie animale* **9**, 443-456.

Caudwell A. and J. Larrue, 1979. Examen des problèmes de la flavescence dorée dans le cadre de la sélection sanitaire des bois et plants de vigne. *Progrès agricole et viticole* **96** (6), 128-134.

Caudwell A. and A. Dalmasso, 1985. Epidemiology and vectors of grapevine viruses and yellows diseases. *Phytopathologia Mediterranea* **24**, 170-176.

Caudwell A. and J. Larrue, 1986. La flavescence dorée dans le midi de la France et dans le Bas- Rhône. *Progrès agricole et viticole* **103**, 517-523.

Caudwell A. and C. Kuszala, 1992. Mise au point d'un test ELISA sur les tissus de vignes atteintes de flavescence dorée. *Research in Microbiology* **143**, 791-806.

Caudwell A., J.C. Bachelier, C. Kuszala and J. Larrue, 1969. Etude de la survie de la cicadelle *Scaphoideus littoralis* Ball sur les plantes herbacées et utilisation de ces données pour transmettre la Flavescence dorée de la vigne à d'autres espèces végétales. *Comptes rendus des séances de l'Académie des Sciences, Paris, Série D,* **268**, 101-103.

Caudwell A., C. Kuszala, J.C. Bachelier and J. Larrue, 1970. Transmission de la Flavescence dorée de la Vigne aux plantes herbacées par l'allongement du temps d'utilisation de la Cicadelle *Scaphoideus littoralis* Ball et l'étude de sa survie sur un grand nombre d'espèces végétales. *Annales de Phytopathologie* **2** (2), 415-428.

Caudwell A, J. Gianotti, C. Kuszala and J. Larrue, 1971a. Etude du rôle de particules de type "Mycoplasme" dans l'étiologie de la Flavescence dorée de la Vigne. Examen cytologique des plantes malades et des cicadelles infectieuses. *Annales de Phytopathologie* **3** (1), 107-123.

Caudwell A., J. Larrue, C. Kuszala and J.C. Bachelier, 1971b. Pluralité des Jaunisses de la vigne. *Annales de Phytopathologie* **3** (1), 95-105.

Caudwell A., P. Brun, A. Fleury and J. Larrue, 1972a. Les traitements ovicides contre la cicadelle vectrice, leur intérêt dans la lutte contre la Flavescence dorée en Corse et dans les autres régions. *Vignes et Vins* **214**, 5-10.

Caudwell A, C. Kuszala, J. Larrue and J.C. Bachelier, 1972b. Responsabilité d'un vecteur aérien dans l'épidémiologie du Bois noir de la vigne. Etude de l'existence de ceps sensibles et de ceps tolérants expliquant la permanence de la maladie sur les mêmes ceps. *Annales de Phytopathologie* N° Hors série, 171-180.

Caudwell A., C. Kuszala, J. Larrue and J.C. Bachelier, 1972c. Transmission de la Flavescence dorée de la fève à la fève par des cicadelles des genres *Euscelis* et *Euscelidius*. Intervention possible de ces insectes dans l'épidémiologie du Bois noir en Bourgogne. *Annales de Phytopathologie* N° hors série, 181-189.

Caudwell A., D. Schvester and G. Moutous, 1972d. Variétés des dégats des Cicadelles nuisibles à la Vigne. Les méthodes de lutte contre *Scaphoideus littoralis*. *Progrès agricole et viticole* **89**, 583-590.

Caudwell A., C. Kuszala and J. Larrue, 1974. Approches de la survie et de la culture de l'agent (MLO) d'une jaunisse végétale, la Flavescence dorée de la vigne, par des épreuves d'infectivité. *Comptes rendus des séances de l'Académie des Sciences, Paris, Série D* **279**, 523-525.

Caudwell A., J. Larrue, G. Moutous, A. Fos and P. Brun, 1978. La transmission par des cicadelles de la jaunisse du vignoble Corse. Identification de cette maladie à la Flavescence dorée. *Annales de Zoologie et d'Ecologie animale* **10** (4), 613-625.

Caudwell A., R. Meignoz, C. Kuszala, C. Schneider, J. Larrue, A. Fleury and E. Boudon-Padieu, 1982. Purification immunologique et observation ultramicroscopique en milieu liquide de l'agent pathogène d'une jaunisse végétale, la Flavescence dorée de la vigne. *Comptes rendus des séances de l'Académie d'Agriculture de France* **68**, 407-415.

Caudwell A., E. Boudon-Padieu, C. Kuszala and J. Larrue, 1987. Biologie et étiologie de la Flavescence dorée. Recherches sur son diagnostic et sur les méthodes de lutte. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 175-208.

Caudwell, A., J. Larrue, C. Valat and S. Grenan, 1990. Les traitements à l'eau chaude des bois de vigne atteints de la Flavescence dorée. *Progrès agricole et viticole* **107**, 281-286.

Caudwell, A., J. Larrue, V. Tassart, S. Grenan and R. Boidron, 1993. Flavescence dorée on rootstock varieties, indexing results and hot water treatments. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 98.

Caudwell A., J. Larrue, V. Tassart, R. Boidron, S. Grenan, M. Leguay and P. Bernard, 1994. Caractère "porteur de la flavescence dorée" chez les vignes porte-greffes, en particulier le 3309 Couderc et le Fercal. *Agronomie* **14**, 83-94.

Caudwell A., J. Larrue, E. Boudon-Padieu and G. D. McLean, 1997. Flavescence dorée elimination from dormant wood of grapevines by hot-water treatment. *Australian Journal of Grape and Wine Research* **3**, 21-25.

Cavallini G., A. Castiglioni, P. Bortolotti, N. Mori, R. Nicoli Aldini, S. Botti, A. Malossi and A. Bertaccini, 2003. Flavescenza dorata e legno nero in vigneti del Modenese. *L'Informatore agrario* **21**, 69-71.

Cazelles, O. and C. Kuszala, 1993. Prospection des jaunisses de la vigne en Suisse romande et au Tessin et comparaison avec la flavescence dorée par le test ELISA. *Revue suisse de viticulture, arboriculture et horticulture* **25**, 257-259.

Cazelles, O., C. Desbaillet and A. Schmid, 1992. Jaunisses de la vigne en Suisse romande et au Tessin. *Revue suisse de viticulture, arboriculture et horticulture* **24**, 133-134.

Cazenove, R. and R. Planas, 1991. Lutte contre la Flavescence dorée de la vigne dans le cadre de l'agriculture biologique. *Progrès agricole et viticole* **108**, 44-46.

Chabbouh N., S. Bouhachem, S. Mh'irsi, N. Mahfoudhi, N. Marzouki and M. Marrakchi, 2003. Occurrence of Grapevine Yellows and potential vectors in Tunisia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 103. http://www.agr.uniba.it/ICVG2003/

Chen, K.H., J. R. Guo, X. Y. Wu, N. Loi, L. Carraro, Y. H. Guo, Y. D. Chen, R. Osler, R. Pearson, and T. A. Chen, 1993. Comparison of monoclonal antibodies, DNA probes, and PCR for detection of the grapevine yellows disease agent. *Phytopathology* **83**, 915-922.

Chen, K.H., R. Credi, N. Loi, M. Maixner, and T. A. Chen, 1994. Identification and grouping of mycoplasmalike organisms associated with grapevine yellows and clover phyllody diseases based on immunological and molecular analyses. *Applied and Environmental Microbiology* **60**, 1905-1913.

Choueiri E., F. Jreijiri, S. El Zammar, E. Verdin, P. Salar, J.L. Danet, J. Bové and M. Garnier, 2003. Grapevine "Bois noir" disease in Lebanon. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 101-102. http://www.agr.uniba.it/ICVG2003/

Cicotti A., L. De Sutter, D. Guriolo and M.E. Vindimian, 2003. Bois noir (BN) in Trentino vineyards : twelve years visual observations and research about root analysis. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 106. http://www.agr.uniba.it/ICVG2003/

Clair D., A. Frelet, G. Aubert, E. Collin E. and E. Boudon-Padieu, 2000. Improved detection of flavescence dorée and related phytoplasma in the elm yellows group in difficult material, with specific PCR primers that amplify a variable non ribosomal DNA fragment. *Extended Abstracts 13th Meeting of ICVG, Adelaide 2000*, 101-102.

Clair D., J. Larrue and E. Boudon-Padieu, 2001. Evaluation of vectoring ability of phytoplasmas by *Metcalfa pruinosa* SAY (Homoptera, Flatidae) recently introduced in Europe. *In*: Lozzia C. (Ed.) : *Proceedings of the Working Group "Integrated control in Viticulture", OILB/IOBC Bulletin* **24** (7), 195-198.

Clair D., J. Larrue, G. Aubert, J. Gillet, G. Cloquemin and E. Boudon-Padieu, 2003. A multiplex nested-PCR assay for sensitive and simultaneous detection and direct identification of phytoplasma in the Elm yellows group and Stolbur group and its use in survey of grapevine yellows in France. *Vitis* **42** (3), 151-157.

Clerc, L., C. Linder and H. Günthart, 1997. Première observation en Suisse romande de la cicadelle *Scaphoideus titanus* Ball (Homoptera, Jassidae), vecteur de la flavescence dorée de la vigne. *Revue suisse de viticulture, arboriculture et horticulture* **29**, 245-247.

Constable F.E., 2002. The biology and epidemiology of Australian grapevine phytoplasmas. PhD thesis, Department of plant Science, The University of Adelaide, South Australia, Australia.

Constable F.E. and E. Boudon-Padieu, 2003. Genomic diversity of the Flavescence dorée phytoplasma. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 81. http://www.agr.uniba.it/ICVG2003/

Constable F.E. and R.H. Symons, 1999. Seasonal detection of phytoplasmas in Australian grapevines. *The Australian Grapegrower and Winemaker* **429**, 49-53.

Constable F.E. and R.H. Symons, 2004. Genetic variability amongst isolates of Australian grapevine phytoplasmas. *Australasian Plant Pathology* **33**, 115-119.

Constable F.E., K.S. Gibb, J.R. Moran and Y.M. Wilson, 1998. Incidence of phytoplasma associated with yellows, restricted spring growth and late season leaf curl symptoms in grapevines. *The Australian Grapegrower and Winemaker* **409**, 19-20.
Constable F.E., J.R. Whiting and R.H. Symons, 2000. A new grapevine phytoplasma from the Ovens Valley of Victoria, Australia. *Extended abstracts 13th Meeting ICVG, Adelaide 2000,* 92-93.
Constable F.E., J.R. Whiting, K.S. Gibb and R.H. Symons, 2002a. A new grapevine yellows phytoplasma from the Buckland Valley of Victoria, Australia. *Vitis* **41**, 147-153.
Constable F.E., J.R. Whiting, J. Jones, K.S. Gibb and R.H. Symons, 2002b. The distribution of grapevine yellows disease associated with the Buckland valley grapevine yellows phytoplasma. *Journal of Phytopathology* **151**, 65-73.
Constable F.E., K.S. Gibb, J.W. Randles and R.H. Symons, 2003a. Biology and epidemiology of Australian grapevine yellows. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003*, 58-59. http://www.agr.uniba.it/ICVG2003/
Constable F.E., K.S. Gibb and R.H. Symons, 2003b. Seasonal distribution of phytoplasmas in Australian grapevines. *Plant Pathology* **52**, 267-276.
Constable F.E., J. Jones, K.S. Gibb, Y.M. Chalmers and R.H. Symons, 2004. The incidence, distribution and expression of Australian grapevine yellows, restricted growth and late season leaf curl diseases in selected Australian vineyards. *Annals of Applied Biology* **144**, 205-218.
Conti M, 1986. Micoplasmi ed altri procarioti intracellulari, agenti fitopatogeni di crescente interesse. *Annali della Academia di Agricoltura di Torino* **129**, 25-41.
Conti M, 1991. Studies on a yellows-type disease of "Chardonnay" grapevine in Tuscany. *Proceedings 10th Meeting of the ICVG, Volos 1990*,155-163.
Conti M., C. Minucci, V. Territo and G. Boccardo, 1997. Epidemiology of grapevine die-back disease in Liguria, northern Italy. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 61-62.
Cravedi P. and R. N. Aldini, 2000. Lo *Scaphoideus titanus*, vettore della flavescenza dorata della vite in Oltrepò pavese. *Vignevini* **27**(9), 56-60.
Cravedi P., P. Cervato, E. Mazzoni and A. Libè, 1993a. Ricerche sulla diffusione di *Scaphoideus titanus* Ball (Homoptera, Cicadellidae) in vigneti della provincia di Piacenza. *Annali della Facultà di Agricoltura, Università di Milano* **33**, 131-149.
Cravedi P., E. Mazzoni and P. Cervato, 1993b. Osservazioni sulla biologia di *Scaphoideus titanus* Ball (Homoptera, Cicadellidae). *Redia* **76**(1), 57-70.
Credi R, 1989. Flavescenza dorata della Vite in Emilia Romagna, evoluzione della malattia nelle piante e suoi effetti sulla produzione e sullo sviluppo vegetativo. *Phytopathologia Mediterranea* **28**, 113-121.
Credi R, 1994a. Mycoplasma-like organisms associated with a grapevine yellows disease occurring in Italy. *Journal of Phytopathology* **141**, 113-120.
Credi R, 1994b. Occurrence of anomalous mycoplasma-like organisms in grapevine yellows-diseased phloem. *Journal of Phytopathology* **142**, 310-316.
Credi, R. and A.R. Babini, 1984. Casi epidemici di Giallume della vite in Emilia Romagna. *Vignevini* **11** (3), 35-39.
Credi, R. and A.R. Babini, 1987. Attempted transmission of the pathogem causing a grapevine yellows disease in Italy. *Proceedings 7th Congress of the Mediterranean Phytopathological Union, Granada 1987*, 177-178
Credi R. and D. Callegari, 1988. Profilo epidemiologico della flavescenza dorata della Vite in Emilia-Romagna, diffusione temporale, distribuzione spaziale delle piante ammalate e gradienti d'incidenza. *Phytopathologia Mediterranea* **27**, 90-98.
Credi R. and A. Santucci, 1991. Sviluppo epidemico della flavescenza dorata in relazione ad alcune forme di allevamento della vite. *Vignevini* **18**(6), 33-36.
Credi R. and A. Santucci, 1992. Dodder transmission of mycoplasma-like organisms (MLOs) from grapevines affected by a flavescence dorée-type disease to periwinkle. *Phytopathologia Mediterranea* **31**, 154-162.
Credi R., A.R. Babini and C. Petrini, 1987. Ulteriori osservazioni su una malattia della vite simile alla flavescenza dorata in Emilia-Romagna. *Atti del Convegno sulla Flavescenza Dorata della vite, Vicenza-Verona, Italy,* 1987, 141-148.
Credi R., A. Santucci and L. Martini, 1990. Trials on graft transmission of a Grapevine flavescence dorée-like disease. *Phytopathologia Mediterranea* **29**, 7-13.
Credi R., F. Terlizzi, R. Bissani and C. Poggi Pollini, 2001. Presenza e diffusione dei fitoplasmi del legno nero e della flavescenza dorata della vite in Emilia-Romagna. *Vignevini* **28** (12), 107-110.
Credi R., F. Terlizzi, L. Cricca and D. Dradi, 2002a. Studi epidemiologici sul legno nero della vite in Emilia-Romagna. *Atti II Incontro Nazionale sulle Malattie da Fitoplasmi, Roma 2002,* 79.
Credi R., F. Terlizzi, G. Stimilli, S Nardi and R. Lagnese, 2002b. Flavescenza dorata della vite nelle Marche. *L'Informatore agrario* **22**, 61-63.

Crocker J., H. Waite, P. Wright and G. Fletcher, 2002. Source area management, Avoiding cutting dehydration and good nursery management may be the keys to successful hot water treatment. *The Australian and New Zealand Grapegrower and Winemaker* **461a**, 33-37.

Crocker J., P. Wright, P. Deverell and H. Waite, 2003. Australian advances in hot water treatment research. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 71-72. http://www.agr.uniba.it/ICVG2003/

Curkovic Perica M., D. Škoric, M. Šeruga, B. Kozina and M. Krajacic, 2001. Recent progress in phytoplasma research in Croatian vineyards. *Agriculturae Conspectus Scientificus* **66**, 65-69.

Curkovic Perica M., M. Šeruga, B. Kozina, Krajacic M. and D. Škoric, 2003. Grapevine yellows spread of the disease in Croatia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 95. http://www.agr.uniba.it/ICVG2003/

Daire X, 1994. Détection et différenciation de mycoplasma-like organisms (MLO) associés aux maladies de la vigne de type jaunisse. Thèse de Doctorat, Université de Bourgogne, Dijon, France.

Daire X., B. Schneider, E. Seemüller, S. Santoni, A. Bervillé, E. Boudon-Padieu and A. Caudwell, 1991. DNA cloning and detection of flavescence dorée mycoplasma-like organism (MLO). *Proceedings 10th Meeting of ICVG, Volos 1990,* 484-487

Daire X., E. Boudon-Padieu, A. Bervillé, B. Schneider and A. Caudwell, 1992. Cloned DNA probes for detection of grapevine Flavescence dorée mycoplasma-like organism (MLO). *Annals of Applied Biology* **121**, 95-103.

Daire X., D Clair, J. Larrue, E. Boudon-Padieu, A. Alma, A. Arzone, L. Carraro, R. Osler, E. Refatti, G. Granata, R. Credi, E. Tanne, R. Pearson and A. Caudwell, 1993a. Occurrence of diverse MLOs in tissues of grapevine affected by grapevine yellows in different countries. *Vitis* **32**, 247-248.

Daire X. D. Clair, J. Larrue, E. Boudon-Padieu and A. Caudwell, 1993b. Diversity among mycoplasma-like organisms inducing grapevine yellows in France. *Vitis* **32**, 159-163.

Daire X., D. Clair, J. Larrue and E. Boudon-Padieu, 1997a. Survey for grapevine yellows phytoplasmas in diverse European countries and Israel. *Vitis* **36**, 53-54.

Daire X., D. Clair, W. Reinert and E. Boudon-Padieu, 1997b. Detection and differentiation of grapevine yellows phytoplasmas belonging to the elm yellows group and to the stolbur subgroup by PCR amplification of non-ribosomal DNA. *European Journal of Plant Pathology* **103**, 507-514.

Danielli A., A. Bertaccini, M. Vibio, N. Mori, E. Murari, G. Posenato and V. Girolami, 1996. Detection and molecular characterization of phytoplasmas in the planthopper *Metcalfa pruinosa* (Say) *(Homoptera, Flatidae)*. *Phytopathologia Mediterranea* **35**, 62-65.

Darimont H. and M. Maixner, 2000. Übertragungseffizienz der Vektoren von Rebphytoplasmosen. *Mittleilungen der Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* **376**, 371-372.

Darimont H. and M. Maixner, 2001. Actual distribution of *Hyalesthes obsoletus* Signoret (Auchenorrhyncha, Cixiidae) in German viticulture and its significance as a vector of Bois noir. *IOBC/wprs Bulletin* **24** (7), 199-202.

D'Ascenzo D., S. Botti, J. Rahola, V. Blanco, M.P. Martin and A. Bertaccini, 2003. Identification of phytoplasmas associated with grapevine yellows in Abruzzo region (Italy). *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 89-90. http://www.agr.uniba.it/ICVG2003/

Davis R.E. and J. P. Prince, 1993. Grapevine yellows diseases, diverse etiologies indicated by new DNA-based methods for pathogen detection and identification -- Implications for epidemiology. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 93-94.

Davis R.E. and E.L. Dally, 2001. Revised subgroup classification of group 16SrV phytoplasmas and placement of flavescence dorée-associated phytoplasmas in two distinct subgroups. *Plant Disease* **85**, 790-797.

Davis R.E., E.L. Dally, A. Bertaccini, R. Credi, I-M. Lee, R. Osler, L. Carraro and M. Barba, 1992a. Cloned DNA probes for specific detection of Italian periwinkle virescence mycoplasmalike organism (MLO) and investigation of genetic relatedness with other MLOs. *Phytopathologia Mediterranea* **31**, 5-12.

Davis R.E., J.P. Prince, R.W. Hammond, E.L. Dally and I-M. Lee, 1992b. Polymerase chain reaction detection of Italian periwinkle virescence mycoplasmalike organism (MLO) and evidence for relatedness with aster yellows MLOs. *Petria* **2**, 183-192.

Davis R.E., A. Bertaccini, J.P. Prince and M. Vibio, 1993a. Infection of grapevines in Emilia-Romagna by mycoplasmalike organisms (MLOs) related to Italian periwinkle virescence MLO, evidence from enzymatic amplification of MLO DNA. *Phytopathologia Mediterranea* **32**, 149-152.

Davis R.E., E.L. Dally, A. Bertaccini, I-M. Lee, R. Credi, R. Osler, V. Savino, L. Carraro, B. Di Terlizzi and M. Barba, 1993b. Restriction fragment length polymorphism analyses and dot hybridizations distinguish mycoplasmalike organisms associated with flavescence dorée and southern European grapevine yellows disease in Italy. *Phytopathology* **83**, 772-776.

Davis R.E., E.L. Dally, D.E. Gundersen, I-M. Lee and N. Habili, 1997a. "*Candidatus* Phytoplasma

australiense," a new phytoplasma taxon associated with Australian grapevine yellows. *International Journal of Systematic Bacteriology* **47**, 262-269.
Davis R.E., E.L. Dally and R. Jomantiene, 1997b. Grapevine yellows diseases, new perspectives on detection and identification of associated phytoplasmas. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 53-54.
Davis, R.E., E.L. Dally, E. Tanne and I.C. Rumbos, 1997c. Phytoplasmas associated with grapevine yellows in Israel and Greece belong to the stolbur phytoplasma subgroup, 16SrXII-A. *Journal of Plant Pathology* **79**, 181-187.
Davis, R.E., R. Jomantienne, E.L. Dally and T.K. Wolf, 1998. Phytoplasmas associated with grapevine yellows in Virginia belong to group 16SrI, subgroup A (tomato big bud phytoplasma subgroup), and group 16SrIII, new subgroup I. *Vitis* **37**, 131-137.
Del Serrone P, 1997. I "Giallumi della vite", un caso fitopatologico ancora aperto. *Petria* **7**, 51-62.
Del Serrone P. and M. Barba, 1996a. Giallume fitoplasmale della vite, quattro anni di esperienze in vigneti laziali. *Atti Convegno Annuale SIPaV, Udine 1996*, 30-31.
Del Serrone P. and M. Barba, 1996b. Importance of the vegetative stage for phytoplasma detection in yellows-diseased grapevines. *Vitis* **35**, 101-102.
Del Serrone P., C. Minucci and M. Barba, 1995a. Diffusione del Giallume Fitoplasmale della vite in impianti laziali. *Rivista di Viticoltura e di Enologia* **48** (4), 11-16.
Del Serrone P., C. Minucci, M. Barba, M. Conti and G. Boccardo, 1995b. Ottimizzazione della diagnosi molecolare di fitoplasmi in vite. *Petria* **5**, 161-170.
Deng, S. and C. Hiruki, 1991. Amplification of 16S rRNA genes from culturable and nonculturable mollicutes. *Journal of Microbiological Methods* **14**, 53-61.
De Sousa E., F. Cardoso, P. Casati, P.A. Bianco, M. Guimarães and V. Pereira, 2003. Detection and identification of phytoplasmas belonging to 16SrV-D in *Scaphoideus titanus* adults in Portugal. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 78. http://www.agr.uniba.it/ICVG2003/
Di Terlizzi B., S. Rivieccio, M. A. Castellano and V. Savino, 1991. Occasional occurrence of yellows-like symptoms in Apulian grapevines. *Proceedings 10th Meeting of ICVG, Volos 1990,* 425-431.
Di Terlizzi B., A. Alma, M.A. Castellano and V. Savino, 1993. Further studies on yellows-like disorders in Apulia. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 95-96.
Di Terlizzi B., M.A. Castellano, A. Alma and V. Savino, 1994. Present status of grapevine yellows in Apulia. *Phytopathologia Mediterranea* **33**, 125-131.
Doi Y., M. Teranaka, K. Yora and H. Asuyama, 1967. Mycoplasma or PLT group-like microorganisms found in the phloem elements of plants infected with mulberry dwarf, potato witches' broom, aster yellows, or paulownia witches' broom. *Annals of the Phytopathological Society of Japan* **33**, 259-266.
Duduk B., S. Botti, M. Ivanovic, N. Dukic and A. Bertaccini, 2003a. Molecular characterization of a Flavescence dorée phytoplasma infecting grapevine in Serbia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 91-92. http://www.agr.uniba.it/ICVG2003/
Duduk B., M. Ivanovic, N. Dukic, S. Botti and A. Bertaccini, 2003b. First report of an Elm yellows subgroup 16SrV-C phytoplasma infecting grapevine in Serbia. *Plant Disease* **87**, 559.
Du Fretay G., C. Vial, P. Bernard and A. Bouet, 1989. Lutte contre la cicadelle de la flavescence dorée. Des résultats intéressants obtenus lors des expérimentations de 1988. *Progrès agricole et viticole* **106**, 170-174.
Egger E. and A. Grasselli, 1988. Diffusione in Toscana di una malattia della vite assimilabile alla flavescenza dorata sulla cultivar "Chardonnay". *L'Informatore agrario* **44** (11), 101-105.
Egger E., A. Grasselli and P. Storchi, 1995. Flavescenza, esistono vitigni resistenti? *Vignevini* **22** (1/2), 54-56.
Farmer M.J. and E. Boudon-Padieu, 1994. Cloning and expression of Flavescence dorée mycoplasma-like organism membrane protein in Lambda Zap expression vector. *IOM Letters* **3**, 237.
Firrao G., S. Palmano, G. Malossini, I. Tomada, A. Carpanelli, M. Dazzan and C. Frausin, 1999. Monitoring grapevine yellows in North-eastern Italy. *First Internet conference on Phytopathogenic mollicutes 1999*, http://www.uniud.it/phytoplasma/pap/firr4200.Html
Fortusini A. and G. Belli, 1987. La flavescenza dorata della vite in Italia, inizi e sviluppi della malattia; affinità e differenze con altre ampelopatie. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 91-98.
Fortusini A., R. Pontiroli and G. Belli, 1988. Nuovi dati e osservazioni sulla Flavescenza dorata della vite nell'Oltrepò pavese. *Vignevini* **15** (3), 67-69.
Fortusini A., M. Saracchi and G. Belli, 1989. Trasmissione sperimentale della flavescenza dorata della vite mediante *Scaphoideus titanus* Ball in Italia. *Vignevini* **16** (9), 43-46.
Fortusini A., G. Scattini, M. Saracchi and S. Cinquanta, 1995. Indagini sull'epidemiologia della Flavescenza dorata della vite e su possibili interazioni tra infezioni virali e malattia. *Rivista di Patologia Vegetale* (S. V) **5**, 75-84.

Fos A., J.L. Danet, L. Zreik, M. Garnier and J.M. Bové, 1992. Use of a monoclonal antibody to detect the stolbur mycoplasma-like organism in plants and insects and to identify a vector in France. *Plant Disease* **76**, 1092-1096.

Frausin C., A. Gregoris and F. Anaclerio, 2000. Verifica di pratica utilizzazione della tecnica di termoterapia in aqua calda per il risanamento di talee di vite affette da giallume. *Atti del Convegno "Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia", Gorizia 1999,* 85-90.

Freeman, B, 2000. Spring growth disorders in grapevine. *The Australian Grapegrower and Winemaker* **426a**, 61-65.

Frosini A., P. Casati, PA. Bianco, R. Bordoni, C. Consolandi, B. Castiglioni, A. Mezzeloni, E. Rizzi, C. Battaglia, G. Belli, L. Rossi Bernardi and G. De Bellis, 2002. Ligase detection reaction and universal arrays as a tool to detect grapevine infecting phytoplasmas. *Minerva Biotecnologica*, **14** (3-4), 265-267.

Gajardo A., S. Botti, J. Montealegre, N. Fiore and A. Bertaccini, 2003. Survey on phytoplasmas identified in Chilean grapevines. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 85-86. http://www.agr.uniba.it/ICVG2003/

Garau R., C. Minucci, V.A. Prota, G. Boccardo and M. Fiori, 1997. Phytoplasma diseases of grapevines in Sardinia. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 71-72.

Gärtel W., 1965. Untersuchungen über das Auftreten und das Verhalten der flavescence dorée in den Weinbaugebieten an Mosel und Rhein. *Weinberg und Keller* **12**, 347-376.

Gatineau F., J. Larrue, D. Clair, F. Lorton, M. Richard-Molard and E. Boudon-Padieu, 2001. A new natural planthopper vector of stolbur phytoplasma in the genus *Pentastiridius* (Hemiptera: Cixiidae). *European Journal of Plant Pathology* **107**, 263-271.

Ge Q. and M. Maixner, 2003a. An internal positive control in PCR-tests for the detection of phytoplasma in plants and insects. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 77. http://www.agr.uniba.it/ICVG2003/

Ge Q. and M. Maixner, 2003b. Comparative experimental transmission of grapevine yellows phytoplasmas to plants and artificial feeding medium. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 109-110. http://www.agr.uniba.it/ICVG2003/

Ge Q., M. Maixner and F. Wen, 2004. The adaptability of an artificial medium in the screening of phytoplasma insect vectors. *Acta Phytophylacica Sinica* 31 (3) : 276-282.

Gilge U., P. Schwappach, J.V. Herrmann, and M. Maixner, 2004. Schwarzholzkrankheit - Feldstudie zum Vorkommen in Franken und Methoden zu deren Bestimmung. *Schweizerische Zeitschrift für Obst- und Weinbau*, **19/4**, 10-13.

Gilge, U., P. Schwappach, J.V. Herrmann and M. Maixner, 2003. Schwarzholzkrankheit - Feldstudie zum Vorkommen in Franken und Methoden zu deren Bestimmung. *Rebe & Wein* **2/2004**, 17-20.

Gibb KS.S., F.E. Constable, J.R. Moran and A.C. Padovan, 1999. Phytoplasmas in Australian grapevines - detection, differentiation and associated diseases. *Vitis* **38**, 107-114.

Girolami V. and E. Egger, 1993. Prevenzione e cura. *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 49-54.

Granata G., 1985. Epidemic yellows in vineyards of cv. Inzolia in Sicily. *Phytopathologia Mediterranea* **24**, 79-81.

Granata G. and A. Russo, 1990. Indagini su un giallume epidemico simile alla "Flavescenza dorata". *Vignevini* **17** (5), 69-71.

Granata G. and V. Grimaldi, 1991. Electron microscopic detection of mycoplasma-like organisms in epidemic yellow affected grapevines. *Petria* **1**, 171-175.

Granata G. and L. Carraro, 1993. Sintomatologia ed evoluzione della malattia nelle piante infette. *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 19 -22.

Gregoris A., F. Pavan, G. Stasi, C. Coiutti and A. Ortez, 2000. Indagine sulla presenza di auchenorrinchi possibili vettori di fitoplasmi in vigneti del Friuli-Venezia Giulia. *Atti del Convegno "Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia", Gorizia 1999,* 45-49.

Griffiths H.M., W.A. Sinclair, E. Boudon-Padieu, X. Daire, I-M. Lee, A. Sfalanga and A. Bertaccini, 1999. Phytoplasmas associated with elm yellows, molecular variability and differentiation from related organisms. *Plant Disease* **83**, 1101-1104.

Guadagnini M., N. Mori, S. Alberghini, E. Carturan, V. Girolami and A. Bertaccini, 2000. Molecular evidence of phytoplasma transmission to grapevine by *Metcalfa pruinosa* (Say) in Italy. *Extended abstracts 13th Meeting ICVG, Adelaide 2000,* 99-100.

Gugerli P., O. Cazelles, M. Genini, S. Emery and L. Colombi, 2002. Maladie du bois noir de la vigne en Suisse romande et au Tessin. *Revue suisse de viticulture, arboriculture et horticulture* **34**, 15-17.

Habili N. and R. H. Symons, 2001a. Update on Australian grapevine yellows in Australian vineyards. *The Australian Grapegrower and Winemaker* **452**, 45-49.

Habili N. and R.H. Symons, 2001b. Virus and phytoplasma content of major grapevine varieties in Australia. *The Australian Grapegrower and Winemaker* **451**, 18-22.
Habili N., L. Schliefert and R. H. Symons, 2000. Viruses and phytoplasmas in neighboring grapevines showing or not showing symptoms, visual assessment versus diagnostic assay. *The Australian Grapegrower and Winemaker* **438a**, 156-158.
Haidar M.M., M. Digiaro, W. Khoury and V. Savino, 1996. Viruses and virus diseases of grapevine in Lebanon. *Bulletin OEPP/EPPO Bulletin* **26**, 147-153.
Harrison N. A., Griffiths H.M., Carpio M.L. and Richardson P.A., 2001. Detection and characterization of an elm yellows (16SrV) group phytoplasma infecting Virginia creeper plants in southern Florida. *Plant Disease* **85**, 1055-1062.
Herrmann J.V. and M. Maixner, 2002. Vergilbungskrankheiten an Reben - auf dem Vormarsch? *Rebe und Wein* **55** (7), 19-22.
International Committee of Systematic Bacteriology (ICSB), Subcommittee on the Taxonomy of Mollicutes, 1993. Minutes of the interim meetings, 1 and 2 August 1992, Ames, Iowa, USA. *International Journal of Systematic Bacteriology*, 43, 394-397.
International Committee of Systematic Bacteriology (ICSB), Subcommittee on the Taxonomy of Mollicutes, 1997. Minutes of the interim meetings, 12 and 18 July 1996, Orlando, Florida, USA. *International Journal of Systematic Bacteriology*, 47, 911-914.
Jermini M. and M. Baillod, 1996. Proposition d'une méthode de contrôle des populations de *Scaphoideus titanus* Ball dans le vignoble. *Revue suisse de viticulture, arboriculture et horticulture* **28**, 201-204.
Jermini M., A. Rossi and M. Baillod, 1992. Etat actuel de la diffusion au Tessin de *Scaphoideus titanus* Ball, vecteur de la flavescence dorée. *Revue suisse de viticulture, arboriculture et horticulture* **24**, 137-139.
Jermini M., G. D'Adda, J. Baumgärtner, G.C. Lozzia and M. Baillod, 1993. Nombre des pièges englués nécessaires pour estimer la densité relative des populations de la cicadelle *Scaphoideus titanus* Ball en vignoble. *Bolletino di Zoologia Agraria e di Bachicoltura* (Ser. II) **25** (1), 91-102.
Kelly M., F. Constable and M. Malipatil, 1998. Identifying the vector of Australian grapevine yellows phytoplasma. *The Australian Grapegrower and Winemaker* **412**, 18-20.
Klein M., P. Weintraub, M. Davidovich, L. Kuznetsova, T. Zahavi, A. Ashanova, S. Orenstein and E. Tanne, 2001. Monitoring phytoplasma-bearing leafhoppers / planthoppers in vineyards in the Golan Heights, Israel. *Journal of Applied Entomology* **125**, 19-23.
Kölber M., J. Lázár, R.E. Davis, E. Dally, G. Tõkés, G. Szendrey, J. Mikulás, L. Krizbai and E. Papp, 1997. Occurrence of grapevine yellows disease in grapevine-growing regions of Hungary. *Proceedings 12th Meeting of ICGV, Lisbon 1997,* 73-74.
Kölber M., I. Ember, K. Varga, S. Botti, M. Martini, J. Lázár and A. Bertaccini, 2003. Six-year survey of grapevine yellows distribution in Hungary. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 99-100. http://www.agr.uniba.it/ICVG2003/
Koruza, B, 1996. [Results of the study of grapevine yellows disease dispersal in Slovenia]. *Sodobno Kmetijstvo* **29**, 403-406.
Krake L. and N.S. Scott, 1999. Managing viruses and virus-like organisms starts with the facts. *Australian Viticulture* **3** (6), 10-13.
Krake L.R., N.S. Scott, M.A. Rezaian and R.H. Taylor, 1999. Graft-transmitted diseases of grapevines. CSIRO Publishing, Collingwood, Australia.
Kuszala C., 1986. Influence du sexe et de l'âge des insectes vecteurs injectés dans l'épreuve d'infectivité des jaunisses des plantes. Mesure radiographique du volume injecté à *Euscelidius variegatus* (Kirschbaum). *Agronomie* **6**, 591-598.
Kuszala C., 1996. Influence du milieu d'extraction sur la détection du bois noir et de la flavescence dorée de la vigne, par des anticorps poly- et monoclonaux dirigés contre les phytoplasmes du stolbur et de la flavescence dorée. *Agronomie* **16**, 355-365.
Kuszala C., O. Cazelles, J. Boulud, R. Credi, G. Granata, G. Kriel, P. Magarey, C. Magnien, R. C. Pearson, E. Refatti, E. Tanne and A. Caudwell, 1993. Contribution à l'étude des jaunisses de la vigne dans le monde. Prospection par test ELISA spécifique du mycoplasma-like organism (MLO) de la flavescence dorée. *Agronomie* **13**, 929-933.
Kuzmanovic S., M. Starovic, M. Tosic, S. Stojanovic and T. Tomic, 2003. Phytoplasmas on grapevine in Serbia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 93-94. http://www.agr.uniba.it/ICVG2003/.
Langer M. and M. Maixner, 2004. Molecular characterisation of grapevine yellows associated phytoplasmas of the stolbur-group based on RFLP-analysis of non-ribosomal DNA. *Vitis* **43**, 191-200.
Langer M., H. Darimont and M. Maixner, 2003a. Characterization of isolates of Vergilbungskrankheit phytoplasma by RFLP-analysis and their association with grapevine, herbaceous host plants

and vectors. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 66-67.http://www.agr.uniba.it/ICVG2003/
Langer M., H. Darimont and M. Maixner, 2003b. Control of phytoplasma vectors in organic viticulture. *IOBC/wprs Bulletin* **26**, 197-202.
Larrue J., A. Caudwell and E. Boudon-Padieu, 2000. Occurrence and symptom expression of bois noir in Burgundy over a 15 years period. *Extended abstracts 13th Meeting ICVG, Adelaide 2000,* 118.
Laurent J.C. and R. Agulhon, 1989. La flavescence dorée de la vigne. Situation et évolution de la maladie et de la cicadelle vectrice dans le vignoble français. *In:* R. Cavalloro (Ed.), Plant-Protection Problems and Prospects of Integrated Control in Viticulture. *Proceedings of the CEC/IOBC International Symposium, Lisboa-Vila Real 1988,* 489-496.
Laviña A., A. Batlle, J. Larrue, X. Daire, D. Clair and E. Boudon-Padieu, 1995. First report of grapevine bois noir phytoplasma in Spain. *Plant Disease* **79**, 1075.
Laviña A., A. Batlle, J. Larrue, D. Clair and E. Boudon-Padieu, 1997. Incidence and dissemination of grapevine bois noir phytoplasma. *Proceedings 10th Congress of the Mediterranean Phytopathological Union, Montpellier 1997,* 237-240.
Laviña A., J. Sabaté, M. Garcia and A. Batlle, 2003. Seasonal fluctuation and detection of stolbur phytoplasma in grapevine. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 115. http://www.agr.uniba.it/ICVG2003/
Leclant F., 1968. Premières observations sur *Hyalesthes obsoletus* Signoret dans le midi de la France (Homoptera: Cixiidae). *Annales des Epiphyties* **19**, 111-113.
Leclant F. and J.P. Lacote, 1969. Recherches sur les vecteurs du stolbur dans le midi de la France. *Annales de Phytopathologie* N° hors série, 439-442.
Lee I-M.; D.E. Gundersen-Rindal, R.E. Davis and I.M. Bartoszyk, 1998. Revised classification scheme of phytoplasmas based on RFLP analyses of 16S rRNA and ribosomal protein gene sequences. *International Journal of Systematic Bacteriology* **48**, 1153-1169.
Lefol C, 1993. Etude des systèmes de reconnaissance entre le MLO (Mycoplasma-like organism) de la Flavescence dorée de la vigne et une cicadelle vectrice *Euscelidius variegatus* Kbm. Thèse de doctorat, Université de Bourgogne, Dijon, France.
Lefol C., A. Caudwell, J. Lherminier and J. Larrue, 1993. Attachment of the Flavescence dorée pathogen (MLO) to leafhopper vectors and other insects. *Annals of Applied Biology* **123**, 611-622.
Lefol C., J. Lherminier, E. Boudon-Padieu, J. Larrue, C. Louis and A. Caudwell, 1994a. Propagation of flavescence dorée MLO (Mycoplasma-like organism) in the leafhopper vector *Euscelidius variegatus* Kbm. *Journal of Invertebrate Pathology* **63**, 285-293.
Lefol C., J. Lherminier, E. Boudon-Padieu, R. Meignoz, J. Larrue, C. Louis, A. C. Roche and A. Caudwell, 1994b. Presence of attachment sites accounting for recognition between the Flavescence dorée MLO and its leafhopper vector. *IOM Letters* **3**, 282-283.
Leitner G., 2004. Bakterien als Ursache: Phytoplasmen im österreichischen Weinbau. *Der Winzer* **60** (1), 11-13.
Lessio F. and A. Alma, 2004. Dispersal patterns and chromatic response of *Scaphoideus titanus* Ball (Homoptera Cicadellidae), vector of the phytoplasma agent of grapevine flavescence dorée. *Agricultural and Forest Entomology* **6** (2), 121-127.
Lessio F., S. Palermo, R. Tedeschi and A. Alma, 2003. Presence of grapevine yellows phytoplasma vectors. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 75-76. http://www.agr.uniba.it/ICVG2003/
Levadoux L., 1955. L'état sanitaire et la sélection du Baco 22A. *Agriculture* **18**, 257-259.
Lherminier J. and E. Boudon-Padieu, 1996. In situ detection of grapevine flavescence dorée phytoplasmas and their infection cycle in experimental and natural host plants. *In*: Nicole M. and V. Gianinazzi-Pearson (Editors), Histology, Ultrastructure and Molecular Cytology of Plant-Microorganism Interactions. Kluwer Academic Publishers, Doordrecht, The Netherlands. 245-255.
Lherminier J., T. Terwisscha Van Scheltinga, E. Boudon-Padieu and A. Caudwell, 1989. Rapid immunofluorescent detection of the grapevine flavescence dorée mycoplasmalike organism in the salivary glands of the leafhopper *Euscelidius variegatus* Kbm. *Journal of Phytopathology* **125**, 353-360.
Lherminier J., E. Boudon-Padieu, R. Meignoz, A. Caudwell and R.G. Milne, 1990a. Immunological detection and localization of mycoplasma-like organisms (MLOs) in plants and insects by light and electron microscopy, *In:* Mendgen K. and E. Lesemann (Editors), Electron Microscopy of Plant Pathogens. Springer, Berlin, Tokyo. 177-184.
Lherminier J., G. Prensier, E. Boudon-Padieu and A. Caudwell, 1990b. Immunolabeling of grapevine flavescence dorée MLO in salivary glands of *Euscelidius variegatus*, a light and electron microscopy study. *Journal of Histochemistry and Cytochemistry* **38**, 79-85.

Lherminier J., M. Courtois and A. Caudwell, 1994. Determination of the distribution and multiplication sites of Flavescence Dorée mycoplasma-like organisms in the host plant *Vicia faba* by ELISA and immunocytochemistry. *Physiological and Molecular Plant Pathology* **45**, 125-138.

Lherminier J., R.G. Bonfiglioli, X. Daire, R.H. Symons and E. Boudon-Padieu, 1999. Oligo-deoxynucleotides as probes for in situ hybridization with transmission electron microscopy to specifically localize phytoplasma in plant cells. *Molecular and Cellular Probe*s **13**, 41-47.

Lherminier J., N. Benhamou, J. Larrue, M.-L. Milat, E. Boudon-Padieu, M. Nicole and J.P. Blein, 2003. Cytological characterization of elicitin-induced protection in tobacco plants infected by *Phytophthora parasitica* or phytoplasma. *Phytopathology* **93**, 1308-1309.

Liefting L.W., A.C. Padovan, K.S. Gibb, R.E. Beever, M.T. Andersen, R.D. Newcomb, D.L. Beck and R.L.S. Forster, 1998. *'Candidatus* Phytoplasma australiense' is the phytoplasma associated with Australian grapevine yellows, papaya dieback and Phormium yellow leaf diseases. *European Journal of Plant Pathology* **104**, 619-623.

Lozzia G.C, 1992. Distribuzione, biologia e controllo di *Scaphoideus titanus* Ball. *Atti Giornate Fitopatologiche 1992*, 173-182.

Magarey P.A, 1986. Grapevine yellows - Aetiology, epidemiology, and diagnosis. *South African Journal of Enology and Viticulture* **7**, 90-100.

Magarey, P.A, 1988. Grapevine yellows diseases. *In*: Raychaudhuri S.P. and N. Rishi (Eds.), Mycoplasma Diseases of Woody Plants. Malhotra Publishing House, New Dehli, India. 67-105.

Magarey, P.A. and M.F. Wachtel, 1982. The Rhine Riesling problem recent findings. *The Australian Grapegrower and Winemaker* **220**, 78-80.

Magarey P.A., M.F. Wachtel and R.W. Emmett, 1983. Australian vine Yellows a new name. *The Australian Grapegrower and Winemaker* **232***,* 32-33

Magarey P.A. and M.F. Wachtel, 1985. A review of the present status of Australian grapevine yellows. *Agricultural Record (South Australia)* **12** (17), 12-18.

Magarey P.A. and M.F. Wachtel, 1986. Australian grapevine yellows. *International Journal of Tropical Plant Diseases* **4**, 1-14.

Magarey, P.A. and M F. Wachtel, 1989. Australian Grapevine Yellows - a review. *The Australian Grapegrower and Winemaker* **26** (309), 39.

Magarey, P.A., B. Plavsic and M. F. Wachtel, 1988. MLO associated with Australian grapevine yellows diseased phloem cells. *International Journal of Tropical Plant Diseases* **6**, 175-179.

Maixner M., 1992. Untersuchungen zur Epidemiologie der Vergilbungskrankheit der Rebe. *Mitteilungen der Biologische Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* **283**, 304.

Maixner M., 1993a. PATCHY - Ein Programm zur Analyse räumlicher Verteilungsmuster von Rebkrankheiten. *Nachrichtenblatt des Deutschen Pflanzenschutzdienstes* **45**, 157-164.

Maixner M., 1993b. Leafhoppers (Homoptera, Auchenorrhyncha) in German vineyards - Search for possible vectors of German grapevine yellows, *Abstracts of the IOBC working group "Integrated control in viticulture".* INRA, Bordeaux, France, 1993.

Maixner M., 1993c. Occurrence of Grapevine yellows in Germany. *Phytopathologia* M*editerranea* **32**, 69-70.

Maixner M., 1993d. Spatial pattern analysis for epidemiological studies on grapevine diseases. *Extended Abstracts 11th Meeting ICVG, Montreux 1993,* 121.

Maixner M., 1994. Transmission of German grapevine yellows (Vergilbungskrankheit) by the planthopper *Hyalesthes obsoletus* (Auchenorrhyncha: Cixiidae). *Vitis* **33**, 103-104.

Maixner M, 1995. Monitoring of *Hyalesthes obsoletus* (Auchenorrhyncha: Cixiidae) in vineyards and its significance as a vector of "Vergilbungskrankheit" (German Grapevine Yellows). *Abstracts of the IOBC working group "Integrated control in viticulture".* Staatliches Weinbauinstitut, Freiburg i.Br., Germany, 1995.

Maixner M, 1996. Vergilbungskrankheit der Rebe. *Der Deutsche Weinbau* **8**, 14-17.

Maixner M. and R. C. Pearson, 1991. Studies on *Scaphoideus titanus* Ball, a possible vector of grapevine yellows in New York. *Proceedings 10th Meeting of ICVG, Volos 1990,* 193-201.

Maixner, M. and U. Ahrens, 1993. Studies on grapevine yellows (Vergilbungskrankheit) in Germany -- Detection of MLOs in grapevines and search for possible vectors. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 101-102.

Maixner M. and W. Reinert, 1997a. Heisswasserbehandlung von Rebholz zur Eliminierung der Vergilbungskrankheit. *In*: Biologische Bundesanstalt für Land- und Forstwirtschaft Berlin und Braunschweig. Jahresbericht 1996. Bundesministerium für Ernährung, Landwirtschaft und Forsten, 88.

Maixner M. and W. Reinert, 1997b. Spatio-temporal analysis of the distribution of grapevine yellows in Germany. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 75-76.

Maixner M. and W. Reinert, 1998. Vergilbungskrankheiten der Rebe. *Mittleilungen der Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* **349**, 47-87.

Maixner M. and W. Reinert, 1999. *Oncopsis alni* (Schrank)(Auchenorrhyncha, Cicadellidae) as a vector of the alder yellows phytoplasma of *Alnus glutinosa* (L.) Gaertn. *European Journal of Plant Pathology* **105**, 87-94.

Maixner M. and H. Darimont, 2000. Verbreitung rebpathogener Phytoplasmen und ihrer Vektoren in den deutschen Weinbaugebieten. *Mittleilungen der Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* **376**, 374.

Maixner, M. and W. Reinert, 2000. Monitoring of planthopper vectors in vineyards, an aid for grapevine yellows management decisions. *IOBC/wprs Bulletin* **23**, 123-124.

Maixner M., R. C. Pearson, E. Boudon-Padieu and A. Caudwell, 1993. *Scaphoideus titanus*, a possible vector of grapevine yellows in New York. *Plant Disease* **77**, 408-413.

Maixner M., U. Ahrens and E. Seemüller, 1994. Detection of mycoplasmalike organisms associated with a yellows disease of grapevine in Germany. *Journal of Phytopathology* **142**, 1-10.

Maixner M., U. Ahrens and E. Seemüller, 1995a. Detection of the German grapevine yellows (Vergilbungskrankheit) MLO in grapevine, alternative hosts and a vector by a specific PCR procedure. *European Journal of Plant Pathology* **101**, 241-250.

Maixner M., M. Rüdel, X. Daire and E. Boudon-Padieu, 1995b. Diversity of grapevine yellows in Germany. *Vitis* **34**, 235-236.

Maixner M., X. Daire, E. Boudon-Padieu, A. Laviña, A. Batlle and W. Reinert, 1997a. Phytoplasmas. *In*: Walter B. (Editor), Sanitary selection of the grapevine. Protocols for detection of viruses and virus-like diseases. Les Colloques No 86. INRA Editions, Paris. 183-195.

Maixner M. W. Reinert and A. Weber, 1997b. Insect parasitoids and mite parasites of leafhoppers and planthoppers (Auchenorrhyncha) in vineyards. *IOBC/wprs Bulletin* **21**, 75-76.

Maixner M., H. Darimont and W. Reinert, 2000a. Course of infestation by grapevine yellows in vineyards after replanting. *Extended abstracts 13th Meeting of ICVG, Adelaide 2000,* 109-110.

Maixner M., W. Reinert and H. Darimont, 2000b. Transmission of grapevine yellows by *Oncopsis alni* (Schrank) (Auchenorrhyncha: Macropsinae). *Vitis* **39**, 83-84.

Maixner M., J. Lüers and H. Darimont, 2002. Prognose des Flugaktivität von *Hyalesthes obsoletus* und Einfluss klimatologischer Faktoren auf die Phänologie des Reben. *Mitteilungen aus des Biologischen Bundesanstalt* **390**, 228-229.

Malausa J.C., B. Nusillard and L. Giuge, 2003. Lutte biologique contre la cicadelle vectrice de la flavescence dorée. Bilan des recherches sur l'entomofaune antagoniste de *Scaphoideus titanus* en Amérique du Nord en vue de l'introduction d'auxiliaires en France. *Phytoma La Défense des Végétaux* **565**, 24-27.

Marcone C., A. Ragozzino, R. Credi and E. Seemüller, 1996. Detection and characterization of phytoplasmas infecting grapevine in southern Italy and their genetic relatedness to other grapevine yellows phytoplasmas. *Phytopathologia Mediterranea* **35**, 207-213.

Marcone C., A. Ragozzino and E. Seemüller, 1997a. Identification and characterization of the phytoplasma associated with elm yellows in southern Italy and its relatedness to other phytoplasmas of the elm yellows group. *European Journal of Forest Pathology* **27**, 45-54.

Marcone C., G. Scaglione, M. Nicotina, N. De Florio and A. Ragozzino, 1997b. Presenza d'infezioni fitopla-smatiche della vite e relativi possibili vettori in Campania. *Informatore Fitopatologico* **47** (10), 49-52.

Marcone C., G. Scaglione and A. Ragozzino, 2000. Aspetti epidemiologichi delle fitoplasmosi delle drupacee e della vite in Campania. *Informatore Fitopatologico* **50** (1-2), 58-62.

Marcone C., G. Scaglione, I. Camele, A. Ragozzino and G.L. Rana, 2002. Presenza di giallumi della vite in impianti di « Falanghina » nel beneventano e di altri vigniti in Basilicata. *Atti II Incontro Nazionale sulle Malattie da Fitoplasmi, Roma 2002,* 83-84.

Marinesku V.G., Y.A. Kalashyan and T. D. Verderevskaya, 1991. Grapevine yellows in Moldavian SSR. *Proceedings 10th Meeting of ICVG, Volos 1990,* 218.

Martelli G.P, 1986. Grapevine diseases induced by phloem- or xylem-limited prokaryotes in Europe, with special reference to Italy. *In*: Cappelini R. A. and J. M. Wells (Editors), Fastidious Plant Prokaryotes, Cultivation, Detection, and Associated Economic Problems. Rutgers University Press, New Brunswick, NJ, USA. 35-43.

Martelli G.P, 1999. The impact of propagation material on vine health - a European perspective. *Proceedings 10th Australian Wine Industry Technical Conference, Sydney 1998.* 197-207.

Martelli G.P. and A. Caudwell, 1993. Grapevine yellows. *In:* Martelli G. P. (Ed.), Graft-transmissible diseases of grapevines. Handbook for detection and diagnosis. FAO, Publication Division, Rome. 103-105.

Martelli, G.P. and U. Prota, 1999. Selezione e sanità della vite. *Vignevini* **26** (5), 51-58.

Martini M., E. Murari, N. Mori and A. Bertaccini, 1999. Identification and epidemic distribution of two flavescence dorée-related phytoplasmas in Veneto (Italy). *Plant Disease* **83**, 925-930.

Martini M., S. Botti, C. Marcone, C. Marzachì, P. Casati, P.A. Bianco, R. Benedetti and A. Bertaccini, 2002. Genetic variability among Flavescence dorée phytoplasmas from different origins in Italy and France. *Molecular and Cellular Probes* **16**, 197-208.

Marzachi C., A. Boarino, A. Vischi, S. Palermo, C. Morone, A. Loria and G. Boccardo, 2001a. Flavescenza dorata, legno nero e giallume dell'astro in vitigni del Piemonte sud orientale. *Informatore Fitopatologico* **51** (9), 58-63.

Marzachi C., S. Palermo, A. Boarino, F. Veratti, M. D'Aquilio, A. Loria and G. Boccardo, 2001b. Optimisation of a one-step PCR assay for the diagnosis of Flavescence dorée-related phytoplasmas in field-grown grapevines and vector populations. *Vitis* **40**, 213-217.

Marzachi C., L. Galetto and D. Bosco, 2003. Real-time PCR detection of Bois noir and Flavescence dorée from field collected symptomatic grapevines. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 56-57. http://www.agr.uniba.it/ICVG2003/

Meignoz R., E. Boudon-Padieu, J. Larrue and A. Caudwell, 1992. Flavescence dorée de la vigne. Présence de MLO et effets cytopathogènes associés, dans le liber de la vigne. J*ournal of Phytopathology* **134**, 1-9.

Mendgen K., 1971. Untersuchungen über eine Vergilbungskrankheit an Rhein, Mosel und Saar. *Weinberg und Keller* **18**, 345-431.

Mescalchin E. and L. Mattedi, 2003. Das Auftreten der Vergilbungskrankheiten der Rebe in Norditalien/Trentino. *Obstbau - Weinbau* **40** (11), 322-325.

Mescalchin E., F. Michelotti and M. E. Vindimian, 1986. Riscontrata in alcuni vigneti del Basso Sarca Flavescenza dorata della vite. *Terra Trentina* **32** (9), 36-38.

Milkus B., Clair D., Idir S., Habili N. and Boudon-Padieu E. 2004. First detection of stolbur phytoplasma in grapevines (*Vitis vinifera*, cv Chardonnay) affected with grapevine yellows in the Ukraine. *New Disease Reports* **10,** August 2004 - January 2005. http://www.bspp.org.uk/ndr/jan2005/2004-60.asp

M'hirsi S., H. Acheche, S. Fattouch, G. Boccardo, M. Marrakchi and N. Marzouki, 2004. First report of phytoplasmas in the aster yellows group infecting grapevine in Tunisia. *New Disease Reports* **9**, Feb-July 2004, http://www.bspp.org.uk/ndr/july2004/2004-10.asp

Minucci C., G. Boccardo and M. Conti, 1994. A severe disease of grapevines in the Italian Riviera associated with mycoplasma-like organisms. *Proceedings 9th Congress of the Mediterranean Phytopathological Union, Kusadasi-Aydin, Turkey 1994,* 429-431.

Morandell A., 2003. Vergilbungskrankheiten im Südtiroler Weinbau. *Obstbau Weinbau* **40**, 320-322.

Moretti G. and F. Anaclerio, 2000. Influenza del trattamento con acqua calda su talee di alcuni vitigni (*Vitis vinifera* L.). I. Indicazioni preliminari. *Vignevini* **27** (7/8), 88-94.

Moretti G., F. Anaclerio, M. Gardiman and L. Lovat, 2002. Trattamento con acqua calde su legno di marze e su radici di barbatelle innestate di aluni vitigni (*Vitis vinifera* L.). II. Effetti sull'innesto e sulla ripresa delle barbatelle. *Vignevini* **29** (9), 84-91.

Mori N., M. Martini, V. Malagnini, P. Fontana, A. Bressan, V. Girolami and A. Bertaccini, 1999. Vettori dei giallumi della vite, diffusione e strategie di lotta. *L'Informatore agrario* **55** (24), 53-56.

Mori N., A. Bressan, M. Martini, M. Guadagnini, V. Girolami and A. Bertaccini, 2002. Experimental transmission by *Scaphoideus titanus* Ball of two Flavescence dorée-type phytoplasmas. *Vitis* **41**, 99-102.

Morone C., P. Gotta and G. Boccardo, 2000. Sintomi di fitoplasmi in vitigni coltivati in Piemonte. *L'Informatore agrario* **56** (23), 69-77.

Moutous G., A. Fos, J. Besson, E. Joly and P. Biland, 1977. Résultats d'essais ovicides contre *Scaphoideus littoralis* Ball, la cicadelle vectrice de la Flavescence dorée. *Revue de Zoologie agricole et de Pathologie végétale* **76** (2), 37-49.

Murari E., A. Bertaccini, M. Vibio and G. Posenato, 1996. Presenza di fitoplasmi in un vigneto del Soave. *L'Informatore agrario* **52** (20), 66-68.

Murari E., M. Borgo, M. Vibio, E. Sartori and A. Bertaccini, 1997. Thermotherapy trials to eliminate phytoplasmas from Prosecco, Chardonnay and Incrocio Manzoni 6.0.13 grapevine cultivars, preliminary results. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 85-86.

Mutton P.B., W. Boccalon, S. Bressan, C. Coassin, M. Colautti, D.B. Del Cont, A. Floreani, V. Zucchiatti, F. Pavan, D. Mucignat, C. Frausin, P. Antoniazzi, G. Stefanelli and A. Villani, 2002. Legno nero della vite nei vigneti di Chardonnay del Friuli-Venezia Giulia. *Informatore Fitopatologico* **52**, 51-60.

Myrta A., P. Ermacora, B. Stamo and R. Osler, 2003. First report of phytoplasma infections in fruit trees and grapevine in Albania. *Journal of Plant Pathology* **85**, 64.

Nienhaus F. and I.C. Rumbos, 1979. Rickettsialike organisms in grapevines with Yellows disease in Germany. *In : Monografias INIA No. 18. Proceedings 6th Meeting of ICVG, Cordoba 1976,* 223-226.

Nienhaus F., I.C. Rumbos and E. Greuel, 1978. First results in the cultivation of Rickettsia-like organisms of Yellows diseased grapevines in chick embryos. *Zeitschrift für Pflanzenkrank-heiten und Pflanzenschutz* **85**, 113-117

Nusillard B., J.C. Malausa, L. Giuge and P. Millot, 2003. Assessment of a two years study of the natural enemies fauna of *Scaphoideus titanus* Ball in its North American native area. *IOBC/wprs Bulletin* **26** (8), 237-240.

Orenstein S., T. Zahavi and P. Weintraub, 2001. Distribution of phytoplasma in grapevines in the Golan Heights, Israel, and development of a universal primer. *Vitis* **40**, 219-223.
Orenstein S., T. Zahavi, D. Nestel, R. Sharon, M. Barkalifa, P.G. Weintraub, 2003. Spatial dispersion patterns of potential leafhopper and planthopper (Homoptera) vectors of phytoplasma in wine vineyards. *Annals of Applied Biology* **142**, 341-348.
Osler R. and E. Refatti, 2002. Malattie da fitoplasmi della vite. Situazione nell'Italia settentrionale. *Informatore Fitopatologico* **10**, 53-56.
Osler R, A. Fortusini, G. Belli, 1975. Presenza di *Scaphoideus littoralis* in vigneti dell'Oltrepò pavese affetti da una malattia del tipo “flavescence dorée”. *Informatore Fitopatologico* **25** (6), 13-15.
Osler R., E. Boudon-Padieu, L. Carraro, A. Caudwell and E. Refatti, 1992. First results on the trials in progress to identify the vector of the agent of a Grapevine yellows in Italy. *Phytopathologia Mediterranea* **31**, 175-181.
Osler R., A. Arzone, R. Credi, B. Di Terlizzi and P. Del Serrone, 1993a. Trasmissione sperimentale dell'agente della malattia. *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 31-37.
Osler R., L. Carraro, N. Loi and E. Refatti, 1993b. Symptom expression and disease occurrence of a yellows disease of grapevine in northeastern Italy. *Plant Disease* **77**, 496-498.
Osler R., M. E. Vindimian, L. Carraro, C. Frausin and E. Refatti, 1997a. On the transmission of grapevine yellows disease by bench-grafting. *Extended abstracts 12th Meeting of ICVG, Lisbon 1997,* 63-64.
Osler R., M. E. Vindimian, M. Filippi, L. Carraro and E. Refatti, 1997b. Possibilità di propagazione del giallume della vite (legno nero) a mezzo del materiale vivaistico. *Informatore Fitopatologico* **47** (11), 61-63.
Osler R., N. Loi, L. Carraro, P. Ermacora and E. Refatti, 2000. Recovery in plants affected by phytoplasmas. *V Congress of European fundation for Plant Pathology, Taormina 2000*, 91.
Osler R., C. Zucchetto, L. Carraro, C. Frausin, F. Pavan, G. Vettorello and V. Girolami, 2002. Trasmissione di flavescenza dorata e legno nero e comportamento delle viti infette. *Informatore agrario* **58**, 61-65.
Osler R., L. Carraro, P. Ermacora, F. Ferrini, N. Loi, A. Loschi, M. Martini, P.B. Mutton and E. Refatti, 2003. Roguing, a controversial practice to eradicate grape yellows caused by phytoplasmas. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 68-69. http://www.agr.uniba.it/ICVG2003/
Osmelak J.A., R. W. Emmett and M. Pywell, 1989. Monitoring for potential leafhopper vectors (Hemiptera: Cicadelloidea and Fulgoroidea) of the causal agent of Australian grapevine yellows. *Plant Protection Quarterly* **4**, 8-10.
Padovan A.C., K.S. Gibb, A. Bertaccini, M. Vibio, R.G. Bonfiglioli, P.A. Magarey and B.B. Sears, 1995a. Molecular detection of the Australian grapevine yellows phytoplasma and comparison with grapevine yellows phytoplasmas from Italy. *Australian Journal of Grape and Wine Research* **1**, 25-31.
Padovan A.C., K.S. Gibb, P.A. Magarey and M.F. Wachtel, 1995b. Detection of the phytoplasma associated with Australian Grapevine Yellows disease. *The Australian Grapegrower and Winemaker* **32** (378a), 97-98.
Padovan A.C., K.S. Gibb, X. Daire and E. Boudon-Padieu, 1996. A comparison of the phytoplasma associated with Australian grapevine yellows to other phytoplasmas in grapevine. *Vitis* **35**, 189-194.
Palermo S., R. Tedeschi, C. Marzachi and A. Alma, 2003. Quick and reliable methods to detect Flavescence dorée and Bois noir phytoplasmas in field collected insect vectors. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 111-112. http://www.agr.uniba.it/ICVG2003/
Parente A.M., I. Abreu and R. Salema, 1994. Mycoplasma-like organisms associated with phloem cells of diseased grapevines in northern Portugal. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* **101**, 124-127.
Pasquini G., E. Angelini, R. Benedetti, A. Bertaccini, L. Bertotto, P.A. Bianco, F. Faggioli, M. Martini, C. Marzachì and M. Barba, 2001. Armonizzazione della diagnosi della flavescenza dorata della vite (FD), risultati di una prova comparativa. *Atti Convegno Locorotondo, Dicembre 2001*, 921-940.
Pavan F, 1989. Possibilità di controllo dei potenziali vettori dell'agente della flavescenza dorata. *L'Informatore agrario* **45** (41), 55-61.
Pavan F., E. Pavanetto and C. Duso, 1987. Dinamica di popolazione di *Scaphoideus titanus* Ball nelle Venezie. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona 1987,* 149-155.
Pavan F., L. Carraro, G. Vettorello, E. Pavanetto, V. Girolami and R. Osler, 1997a. Flavescenza dorata nei vigneti delle colline trevigiane. *L'Informatore agrario* **53** (10), 73-78.
Pavan F., A. Villani, F. Fornasier and V. Girolami, 1997b. Ruolo del vivaismo nella diffusione della flavescenza dorata. *L'Informatore agrario* **53** (10), 69-71.
Pearson R.C., R.M. Pool, D. Gonsalves and M.C. Goffinet, 1985. Occurrence of flavescence dorée like symptoms on "White Riesling" grapevines in New York, USA. *Phytopathologia Mediterranea* **24**, 82-87.

Petrovic, N., N. Jeraj and M. Ravnikar, 2000. The use of tissue culture for improved detection of phytoplasma in grapevine. *Extended abstracts 13th Meeting of ICVG, Adelaide 2000,* 119-120.

Petrovic N., G. Seljak, G. Matis, J. Miklavc, K. Beber, J. Boben and M. Ravnikar, 2003. The presence of grapevine yellows and their potential natural vectors in wine-growing regions of Slovenia. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 97-98. http://www.agr.uniba.it/ICVG2003/

Planas R, 1987. Expérience de lutte contre la flavescence dorée dans le vignoble audois. *Atti del Convegno sulla Flavescenza Dorata della Vite, Vicenza-Verona*, 237-247.

Posenato, G. and V. Girolami, 1994. Diffusione ed evoluzione della flavescenza dorata della vite nell'area orientale del Soave. *L'Informatore agrario* **50** (22), 57-60.

Posenato G., R. Consolaro and N. Mori, 1996a. *Scaphoideus titanus* (Ball) e altre cicaline nel Veneto orientale. *L'Informatore agrario* **52** (20), 69-71.

Posenato G., R. Consolaro, N. Mori and V. Girolami, 1996b. La flavescenza dorata nell'area del Soave. *L'Informatore agrario* **52** (20), 61-65.

Posenato G., N. Mori, A. Bressan, G. Stefanelli, F. Pavan and V. Girolami, 2002. Valutazione dell'attività di alcuni insetticidi nei confronti degli adulti di *Scaphoideus titanus* Ball e *Metcalfa pruinosa* (say). *Giornate fitopatologiche 2002*, 459-462.

Prince, J.P., R.E. Davis, T.K. Wolf, I-M. Lee, B.D. Mogen, E.L. Dally, A. Bertaccini, R. Credi and M. Barba, 1993. Molecular detection of diverse mycoplasmalike organisms (MLOs) associated with grapevine yellows and their classification with aster yellows, X-disease, and elm yellows MLOs. *Phytopathology* **83**, 1130-1137.

Prince, J.P., R.E. Davis, T.K. Wolf, I-M. Lee and E.L. Dally, 1994. Genomic diversity and possible wild plant sources of mycoplasma-like organisms (MLOs) infecting grapevines, implications for epidemiology. *IOM Letters* **3**, 288-289.

Quacquarelli A, 1991. "Flavescence dorée" in Italy, A national research program. *Proceedings 10th Meeting of ICVG, Volos 1990,* 444-445.

Quacquarelli A, 1993. Progetto di ricerca MAAF "La flavescenza dorata della vite". *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 9-12.

Quacquarelli A. and M. Barba, 1992. Flavescence dorée and other yellows of grapevine in EEC countries. *In*:. Martelli G. P (Editor), Grapevine Viruses and Certification in EEC countries, State of the Art. Quaderno No 3, Istituto Agronomico Mediterraneo, Bari, Italy. 41-47.

Quaroni S., M. Saracchi, A. Fortusini and G. Belli, 1988. Osservazioni mediante microscopia elettronica a scansione su viti affette da "Flavescenza dorata". *Rivista di Patologia Vegetale* (S. IV) **24**, 71-79.

Quaroni S., M. Saracchi, A. Fortusini and G. Belli, 1991. Investigations by scanning electron microscopy on grapevines affected by "flavescence dorée". *Proceedings 10th Meeting of ICVG, Volos 1990,* 446-449.

Quartau J.A., J.M. Guimarães and G. André, 2001. On the occurrence in Portugal of the nearctic *Scaphoideus titanus* Ball (Homoptera, Cicadellidae), the natural vector of the grapevine "Flavescence dorée" (FD). *IOBC/wprs Bulletin* **24** (7), 273-276.

Rafaila C. and M. Costache, 1968 (1970). Ingalbenirea aurie (Flavescence dorée), o boala noua a Vitei de Vie in Romania. *Analele Institutului de Cercetari Pentru Proteccia Plantelor* **6**, 151-156.

Refatti E., 1993. Stato attuale delle conosenze sulla presenza, difffusione e gravità della flavescenza dorata e di altri giallumi della vite in Italia e in altri Paesi del Mondo. *Extended Abstracts Convegno "La flavescenza dorata ed altri giallumi della vite. Stato attuale delle conoscenze e problemi di lotta", Gorizia 1993,* 13-17.

Refatti E., R. Osler, L. Carraro and F. Pavan, 1991. Natural diffusion of a flavescence dorée-like disease of grapevine in northeastern Italy. *Proceedings 10th Meeting of ICVG, Volos 1990,* 164-172.

Refatti E., L. Carraro and R. Osler, 1993. Epidemiology of a yellows disease of grapevine in northern Italy. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 103-104.

Refatti E., L. Carraro, R. Osler, N. Loi and F. Pavan, 1998. Presenza di differenti tipi di giallumi della vite nell'Italia nord-orientale. *Petria* **8**, 85-98.

Regner, F., 2003. Phytoplasmen im Weinbau. *Obst-Wein-Garten* **72** (11), 10-15,

Reinert, W, 1999. Detektion und Differenzierung rebpathogener Phytoplasmen (Mollicutes, Eubacteria) in Deutschland unter Berücksichtigung Phytopathologischer Aspekte. Ph.D. Thesis, Technische Universität Darmstadt, Darmstadt, Germany.

Reinert W. and M. Maixner, 1996. Untersuchungen zum Nachweis der Erreger der Vergilbungskrankheiten der Rebe. *Mitteilungen der Biologische Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem* **321**, 77.

Reinert W. and M. Maixner, 1997. Epidemiological studies on a new grapevine yellows in Germany. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 65-66.

Reinert W. and M. Maixner, 1998. Die Thermotherapie als Mittel zur Heilung phytoplasmen-verseuchten Vermehrungsguts. *Wein-Wissenschaft* **53** (3) 107-113.
Reinert W. and M. Maixner, 2000. Distribution and differentiation of grapevine phytoplasmas in Germany. *Extended abstracts 13th Meeting of ICVG, Adelaide 2000,* 96-97.
Richter S., 2002. Gefährden Phytoplasmosen unseren Weinbau? *Der Winzer* **58** (12), 8-12.
Roure F., 2000. Flavescence dorée. La lutte sur 300 000 ha. *La Vigne* **110** (mai 2000) 38-41 & 80-82.
Rousseau, J, 1997. Flavescenza dorata, che fare in bio? *Agricoltura Biologica* **11** (suppl. 4), 20-23.
Rouzet J., P. Bernard, G. Du Fretay and M. Tissot, 1989. Flavescence dorée, une maladie sous surveillance. *Phytoma - La Défense des Végétaux* **412**, 18-24.
Rüdel M., 1996. Vergilbungskrankheiten. *Das Deutsche Weinmagazin* **11**, 28-30.
Rui D., G. Belli, A. Fortusini, L. Pizzoli and G.C. Torresin, 1987. Ulteriore contributo conoscitivo sulla flavescenza dorata della vite nel Veneto. *Atti del Convegno sulla Flavescenza Dorata della Vite,* 35-56.
Rumbos I.C., 1978. Untersuchungen über Rickettsien-ähnliche Organismen in vergilbungs-kranken Weinreben (*Vitis vinifera* L.) Ph.D. Thesis, University of Bonn, Germany.
Rumbos I.C, 1989. Present knowledge on the yellows diseases of grapevine. *In:* R. Cavalloro (Ed.), Plant-Protection Problems and Prospects of Integrated Control in Viticulture. *Proceedings of the CEC/IOBC International Symposium, Lisboa-Vila Real,* 473-482.
Rumbos I.C. and A.D. Avgelis, 1985. Natural spread, importance and distribution of yellows, stem pitting and enation disease of grapevine in some viticultural areas of Greece. *Phytopathologia Mediterranea* **24**, 73-78.
Rumbos I.C., R.A. Sikora and F. Nienhaus, 1977. Rickettsia-like organisms in *Xiphinema index* Thorne and Allen found associated with yellows disease of grapevines. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* **84***,* 240-243.
Sabaté J., A. Laviña and A. Batlle, 2003. Potential vectors of grapevine Bois noir phytoplasma in Spain and evaluation of their transmission capacity. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 113. http://www.agr.uniba.it/ICVG2003/
Sancassani P. and G. Posenato, 1995. Flavescenza dorata nel Veneto. *L'Informatore agrario* 51(20), 109-110.
Sancassini G.P., F. Dal Molin, E. Murari and M. Borgo, 1999. Interventi per contenere la flavescenza dorata nel Veneto. *L'Informatore agrario* **24**, 41-44.
Santinelli C., M. Santoni, P. Braccini, S. Bott and A. Bertaccini, 2003. Trovato in Umbria *Scaphoideus titanus*, vettore della flavescenza dorata. *L'Informatore agrario* **15**, 81-82.
Saracchi M., S. Quaroni and A. Fortusini, 1990. Ulteriori indagini sull'eziologia della flavescenza dorata della vite mediante microscopia elettronia a scansione. *Rivista di Patologia Vegetale* (S. IV) **26**, 69-77.
Saracchi M., S. Quaroni and A. Fortusini, 1993. Scanning electron microscopy observations on flavescence dorée transmission by dodder. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 105-106.
Saric A., D. Skoric, A. Bertaccini, M. Vibio and E. Murari, 1997. Molecular detection of phytoplasmas infecting grapevines in Slovenia and Croatia. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 77-78.
Scattini G., P.A. Bianco, P. Casati and G. Belli, 2000. Gravi manifestazioni di flavescenza dorata su Sangiovese in vigneti della Valtenesi (Lombardia). *Vignevini* **27** (9), 104-108.
Schvester D., 1962. Perspectives de lutte contre la Flavescence dorée par destruction de son vecteur, *Scaphoideus littoralis* Ball. *Revue de Zoologie Agricole et Appliquée* **61**, 135-144.
Schvester D., P. Carle and G. Moutous, 1961. Sur la transmission de la flavescence dorée des vignes par une cicadelle. *Comptes rendus des séances de l'Académie d'agriculture de France* **47**, 1021-1024.
Schvester D., G. Moutous and P. Carle, 1962. "*Scaphoideus littoralis*" Ball (Homoptera: Jassidae) cicadelle vectrice de la Flavescence dorée de la vigne. *Revue de Zoologie Agricole et Appliquée* **61**, 118-131.
Schvester D., P. Carle and G. Moutous, 1963a. Transmission de la flavescence dorée de la vigne par *Scaphoideus littoralis* Ball. *Annales des Epiphyties* **14**, 175-198.
Schvester D., G. Moutous and P. Carle, 1963b. Tests insecticides de plein champ contre *Scaphoideus littoralis* Ball (Homoptera: Jassidae) cicadelle vectrice de la Flavescence dorée. *Phytiatrie-Phytopharmacie* **12**, 51-56.
Schwartz Y, 1989. La flavescence dorée de la vigne, obtention et caractérisation d'anticorps monoclonaux spécifiques de l'agent pathogène. Thèse de doctorat de l'Université de Bourgogne, Dijon, France.
Schwartz Y., E. Boudon-Padieu, J. Grange, R. Meignoz and A. Caudwell, 1989. Obtention d'anticorps monoclonaux spécifiques de l'agent pathogène de type mycoplasme (MLO) de la flavescence dorée de la vigne. *Research in Micr*obiology **140**, 311-324.

Seddas A, 1994. Purification du Mycoplasma-like organism (MLO) de la flavescence dorée de la vigne par immunoaffinité. Intégrité physique et biologique. Etude des principaux constituants. Thèse de doctorat de l'Université de Bourgogne, Dijon, France.

Seddas A., R. Meignoz, X. Daire, E. Boudon-Padieu and A. Caudwell, 1993a. Purification of grapevine flavescence doree MLO (Mycoplasma-like organism) by immunoaffinity. *Current Microbiology* **27**, 229-236.

Seddas A., R. Meignoz, C. Kuszala, E. Boudon-Padieu and A. Caudwell, 1993b. Two procedures for immunopurification of flavescence dorée mycoplasma-like organism (FD-MLO), and evidence of the pathogenicity of purified MLO. *Extended abstracts 11th Meeting of ICVG, Montreux 1993,* 107.

Seddas A., F. Marty, R. Meignoz and E. Boudon-Padieu, 1994. Preparation of a MLO-enriched fraction from flavescence dorée infected plants suitable for subsequent purification of MLO by immunoaffinity. *IOM Letters* **3**, 295-296.

Seddas A., R. Meignoz, C. Kuszala and E. Boudon-Padieu, 1995. Evidence for the physical integrity of flavescence dorée phytoplasmas purified by immunoaffinity from infected plants or leafhoppers and the plant pathogenicity of phytoplasmas from leafhoppers. *Plant Pathology* **44**, 971-978.

Seddas A., R. Meignoz, X. Daire and E. Boudon-Padieu, 1996. Generation and characterization of monoclonal antibodies to Flavescence doree phytoplasma. Serological relationships and differences in electroblot immunoassay profiles of Flavescence doree and Elm yellows phytoplasmas. *European Journal of Plant Pathology* **102**, 757-764.

Seemüller E., C. Marcone, U. Lauer, A. Ragozzino and M. Göschl, 1998. Current status of molecular classification of the phytoplasmas. *Journal of Plant Pathology* **80**, 3-26.

Seljak G., 1987. *Scaphoideus titanus* Ball (= *S. littoralis* Ball), novi stetnik vinove loze u Jugoslaviji. *Zastita Bija*, **38** (4), 349-357.

Seljak G., 2002. Non-European Auchenorrhyncha (Hemiptera) and their geographical distribution in Slovenia. *Acta Entomologica Slovenica* **10** (1), 97-101.

Seljak G. and N. Petrovič, 1999. Diffusione e stato della ricerca delle malattie da fitoplasmi in Slovenia. *Petria* **10** (2), 133-139.

Seljak G. and N. Petrovič, 2001. An overview on the presence of phytoplasma diseases of grapevine and fruit trees in Slovenia, and research on them. *Sodobno Kmetijstvo* **34**, 466-471.

Šeruga M., M. Curkovic Perica, D. Škorić, B. Kozina, N. Mirosevic, A. Saric, A. Bertaccini and M. Krajačić, 2000. Geographic distribution of Bois Noir phytoplasmas infecting grapevines in Croatia. *Journal of Phytopathology* **148**, 239-242.

Šeruga M., D. Škoric, B. Kozina, M. Curkovic Perica and M. Krajacic, 2003a. Comparison of stolbur phytoplasma isolates from Croatian grapevine by analyses of ribosomal and non-ribosomal gene regions. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 96. http://www.agr.uniba.it/ICVG2003/

Šeruga M., D. Škoric, B. Kozina, S. Mitrev, M. Krajacic, M. Curkovic Perica, 2003b. Molecular identification of a phytoplasma infecting grapevine in the republic of Macedonia. *Vitis* **42**, 181-184.

Sfalanga A., P. Braccini, E. Murari, M. Martini, C. Parrini and A. Bertaccini, 1999. Presenza di legno nero in viti toscane. *L'Informatore agrario* **55** (11), 99-102.

Sforza R, 1998. Epidémiologie du Bois noir de la vigne; recherche d'insectes vecteurs et biologie de *Hyalesthes obsoletus* Sign. (Hemiptera, Cixiidae); évolution de la maladie et perspectives de lutte. Ph.D. Thesis, University of Paris VII, Paris, France.

Sforza R. and E. Boudon-Padieu, 1998. Le principal vecteur de la maladie du Bois noir. *Phytoma - La Défense des Végétaux* **510**, 33-37.

Sforza R. and T. Bourgoin, 1998. Female genitalia and copulation of the planthopper *Hyalesthes obsoletus* Signoret (Hemiptera, Fulgomorpha, Cixiidae). *Annales de la Société Entomologique de France (N. S.)* **34**, 63-70.

Sforza R., D. Clair, X. Daire, J. Larrue and E. Boudon-Padieu, 1997. Study of bois noir epidemiology in France, search and biology of a vector species. *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 107-108.

Sforza R., D. Clair, X. Daire, J. Larrue and E. Boudon-Padieu, 1998. The role of *Hyalesthes obsoletus* (Hemiptera: Cixiidae) in the occurrence of bois noir of grapevines in France. *Journal of Phytopathology* **146**, 549-556.

Sforza R., T. Bourgoin, S. W. Wilson and E. Boudon-Padieu, 1999. Field observations, laboratory rearing and description of immatures of the planthopper *Hyalesthes obsoletus* (Hemiptera: Cixiidae). *European Journal of Entomology* **96**, 409-418.

Sharon R., Weintraub P. and T. Zahavi 2003. Effect of roostock on grapevine yellows facts and explanations. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 73-74. http://www.agr.uniba.it/ICVG2003/

Škoric D., A. Saric, M. Vibio, E. Murari, M. Krajacic and A. Bertaccini, 1998. Molecular identification and seasonal monitoring of phytoplasmas infecting Croatian grapevines. *Vitis* **37**, 171-175.

Smart R. and M. Fletcher, 1996. Potential insect vectors of grapevine yellows in Australian vineyards. *Australian Grapegrower and Winemaker* **395**, 20-22.

Smart R., R. Bonfiglioli and P. Magarey, 1996. Grapevine yellows disease. Avoiding a potential threat to Australian Chardonnay production ? *The Australian Grapegrower and Winemaker* **33** (384), 11-17.

Stefanelli G., A. Villani, C. Coiutti, A. Gregoris and C. Frausin, 1999. Fenologia di *Scaphoideus titanus* Ball in diverse aree viticole del Friuli-Venezia Giulia. *Atti del Convegno "Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia", Gorizia 1999,* 37-43.

Streten C., D. Barbara, A.C. Padovan and K.S. Gibb, 2000. Identification of the major membrane protein of Australian grapevine yellows and related phytoplasmas. *Extended abstracts 13th Meeting ICVG, Adelaide 2000,* 94-95.

Tanne E. and F.E. Nitzany, 1973. Virus diseases of grapevine in Israel. *Vitis* **12**, 222-225.

Tanne E. and S. Orenstein, 1997a. Identification and typing of grapevine phytoplasma amplified by graft transmission to periwinkle. *Vitis* **36**, 35-38.

Tanne, E. and S. Orenstein, 1997b. Molecular detection of phytoplasmas associated with grapevine yellow disease in Israel. *Extended abstracts 12th Meeting ICVG, Lisbon 1997*, 79-80.

Tanne E, E. Boudon-Padieu and C. Kuszala C, 1995. Studies of grapevine Yellows in Israel - Occurrence, Identification and Spread. *Phytoparasitica* **23** (3), 275-276.

Tanne E., S. Melamed, L. Koznetsova, M. Davidovich, P. Weintraub and M. Klein, 2000. Potential vectors of grapevine yellows in Israel. *Extended abstracts 13th Meeting ICVG, Adelaide 2000*, 91.

Tanne E., E. Boudon-Padieu, D. Clair, M. Davidovich, S. Melamed and M. Klein, 2001. Detection of phytoplasma by polymerase chain reaction of insect feeding medium and its use in determining vectoring ability. *Phytopathology* **91**, 741-746.

Tassart-Subirats V., D. Clair, S. Grenan, E. Boudon-Padieu and J. Larrue, 2003. Hot water treatment. Curing efficiency for phytoplasma infection and effect on plant multiplication material. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 69-70. http://www.agr.uniba.it/ICVG2003/

Torres E., S. Botti, J. Rahola, V. Blanco, M.P. Martin and A. Bertaccini, 2003. Molecular characterization and geographical distribution of FD-phytoplasmas in Spain. *Extended Abstracts 14th Meeting of ICVG, Locorotondo 2003,* 87-88. http://www.agr.uniba.it/ICVG2003/

Uyemoto J.K., Cummins, J.R. and Abawi G.S, 1977. Virus and virus-like diseases affecting grapevines in New-York vineyards. *American Journal for Enology and Viticulture* **28**, 131-136.

Varga K., M. Kölber, M. Martini, M. Pondrelli, I. Ember, G. Tökés, J. Lazar, J. Mikulas, E. Papp, G. Szendrey, A. Schweigert and A. Bertaccini, 2000. Phytoplasma identification in Hungarian grapevines by two nested-PCR systems. *Extended abstracts 13th Meeting ICVG, Adelaide 2000,* 113-115.

Vidano C., 1964. Scoperta in Italia dello *Scaphoideus littoralis* Ball cicalina americana collegata all "Flavescence dorée " della Vite. *L'Italia agricola* **101**, 1031-1049.

Vidano C., 1966. Scoperta della ecologia ampelofila del Cicadellide *Scaphoideus littoralis* Ball nella regione neartica originaria. *Annali della Facoltà di Scienze Agrarie della Università degli Studi di Torino* **3**, 297-302.

Vidano C., A. Arzone, A. Alma and C. Arnò, 1987. Auchenorrinchi e diffusione della flavescenza dorata della vite in Italia. *Atti del Convegno sulla Flavescenza Dorata della vite, Vicenza-Verona, Italy, 1987,* 57-68.

Vidano C., A. Arzone, A. Alma and C. Arnò, 1988. Flavescenza dorata della vite e Auchenorrinchi probabili vettori del suo agente patogeno in Piemonte. *Annali della Facoltà di Scienze Agrarie della Università degli Studi di Torino* **15**, 29-37.

Vidano C., A. Arzone, A. Alma and C. Arnò, 1989a. Auchenorryncha and mycoplasma diseases within the vineyard agro-ecosystem in Italy. *In:* R. Cavalloro (Ed.), Plant-Protection Problems and Prospects of Integrated Control in Viticulture. *Proceedings of the CEC/IOBC International Symposium, Lisboa-Vila Real 1988,* 483-488.

Vidano C., A. Arzone, A. Alma and C. Arnò, 1989b. Flavescenza dorata della vite in Piemonte. Indagini su sintomi fogliari, Auchenorrinchi vettori di MLO e piante erbacee affette da micoplasmosi. *Annali della Facoltà di Scienze Agrarie della Università degli Studi di Torino* **16**, 31-44.

Viggiani G, 2002. Il vettore della flavescenza dorata trovato in Basilicata. *L'Informatore agrario* **36**, 59**.**

Vindimian M.E., M. Dalri, L. Delaiti and L. Capra, 1997. Legno nero e presenza di *Scaphoideus titanus* Ball. *L'Informatore agrario* **53** (28), 65-70.

Waite H., J. Crocker, G. Fletcher, P. Wright and A. deLaine, 2001. Hot water treatment in commercial nursery practice an overview. *The Australian Grapegrower and Winemaker* **449a**, 39-43.

Weber A., 1996. Untersuchungen zur Biologie der Zikade *Hyalesthes obsoletus* Signoret, 1865 (Auchenorryncha, Cixiidae) als Vektor der Vergilbungskrankheit der Rebe. Ph.D. Thesis, Johannes-Gutenberg-Universität, Mainz, Germany.

Weber A. and M. Maixner, 1998a. Survey of populations of the planthopper *Hyalesthes obsoletus* Sign. (Auchenorrhyncha: Cixiidae) for infection with the phytoplasma causing grapevine yellows in Germany. *Journal of Applied Entomology* **122**, 375-381.

Weber A. and M. Maixner, 1998b. Habitat requirements of *Hyalesthes obsoletus* (Auchenorrhyncha: Cixiidae) and approaches to control this planthopper in vineyards. *IOBC/wprs Bulletin* **21** (2), 77-78.

Weber A., M. Maixner and W. Reinert, 1997. Monitoring of field populations of the vector *Hyalesthes obsoletus* for infestation with "Vergilbungskrankheit". *Proceedings 12th Meeting of ICVG, Lisbon 1997,* 67-68.

Wilson Y. and R. Hayes, 1996. RSG and AGY - sorting facts from fiction. *The Australian Grapegrower and Winemaker* 33(390a), 139-140.

Wilson Y., F. Constable, P. Magarey and M. Wachtel, 1997. Australian grapevine yellows, a guide to symptoms. *The Australian and New Zealand Wine Industry Journal* **12**, 277-278.

Wolf, T.K., J. P. Prince and R. E. Davis, 1993. Incidence of a grapevine yellows disease in Virginia vineyards. *American Journal of Enology and Viticulture*, **44**, 474.

Wolf T.K., J. P. Prince and R. E. Davis, 1994. Occurrence of grapevine yellows in Virginia vineyards. *Plant Disease* **78**, 208.

Zahavi T., S. Orenstein and E. Tanne, 2000. Factors affecting the occurrence of grapevine yellows in Israel. *Extended abstracts 13th Meeting ICVG, Adelaide 2000*, 103-104.

Zebeyou M.G., A. Caudwell, E. Boudon-Padieu, J. Lherminier and J. Larrue, 1990. Immunological study of MLO development in a vector. *IOM Letters* **1**, 582-583.

Zorloni A., G. Scattini, P.A. Bianco and G. Belli, 2002. Verifica dell'efficacia della potatura invernale come metodo di contenimento della Flavescenza dorata. *Atti II Incontro Nazionale sulle Malattie da Fitoplasmi, Roma 2002*, 55.

PIERCE'S DISEASE

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1. Description

Pierce's disease (PD) was first identified in southern California in 1884 and described by Pierce in 1892. It is known to occur in California and in the Gulf coastal plains of the United States, in northern Mexico, Costa Rica and Venezuela. PD has been considered for many years a virus disease because it was graft-transmissible and spread by insects. The true nature of the causal agent was ascertained only in 1973. Although it is now known to be a bacterial disease, PD has many features in common with virus diseases. Its destructive nature makes PD a major threat to the grapevine industry of the countries where it can be introduced and become established. PD is, therefore, a primary quarantine disease in all viticultural countries where it does not occur. For this reason a short account of PD is given in this Directory quoting only a small part of the large bibliography available.

Main synonyms: Anaheim disease, California vine disease (Eng.), maladie de Pierce (Fr.), Pierce'sche Krankheit (Germ.), malattia di Pierce (Ital.).

Main symptoms: Newly infected vines show symptoms resembling those induced by phytoplasmas, i.e. yellowing or reddening of variously extended sectors the leaf blades in white-berried and red-berried varieties, respectively, followed by scalding and marginal scorching of the leaves. Scorced leaf blades abscise and fall leaving the petiole attached to the cane. Canes lignify irregularly, showing patches of green tissues surrounded by mature brown tissue. Shoot tips may die. By late summer, berries of some or all bunches wither and shrivel. In the second year after infection affected vines show chronic symptoms characterized by delayed spring growth, dwarfing, and progressive decline. Diseased vines usually live longer in cool than in warm climates. The symptoms of Pierce's disease largely result from occlusions of xylem vessels by gum and tyloses.

Agent: The agent of PD is now known to be *Xylella fastidiosa*, a gram-negative bacterium that localizes in the xylem of infected hosts. Its natural host range is wide, as it can infect many wild plants, often without causing symptoms. The PD strain of *X. fastidiosa* causes alfalfa dwarf and almond leaf scorch in California, whereas in the same State another strain induces oleander leaf scorch. In the eastern USA strains of *X. fastidiosa* elicit phony peach disease and leaf scorch diseases of oak, elm, mulberry; plum, and sycamore. In Taiwan *X. fastidiosa* causes leaf scald of pear and in South America, it induces diseases of coffee, plum and citrus. Variegated chlorosis of citrus is a destructive disease that is crippling the industry in some districts of Argentina and Brazil.The genome of the citrus strain of *X. fastidiosa* has been completely sequenced.

Transmission: By grafting, vegetative propagation, needle inoculation with cultured bacteria, and by insect vectors. Xylem-feeding insects acquire bacterial cells while feeding. These attach to the mouthparts and multiply, forming a bacterial plaque. Once contaminated, adult insects can transmit *X. fastidiosa* throughout their life, whereas instars loose transmission capability with moults, thus must have access to a new source of infection. *X. fatidiosa* vectors are leafhoppers belonging to the sharpshooter group of the family *Cicadellidae*, e.g. *Graphocephala atropunctata* (blue-green sharpshooter), *Draeculacephala minerva* (green sharpshooter), *Carneocephala fulgida* (red-headed sharpshooter), and *Homalodisca coagulata* (glassy-winged sharpshooter). This latter species has a lower transmission efficiency than other sharpshooters. However, it is regarded as the most important potential vector of PD for it feeds and repoduces massively on a wide range of plant types from where it moves deeply into the vineyards. As it feeds at the base, rather at the tip of the shoots as well on 2-year-old wood, *H. coagulata* can acquire and transmit PD bacterium from grape to grape, also during dormancy. Other vectors are spittlebugs of the family *Cercopidae.* One of them, *Philaenus spumarius* L., is common in Europe, but it does not appear to be a very efficient vector in the USA. It is not known whether other potential vectors exist in Europe. A wide range of annual and perennial wild and cultivated plants can carry the PD agent. In a review paper, Hewitt (1970) quotes 97 susceptible plant species in 28 botanical families.

Varietal sensitivity and susceptibility: All *Vitis vinifera* and *V. labrusca* varieties are susceptible and may be killed by the disease. Pinot noir and Chardonnay appear to be particularly susceptible and decline quickly when infected. The only *Vitis* species known to have resistance are grapes native to the Gulf coastal plains in the southeastern part of the United States. Among them, *V. rupestris* Scheele, *V. simpsoni* Munson, and *Muscadinia rotundifolia* Michaux.

Detection: Indexing on *V. vinifera* varieties (transmission by grafting or vectors), isolation of the bacterium on selective culture media, serology (ELISA), and molecular techniques (PCR).

Control: There is no control method for vineyards in regions where the disease is established. However, a number of biological and, to a lesser extent, chemical measures can be taken to reduce the populations of vectors through appropriate management of riparian vegetation and weeds that constitute the breeding grounds of sharpshooters. Heat therapy is effective for sanitizing grapevine propagating material. In fact, *X. fastidiosa* can be killed in dormant canes by hot water treatment for 3 hours at 45 °C or 45 minutes at 50 °C. Quarantine measures should take account of the fact that many plants other than grapevine can carry the disease.

2. Historical review

1892 **Pierce**: First description of the disease, in California.

1941 **Hewitt and Houston**: Pierce's disease of grapes and alfalfa dwarf are caused by the same pathogen, suspected to be a virus.

1942 **Hewitt** *et al*.: Review paper on Pierce's disease.

1946 **Hewitt** *et al*.: Leafhopper transmission of Pierce's disease of grapevine and alfalfa dwarf.

1947 **Houston** *et al*.: Studies on the mode of feeding of several leafhopper vectors of Pierce's disease of alfalfa and grapevine. Most feeding punctures reach xylem tissues. Probes often have multiple channels that branch from a single entry. Disease develops only when the probes have access to the xylem, but not when feeding was restricted to the phloem.

1949 **Winkler** *et al*.: Review on investigations on Pierce's disease: symptoms, yield losses, spread into vineyards, effect of eradicating diseased vines, host range, main vectors.

1966 **Hering**: Occurrence of *Philaenus spumarius* L. on grapevine in the Rhine Valley, Germany. This cercopid species is vector of Pierce's disease in North America.

1970 **Hewitt**: Review paper on Pierce's disease, still supposed to be caused by an undetermined virus.

1973 **Goheen** *et al*.: Association of a rickettsia-like organism with Pierce's disease of grapevine and alfalfa dwarf, inactivation of the pathogen in dormant canes by heat treatment in water at 45 °C for 180 min., 50 °C for 20 min. or 55 °C for 10 min.

1973 **Hopkins and Mollenhauer**: Rickettsia-like organisms were observed by electron microscopy in thin sections of xylem tissues of grapevines infected with Pierce's disease. No similar organisms were found in healthy grapevines. Because of their constant association with Pierce's disease, their failure to grow on cell-free medium and their sensitivity to tetracycline antibiotics, these organisms were considered by the authors as the probable cause of Pierce's disease.

1974 **Auger** *et al*.: The authors give evidence that a bacterium of the genus *Lactobacillus* (gram-positive), isolated from the leafhopper *Draeculacephala minerva* which had fed on plants infected with Pierce's disease, is the causal agent of the disease. When the pure culture of this bacterium was injected into uncontaminated leafhoppers and these were transferred to disease-free grapevines, typical symptoms of Pierce's disease developed. The same bacteria were isolated from the inoculated plants.

1974 **Purcell**: Spatial distribution of Pierce's disease in the Napa Valley vineyards. Varietal susceptibility and sensitivity.

1977 **Mortensen** *et al*.: Identification of sources of resistance to Pierce's disease in *Vitis.*

1978 **Davis** *et al.*: Isolation of a gram-negative rod-shaped bacterium from Pierce's disease affected vines. Experimental evidence that it is the agent of the disease.

1979 **Goheen** *et al*.: Pierce's disease recorded from Central America

1979a **Purcell**: Review on vectors of Pierce's disease. Host and vector range, etiology, vector-pathogen relationships, epidemiology. Confirmation that *Philaenus spumarius* is vector of Pierce's disease.

1979b **Purcell**: Control of the blue-green sharpshooter, vector of Pierce's disease, by spraying dimethoate on the vegetation around vineyards and on the vines adjacent to the borders. Vector populations were strongly reduced. With the less susceptible grapevine cultivars, the incidence of the disease was reduced in the year following the treatments, but with highly susceptible varieties such as Pinot noir or Chardonnay, there was no significant difference in disease attack.

1979 **Purcell and Finlay**: Determination of transmission modality of *X. fastidiosa* by sharpshooters.

1980 **Nomé** *et al*.: Pierce's disease bacteria can be detected by ELISA in infected plant tissues.

1980 **Davis** *et al.*: Description of isolation media for *X. fastidiosa*.

1980 **Raju** *et al.*: Pierce's disease recorded from Mexico.

1982 **Brlansky** *et al*.: Detection of xylem-limited bacteria *in situ* by immunofluorescence.

1982 **Rosenberger**: Review on the epidemiology of Pierce's disease.

1985 **Jimenez A**.: Pierce's disease recorded from Venezuela.

1985 **Kamper** *et al*.: Genetic relationships of *Xylella fastidiosa* and other xylem-limited bacteria

1987 **Wells** *et al*.: Description of *Xylella fastidiosa*, agent of Pierce's disease, a new species and a new genus of gram-negative, xylem-limited, fastidious plant bacteria related to *Xanthomonas* spp.

1987 **Walter**: Up-to-date review on Pierce's disease. Importance of careful quarantine measures in order to avoid introducing this disease in Europe.

1988 **Hopkins**: Description of methods for culturing and identification of *Xylella fastidiosa.*

1988 **Goheen and Hopkins**: Review paper on Pierce's disease.

1989 In: **Gorden et al. 2001**: Glassy winged sharpshooter identified in California

1989 **Boubals**: Report that Pierce's disease bacterium detected by ELISA in grapevines imported from California in Europe, and that urgent measures are necessary in order to avoid the introduction of the disease. However, this information seems to be a false alarm. Evidence presented at an OIV meeting in December 1991 that there are no PD outbreaks in Europe.

1994 **Minsawage** *et al*.: Development of a PCR protocol for the identification of *X. fastidiosa* in plant tissues.

1995 **Hopkins**: History of Pierce's disease.

1997 **Hill and Purcell**: Minimum incubation periods before *X. fastidiosa* can be acquired by vector (*G. atropunctata*) varies from 4 to 29 days according to the host, grapevine having the shortest period (four days).

1997 **Purcell A.H**.: Review article on *Xylella fastidiosa.* List of plant diseases suspected or confirmed to be caused by the bacterium.

1998 **Berisha** *et al*.: Symptoms similar to those caused by Pierce's disease observed in Kosovo in the mid 1980s. *Xylella fastidiosa* isolated from symptomatic grapevines. First record in Europe.

2000 **Simpson** *et al.*: Complete nucleotide sequence of the citrus strain of *X. fastidiosa*.

2001 **Varela** *et al*.: Review of Pierce's disease symptoms, epidemiology , vector monitoring, and disease management.

2001 **Gorden** *et al*.: A guide to the knowledge of the glassy-winged sharpshooter.

3. References

Auger J.G., T.A. Shalla and C.I. Kado, 1974. Pierce's disease of grapevines: evidence for a bacterial etiology. *Science* **184**, 1375-1377.

Berisha B., Chen Y.D., Zhang G.I., XU B.Y. and Chen T.A., 1998. Isolation of Pierce's disease bacteria from grapevines in Europe. *European Journal of Plant Pathology* **104**, 427-433.

Boubals D., 1989. *Attention !* La maladie de Pierce arrive dans les vignobles d'Europe. Il faut réagir rapidement. *Progrès Agricole et Viticole* **106**, 85-87. (The same text appears in the *Bulletin de l'Office international de la Vigne et du Vin* **62**, 309-314).

Brlansky R.H., R.F. Lee, L.W. Timmer, D.E. Purcifull and B.C. Raju, 1982. Immuno- fluorescent detection of xylem-limited bacteria in situ. *Phytopathology* **72**, 1444-1448.

Davis M.J., A.H. Purcell and S.V. Thomson, 1978. Pierce's disease of grapevines: isolation of the causal bacterium. *Science* **199**, 75-77.

Davis M.J., A.H. Purcell and S.V. Thomson, 1980. Isolation media for the Pierce's disease bacterium. *Phytopathology* **70**, 425-429.

Goheen A.C., G. Nyland and S.K. Lowe, 1973. Association of a rickettsia like organism with Pierce's disease of grapevines and alfalfa dwarf and heat therapy of the disease in grapevines. *Phytopathology* **63**, 341-345.

Goheen A.C., B.C. Raju, W.K. Lowe and G. Nyland, 1979. Pierce's diseasse of grapevine in Central America. *Plant Disease Reporter* **63**, 788-792.

Goheen A.C. and D.L. Hopkins, 1988. Pierce's disease. *In* Pearson R.C. and A.C. Goheen (Eds): Compendium of Grape Diseases. APS Press, St. Paul, Minnesota, USA, 44-45.

Gorden J. and several authors, 2001. Glassy-winged sharpshooter and related bacterial diseases. California Citrus Industry Guide, Citrus Research Board, Visalia, California, 23pp.

Hering M., 1966. Auftreten der Wiesenschaumzikade *Philaenus spumarius* L. an Reben. *Weinberg und Keller* **13**, 459-462.

Hewitt W.B., 1970. Pierce's disease of *Vitis* species. *In* Frazier N.W. (Editor): Virus Diseases of Small Fruits and Grapevines (A Handbook), University of California, Division of Agricultural Sciences, Berkeley, 196-200.

Hewitt W.B., N.W. Frazier, H.E. Jacob and J.H. Freitag, 1942. Pierce's disease of grapevines. University of California, College of Agriculture, Agricultural Experiment Station, Berkeley, California, Circular 353, 32 pp.

Hewitt W.B. and B.R. Houston, 1941. Association of Pierce's disease of grapevines and alfalfa dwarf in California. *Plant Disease Reporter* **25**, 475-476.

Hewitt W.B., B.R. Houston, N.W. Frazier and J.H. Freitag, 1946. Leafhopper transmission of the virus causing Pierce's disease of grape and dwarf of alfalfa. *Phytopathology* **36**, 117-128.

Hill B.L. and A.H. Purcell, 1997. Populations of *Xylella fastidiosa* in plants required for transmission by an efficient vector. *Phytopathology* **87**, 1197-1201

Hopkins D.L. and H.H. Mollenhauer, 1973. Rickettsia-like bacterium associated with Pierce's disease of grapes. *Science* **179**, 298-300.

Hopkins D.L., 1988. *Xylella fastidiosa* and other fastidious bacteria of uncertain affiliation. *In* Schaad N.W. (Ed.): Laboratory Guide for Identification of Plant Pathogenic Bacteria. APS Press, St. Paul, Minnesota, USA, 2nd ed., 95-103.

Hopkins D.L., 1995. *Xylella fastidiosa* and associated diseases. History and significance. *Plant Diagnostics Quarterly* **16,** 107-110.

Houston B.R., K. Esau and W.B. Hewitt, 1947. The mode of vector feeding and the tissues involved in the transmission of Pierce's disease virus in grape and alfalfa. *Phytopathology*, **37**, 247-253.

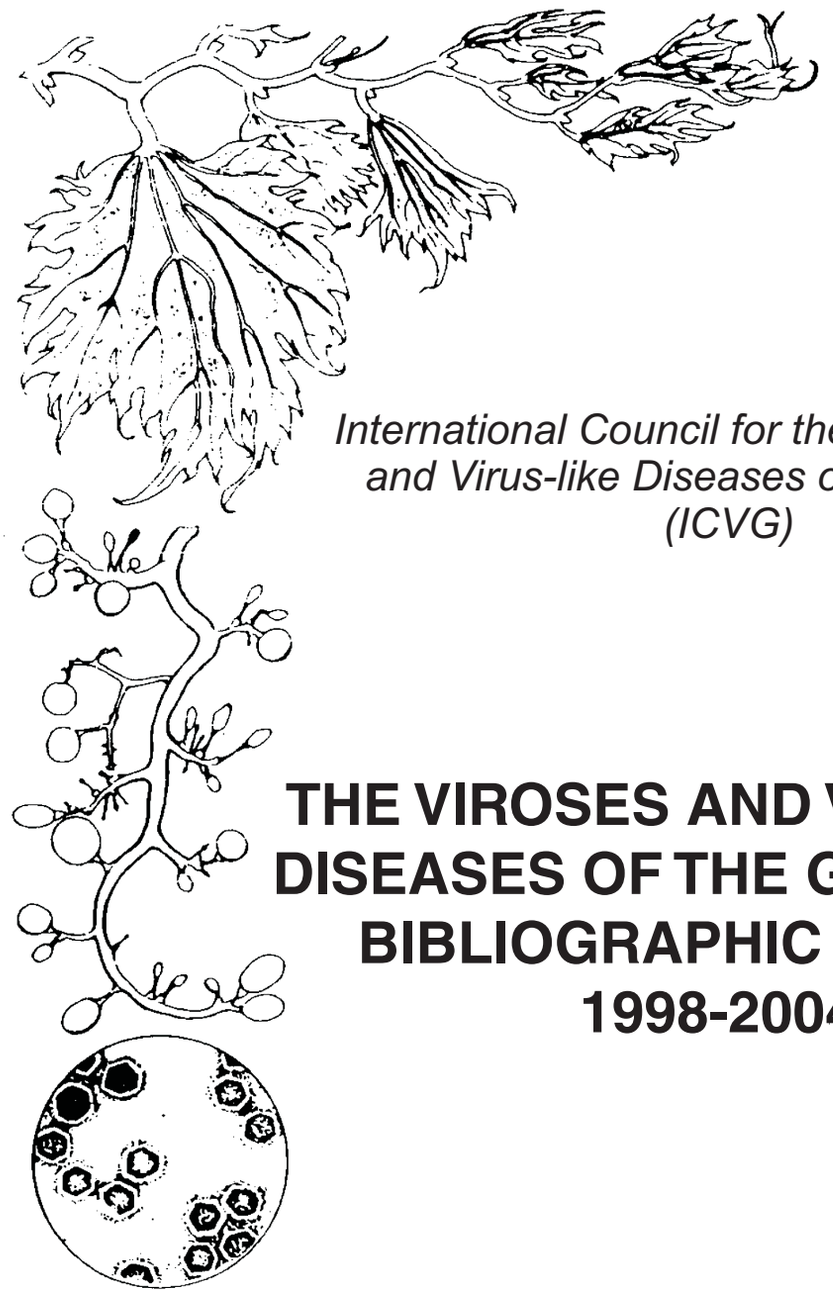
Jimenez A., 1985. Evidencia immunologica del mal del Pierce de la vid en Venezuela. *Turrialba* **35**, 243-247.

Kamper S.M., W.J. Franch, and S.R. De Kloert, 1985. Genetic relationships of some fastidious xylem-limited bacteria . *International Journal of Systematic Bacteriology* **35**, 185-188.

Minsavage G.V., C.M. Thompson, D.L.Hopkins, R.M. Leite and R.E. Stall, 1994. Development of a polymerase chain reaction protocol fro detection of *Xylella fastidiosa* in plant tissues. *Phytopathology* **84,** 456-461.

Mortensen J.A., L.H. Stover and C.F. Balerdi, 1977. Sources of resistance to Pierce's diseases in *Vitis. Journal of the American Society of Horticultural Sciences* **102**, 695-697.

Nomé S.F., B.C. Raju, A.C. Goheen, G. Nyland and D. Docampo, 1980. Enzyme-linked immunosorbent assay for Pierce's disease bacteria in plant tissues. *Phytopathology* **70**, 746-749.
Pierce N.B., 1892. The California vine disease. *Bulletin. Division of Vegetable Physiology and Pathology. United States Department of Agriculture* **2**, 1-222.
Purcell A.H., 1974. Spatial patterns of Pierce's disease in the Napa Valley. *American Journal of Enology and Viticulture* **25**, 162-167.
Purcell A.H., 1997. *Xylella fastidiosa*, a regional problem or global threat? *Journal of Plant Pathology* **79**, 99-105.
Purcell A.H., 1979a. Leafhoppers vectors of xylem-borne plant pathogens. *In* Maramorosh K. and K.F. Harris (Editors): Leafhopper Vectors and Plant Disease Agents. Academic Press New York, 603-625.
Purcell A.H., 1979b. Control of the blue-green sharpshooter and effects on the spread of Pierce's disease of grapevines. *Journal of Economic Entomology* **72**, 887-892.
Purcell A.H. and A.H. Finlay, 1979. Evidence for non circulative transmission of Pierce's disease bacterium by sharpshooter leafhoppers. *Phytopathology* **69**, 393-395.
Raju B.C, A.C. Goheen, D. Teliz, D.M. Docampo and G. Nyland, 1985. Pierce's disease of grapevines in Mexico. *Plant Disease* **64**, 208-282.
Rosenberger D.A., 1982. Fastidious prokaryotes: epidemiology of the hidden pathogens. *In* Mount M.S. and G.H. Lacy (Eds). Phytopathogenic Prokaryotes, Vol. **2**, Academic Press, New York, 71-100.
Simpson A.J. and many others, 2000. The genome sequnece of the plant pathogen *Xylella fastidiosa*. *Nature* **406**, 151-157.
Varela L.C, R.J. Smith and P.A. Phillips, 2001. Pierce's Disease. *Agriculture and Natural Resources*, University of California publication 21600, 20 pp.
Walter B., 1978. La maladie de Pierce: mieux vaut prévenir que guérir. *Phytoma - Défense des cultures* **390**, 32-34.
Wells J.M., B.C. Raju, H.Y. Hung, W.G. Weinsburg, L. Mandelco-Paul and D.J. Brenner, 1987. *Xylella fastidiosa*, gen. nov., sp. nov.: Gram-negative, xylem-limited, fastidious plant bacteria related to *Xanthomonas* spp. *International Journal of Systematic Bacteriology* **37**, 136-143.
Winkler A.J., W.B. Hewitt, N.W. Frazier and J.H. Freitag, 1949. Pierce's disease investigations. *Hilgardia* **19**, 207-264.



International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG)

THE VIROSES AND VIRUS-LIKE DISEASES OF THE GRAPEVINE: BIBLIOGRAPHIC REPORT 1998-2004

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INTRODUCTION

This is the sixth bibliographic report prepared for the members of the International Council for the Study of Virus and Virus-like Diseases of Grapevine (ICVG) and for all colleagues interested in virus and virus-like diseases of grapevine, including phytoplasma and viroid diseases. The five previous reports were:

Caudwell,A., 1965: Bibliographie des viroses de la vigne des origines ˆ 1965. Office International de la Vigne et du Vin, Paris, 76 pp. 1019 references (out of print).

Caudwell,A., W.B.Hewitt and **R.Bovey,** 1972: Les viroses de la vigne. Bibliographie de 1965-1970. Vitis **11**, 303-324. 367 references.

Hewitt,W.B. and **R.Bovey,** 1979: The viroses and virus-like diseases of the grapevine. A bibliographic report 1971-1978. Vitis **18**, 316-376. 777 references.

Bovey,R. and **G.P.Martelli,** 1986. The viroses and virus-like diseases of the grapevine. A bibliographic report, 1979-1984. Vitis **25**, 227-275. 636 references.

Bovey,R., 1999. The viroses and virus-like diseases of the grapevine: Bibliographic report, 1985-1997. Options MŽditerranŽennes, ser.B: Studies and Research, Number 29, Part 3, 1- 172. 1670 references.

With the 920 references presented in this report for the period 1998-2004, this makes a total number of 5389 references from the beginning to the end of 2004. The average yearly number of publications on this subject increased steadily from 1965-72 (61) to 1998-2004 (131) in spite of the fact that from 1997, the papers on Pierce's disease were no more included. It is interesting to note that in the total number of 5389 papers mentioned above, 836 (15%) appeared in the Proceedings or Extended Abstracts or ICVG's successive meetings from 1965 to 2003. Moreover, many papers on grapevine virus, viroid or phytoplasma diseases published in specialized journals during this period concerned the work of ICVG members.

The publications on phytoplasma and phytoplasma diseases are still included in the ICVG bibliography, although these organisms belong to bacteriology. The reason for this apparently illogical situation is partly historical: phytoplasma diseases were for many years considered as virus diseases. On the other hand, phytoplasma diseases of grapevine are closer to virus diseases than to true bacterial diseases by their mode of transmission, the control measures they require and their symptoms. Very often scientists working on grapevine viruses also deal with phytoplasma diseases of grape.

In every ICVG meeting, papers were presented on phytoplasma problems, and this field corresponds partly to the term "virus-like" included in the name of ICVG.

The references presented in this bibliographic report cover the period 1998-2004, as far as they were available till end of March 2005. Most of them were transcribed from the original publication and checked whenever possible from available databases. Great care has been taken to avoid mistakes. However, no bibliography can be absolutely error-free.

The alphabetic order of the list of references has been determined automatically by the computer bibliographic software Refman (Reference Manager, Research Information Systems Inc., USA). No attempt has been made to modify it. The same author may appear with different spellings of his/her name, especially from countries such as Russia, Greece or Israel where transliteration often leads to confusion. In principle, the original spelling was maintained.

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I wish to express my deep thanks to Dr Paul Gugerli for his very valuable help in the final computer handling of references and of the subject index.

Several colleagues kindly helped me in the preparation of this bibliography by sending reprints or photocopies of papers that were not available or by providing information on various points. I wish to

express them my sincere thanks. Many thanks also to Dr G.P.Martelli, president of ICVG for his encouragement and advice.

This printed version of the bibliography could not have been made available to grapevine virologists without the generous contribution of the Mediterranean Agronomy Institute of Bari (IAMB) who accepted to print it in the Options Méditerranéennes. I wish to thank very much its Director, Prof. Dr C.Lacirignola, and his staff in charge of editing this report.

SUBJECT INDEX

I.Viruses and virus diseases of grapevine

II. Phytoplasmas and phytoplasma diseases of grapevine

III. Viroids of grapevine

REFERENCES

The numbers before the first author's name correspond to the Subject index numbers.

1. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, M. A. Castellano, D. Boscia, and G. P. Martelli.** 2000. Properties of a new isolate of grapevine leafroll-associated virus 2. Vitis **39**:119-121.

2. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, and G. P. Martelli.** 2003. Sequence analysis of the 3'end of three *Grapevine fleck virus*-like viruses of grapevine. Virus Genes **27**:11-16.

3. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, and A. Rowhani.** 2004. Preliminary data on a putative new grapevine leafroll associated virus. Phytopathology **95** (Supplement):S2.

4. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, A. Rowhani, and D. Golino.** 2004. Molecular characterization of two viruses involved in the grapevine leafroll complex. Phytopathology **94** (Supplement):S2.

5. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, A. Rowhani, and G. P. Martelli.** 2003. Multiplex RT-PCR detection of *Grapevine fleck virus*-like viruses in grapevine with co-amplification of control plant mRNA, p. 195. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

6. **Abou Ghanem-Sabanadzovic, N., S. Sabanadzovic, G. Roy, and A. Rowhani.** 2003. Partial molecular characterization of *Grapevine leafroll-associated virus 4*, p. 42. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

7. **Abou-Ghanem, N., S. Sabanadzovic, M. A. Castellano, D. Boscia, and G. P. Martelli.** 2000. Characterization of a new strain of grapevine leafroll-associated virus 2, p. 8. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

8. **Abou-Ghanem, N., S. Sabanadzovic, A. Minafra, P. Saldarelli, and G. P. Martelli.** 1998. Some properties of grapevine leafroll-associated virus 2 and molecular organization of the 3' region of the viral genome. Journal of Plant Pathology **80**:37-46.

9. **Abracheva, P.** 2003. Problems in the production of certified grapevine planting material in Bulgaria, p. 183. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

10. **Abracheva, P.** 2004. Influence of some virus diseases on the size of leaf area of grapevines, p. 72-77. *In* II Balkan Symposium of Viticulture and Enology. Symposium Proceedings. Institute of viticulture and enology, Pleven, Bulgaria.

11. **Abu Shirbi, A.** 2001. Effect of thermal therapy treatments and meristem tip culture on freeing grapevine infected with Grapevine fanleaf virus. PhD thesis, University of Jordan, Amman (Jordan).

12. **Acheche, H., S. Fattouch, S. M'hirsi, N. Chabbouh, N. Marzouki, and M. Marrakchi.** 2000. Studies on grapevine leafroll associated virus 3 transmission by mealybugs in Tunisian grapevines, p. 23. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

13. **Acheche, H., S. Fattouch, S. M'hirsi, N. Marzouki, and M. Marrakchi.** 1998. Les viroses de la vigne en Tunisie (Grapevine virus diseases in Tunisia). Archives de l'Institut Pasteur de Tunis **75**:219-226.

14. **Acheche, H., S. Fattouch, S. M'hirsi, N. Marzouki, and M. Marrakchi.** 1999. Use of optimized PCR methods for the detection of GLRaV3: a closterovirus associated with grapevine leafroll in Tunisian grapevine plants. Plant Molecular Biology Reporter **17**:31-42.

15. **Afonso, A.P.S., J. L. C. Faria, T. V. M. Fajardo, M. Botton, O. Nickel, and P. G. Schenato.** 2004. Detecçao de GLRaV-1 e 3 e GVA em *Pseudococcus viburni* (Hemiptera: Pseudococcidae) associado a cultura da videira por DAS-ELISA (Detection of GLRaV-1 and 3 and GVA by DAS-ELISA in *Pseudococcus viburni* (Hemiptera:Pseudococcidae) associated to grape culture), p. 544. *In* XX Congresso Brasileiro de Entomologia, Gramado, RS (Abstract).

16. **Ahmed, H.M.H., M. Digiaro, and G. P. Martelli.** 2003. A preliminary survey for grapevine viruses in Egypt, p. 178-179. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

17. **Ahmed, H.M.H., M. Digiaro, and G. P. Martelli.** 2004. Viruses and virus diseases in Egypt. Bulletin OEPP/EPPO Bulletin **34**:395-398.

18. **Akbas, B. and G. Erdiller.** 1998. Grapevine virus diseases of Karaman, Konya and Nevshehir provinces, p. 149-153. *In* Proceedings of the 8th Turkish Phytopathological Congress, Ankara 1998.

19. **Al-Tamimi, N., M. Digiaro, and V. Savino.** 1998. Viruses of grapevine in Jordan. Phytopathologia mediterranea **37**:122-126.

20. **Alkowni, R., M. Digiaro, and V. Savino.** 1998. Viruses and virus diseases of grapevine in Palestine. Bulletin OEPP/EPPO Bulletin **28**:189-195.

21. **Alkowni, R. and A. Rowhani.** 2003. Molecular characterization of *Grapevine leafroll-associated virus 9,* a new closterovirus associated with grapevine leafroll disease complex, p. 33. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

22. **Alkowni, R., A. Rowhani, S. Daubert, and D. Golino.** 2004. Partial characterization of a new ampelovirus associated with grapevine leafroll disease. Journal of Plant Pathology **86**:123-133.

23. **Alkowni, R., A. Rowhani, and D. A. Golino.** 2002. Partial nucleotide sequence and molecular detection of a putative new grapevine leafroll associated virus. Phytopathology **92** (Supplement):S3.

24. **Alley, L. and D. A. Golino.** 2000. The origins of the grape program at foundation plant materials service, p. 222-230. *In* Proceedings of the 50th Anniversary Meeting of the American Society for Enology and Viticulture, Seattle, Washington, June 19-23, 2000.

25. **Alma, A.** 2001. Auchenorrhinchi vettori di fitoplasmi in Europa (Auchennorrhyncha vectors of phytoplasmas in Europe). Quad. Vitic. Enol. Univ. Torino **25**:109-117.

26. **Alma, A. and M. Conti.** 2002. Flavescenza dorata e altre fitoplasmosi della vite: il punto su vettori ed epidemiologia (Flavescence dorée and other phytoplasma diseases of grapevine: vectors and epidemiology). Informatore Fitopatologico **52**(10):31-35.

27. **Alma, A. and M. Conti.** 2004. Vettori dei fitoplasmi della vite (Vectors of grapevine phytoplasms), p. 1-5. *In* La Vite - Convegno Nazionale, Torino, 2-3.12.2004.

28. **Alma, A., M. Conti, and G. Boccardo.** 2000. Trasmissione a vite mediante cicaline del phytoplasma del Giallume della margherita (CY, gruppo 16Sr-IB) (Leafhopper transmission to grapevine of the phytoplasma of chrysanthemum yellows [CY, group 16Sr-IB]). Petria **10**:173-174.

29. **Alma, A., S. Palermo, G. Boccardo, and M. Conti.** 2001. Transmission of Chrysanthemum yellows, a subgroup 16SrI-B phytoplasma, to grapevine by four leafhopper species. Journal of Plant Pathology **83**:181-187.

30. **Alma, A., G. Soldi, R. Tedeschi, and C. Marzachi.** 2002. Ruolo di *Hyalesthes obsoletus* (Homoptera, Cixiidae) nella trasmissione del Legno nero della vite in Italia (Role of *Hyalesthes obsoletus* in the transmission of bois noir of grapevine in Italy). Petria **12**:411-412.

31. **Anaclerio, F., M. Borgo, and T. Cosmi.** 1999. Prove di risanamento virale su biotipi di *Vitis vinifera* (Viral sanitation attempts on *Vitis vinifera* biotypes). Vignevini **26**(4):100-103.

32. **Andret, P., C. Schmitt, G. Demangeat, V. Komar, M. Bergdoll, E. Vigne, and M. Fuchs.** 2003. RNA2-encoded proteins for the exclusive transmission of *Grapevine fanleaf virus* by its nematode vector *Xiphinema index*, p. 237. *In* 8th International Congress of Plant Pathology, 2-7 February 3003, Christchurch, New Zealand, vol.3.

33. **Andret, P., C. Schmitt, G. Demangeat, V. Komar, E. Vigne, M. Bergdoll, and M. Fuchs.** 2003. The coat protein of *Grapevine fanleaf virus* is the sole viral determinant for the exclusive transmission by its nematode vector *Xiphinema index*, p. 209. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

34. **Andret-Link, P., C. Laporte, L. Valat, C. Ritzenthaler, G. Demangeat, E. Vigne, V. Laval, P. Pfeiffer, C. Stussi-Garaud, and M. Fuchs.** 2004. Grapevine fanleaf virus: still a major threat to the grapevine industry. Journal of Plant Pathology **86**:183-195.

35. **Andret-Link, P., C. Schmitt-Keichinger, G. Demangeat, V. Komar, and M. Fuchs.** 2004. The specific transmission of *Grapevine fanleaf virus* by its nematode vector *Xiphinema index* is solely determined by the viral coat protein. Virology **320**:12-22.

36. **Anfoka, G.H., W. Shahrour, and M. K. Nakhla.** 2004. Detection and molecular characterization of grapevine fanleaf virus and grapevine leafroll-associated virus 3 in Jordan. Journal of Plant Pathology **86**:203-207.

37. **Angelini, E., N. Bertazzon, and M. Borgo.** 2002. Comparison among different isolates of grapevine leafroll associated virus 2 by HMA. Journal of Plant Pathology **84**:172.

38. **Angelini, E., N. Bertazzon, and M. Borgo.** 2003. Occurrence of the Redglobe strain of Grapevine leafroll- associated virus 2 in table and wine grape varieties in Italy. Vitis **42**:203-204.

39. **Angelini, E., N. Bertazzon, and M. Borgo.** 2004. Diversity among grapevine leafroll-associated virus 2 isolates detected by heteroduplex mobility assay. Journal of Phytopathology **152**:416-422.

40. **Angelini, E., M. Borgo, W. Viel, and N. Bertazzon.** 2001. Accertamenti sanitari per *Rupestris stem pitting* tramite saggi biologici ed analisi biomolecolari (Sanitary evaluation on Rupestris stem pitting by means of biological tests and biomolecular analyses). Quad. Vitic. Enol. Univ. Torino **25**:77-87.

41. **Angelini, E., D. Clair, M. Borgo, A. Bertaccini, and E. Boudon-Padieu.** 2001. Flavescence dorée in France and Italy - Occurrence of closely related phytoplasma isolates and their near relationships to Palatinate grapevine yellows and an alder yellows phytoplasma. Vitis **40**:79-86.

42. **Angelini, E., D. Clair, M. Borgo, A. Bertaccini, and E. Boudon-Padieu.** 2002. Comparazione fra i fitoplasmi associati alla flavescenza dorata della vite in Europa (Comparison between phytoplasmas associated with flavescence dorée in Europe). L'Enologo **37** (10):99-108.

43. **Angelini, E., E. Negrisolo, D. Clair, M. Borgo, and E. Boudon-Padieu.** 2003. Phylogenetic relationships among Flavescence dorée strains and related phytoplasmas determined by heteroduplex mobility assay and sequence of ribosomal and nonribosomal DNA. Plant Pathology **52**:663-672.

44. **Angelini, E., F. Squizzato, G. Lucchetta, and M. Borgo.** 2002. Identificazione di un fitoplasma associato a Flavescenza Dorata su clematide (*Clematis vitalba*) (Identification of a phytoplasma associated with flavescence dorée on clematis (*Clematis vitalba*). Petria **12**:387-389.

45. **Angelini, E., F. Squizzato, G. Lucchetta, and M. Borgo.** 2003. Identification of a grapevine flavescence dorée-C phytoplasma and two deletion mutants in Clematis, p. 60-61. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

46. **Angelini, E., F. Squizzato, G. Lucchetta, and M. Borgo.** 2004. Detection of a phytoplasma associated with grapevine *Flavescence dorée* in *Clematis vitalba*. European Journal of Plant Pathology **110**:193-201.

47. **Anonymous,** 2004. "Candidatus Phytoplasma", a taxon for the wall-less non helical prokaryotes that colonize plant ploem and insects. International Journal of Systematic and Evolutionary Microbiology **54**:1243-1255.

48. **Anonymous,** 1999. La flavescence dorée dans l'Hérault. La lutte est obligatoire (Flavescence dorée in Hérault. Control measures are compulsory). Progrès Agricole et Viticole **116**:130-134.

49. **Anonymous,** 1999. Les jaunisses de la vigne (Flavescence dorée et Bois noir). Réunion du groupe national de travail, Dijon, 22 octobre 1998 (Yellows diseases of grapevine. Flavescence dorée and Bois noir. Meeting of the national working group, Dijon, 22 October 1998). Progrès Agricole et Viticole **116**:135-140.

50. **Anonymous,** 2001. Replantation des vignes et gestion du risque court-noué (Grapevine replanting and management of the risk of fanleaf). Progrès Agricole et Viticole **118**:333-342.

51. **Anonymous,** 2002. Le dépérissement de la Syrah. Compte rendu de la réunion du groupe de travail national, 25 mai 2002 (Syrah decline. Report on the meeting of the national working group, 25th May 2002). Progrès Agricole et Viticole **119**:229-234.

52. **Anonymous,** 2002. Colloque sur la maladie de l'enroulement de la vigne. Compte rendu (Working group on grapevine leafroll disease). Progrès Agricole et Viticole **119**:175-177.

53. **Anonymous,** 2002. Good plant protection practice / Bonne pratique phytosanitaire. Grapevine /vigne. Bulletin OEPP/EPPO Bulletin **32**:371-392.

54. **Avgelis A.D., and E. A. Tzortzakakis.** 2001. Occurrence of viruses and *Xiphinema* spp. in vineyards of the Greek islands of Paros and Lemnos. Phytopathologia mediterranea **40**:284-288.

55. **Avgelis, A. and D. Boscia.** 2001. Grapevine leafroll-associated closterovirus 7 in Greece. Phytopathologia mediterranea **40**:289-292.

56. **Avgelis, A. and I. Rumbos.** 2000. Investigations on the distribution of GVA and GVB *Vitivirus* in Greek grapevine varieties and clones by ELISA testing, p. 45-46. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

57. **Barba, M.** 2001. Flavescenza dorata: la malattia e la sua diffusione in Italia (Flavescence dorée: the disease and its spread in Italy), p. 65-68. *In* F. Pasini (ed.), Notizario tecnico N.63. Centro Ricerche Produzioni Vegetali, CRPV, Faenza, Italy.

58. **Barba, M. and G. Albanese.** 2002. Malattie da fitoplasmi della vite. Situazione nell'Italia centro-meridionale (Phytoplasma diseases of grapevine. Situation in centro-meridional Italy). Informatore Fitopatologico **52**(10):49-52.

59. **Barba, M., F. Faggioli, V. Falco, F. Gagliano, G. Spartà, M. Manzo, A. Spiezia, and C. Sardo.** 2004. La selezione sanitaria della vite in Campania e Sicilia: risultati attuali e prospettive future (Sanitary selection of grapevine in Campania and Sicily: present results and future prospects), p. 1-12. *In* La Vite - Convegno Nazionale, Torino, 2-3.12.2004.

60. **Barbier, P., M. Perrin, P. Cobanov, and B. Walter.** 2000. Probing pathogen-derived resistance against the fanleaf virus in grapevine. Acta Horticulturae (528):385-388.

61. **Batlle, A., M. A. Martinez, and A. Laviña.** 2000. Occurrence, distribution and epidemiology of Grapevine Yellows in Spain. European Journal of Plant Pathology **106**:811-816.

62. **Beanland, L. and T. Wolf.** 2003. Possible insect vector of North American grapevine yellows phytoplasma in Virginia, p. 64-65. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

63. **Beanland, L. and T. K. Wolf.** 2003. Surveys and transmission trials of potential insect vectors of grapevine yellows in Virginia. Phytopathology **93** (Supplement):S7.

64. **Beanland, L.A., M. Kelly, R. Faggian, J. MacFarlane, and D. A. Glenn.** 1999. In search of an insect vector of Australian grapevine yellows: species composition and abundance of potential vectors. The Australian Grapegrower and Winemaker (430):41-45.

65. **Belin, C., C. Schmitt, G. Demangeat, V. Komar, L. Pinck, and M. Fuchs.** 2001. Involvement of RNA2-encoded proteins in the specific transmission of *Grapevine fanleaf virus* by its nematode vector *Xiphnema index*. Virology **291**:161-171.

66. **Belin, C., C. Schmitt, F. Gaire, B. Walter, G. Demangeat, and L. Pinck.** 1999. The nine C-terminal residues of the grapevine fanleaf nepovirus movement protein are critical for systemic virus spread. Journal of General Virology **80**:1347-1356.

67. **Belli, G. and P. A. Bianco.** 2001. Fitoplasmosi della vite e relativa diagnosi (Phytoplasma diseases of grapevine and diagnosis). Quad. Vitic. Enol. Univ. Torino **25**:89-99.

68. **Belli, G., P. A. Bianco, P. Casati, and G. Scattini.** 2000. Gravi e diffuse manifestazioni di flavescenza dorata della vite in Lombardia (Severe and diffuse outbreaks of flavescence dorée of grapevine in Lombardia). L'Informatore agrario **56**(30):56-59.

69. **Belli, G., P. A. Bianco, P. Casati, and G. Scattini.** 2002. La Flavescenza dorata della vite in Lombardia (Flavescence dorée of grapevine in Lombardy). Quaderni della ricerca della Regione Lombardia, (April):1-50.

70. **Ben Abdallah, F., S. Chelib, and A. Ghorbel.** 2003. More about *in vitro* grape virus symptomatology. Phytopathologia mediterranea **42**:35-40.

71. **Ben Abdallah, F., A. Fnayou, A. Mliki, and A. Ghorbel.** 2000. Varietal conformity of Tunisian grapevines obtained *in vitro*, p. 170. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

72. **Ben Abdallah, F., A. Fnayou, A. Mliki, and A. Ghorbel.** 2000. New indexing strategy of virus and virus-like diseases of grapevine, p.171. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

73. **Bertaccini, A.** 2002. Phytoplasmes de la vigne: épidémiologie moléculaire et contrôle possible (Grapevine phytoplasmas: molecular epidemiology and possible control). Bulletin de l'O. I. V. **75**:438-469.

74. **Bertaccini, A.** 2002. Il punto sull'epidemia di flavescenza dorata in Italia (Present situation on the epidemic of flavescence dorée in Italy). L'Informatore agrario **58**(15):97-98.

75. **Bertaccini, A., M. Borgo, L. Bertotto, A. Bonetti, S. Botti, S. Sartori, M. Pondrelli, and E. Murari.** 2001. Termoterapia e chemioterapia per eliminare i fitoplasmi da materiali di moltiplicazione della vite (Thermotherapy and chemotherapy for eliminating phytoplasmas from planting material of grapevine). L'Informatore agrario **57**(42):137-144.

76. **Bertaccini, A., M. Borgo, F. Dal Molin, P. Fontana, V. Girolami, V. Malagnini, M. Martini, N. Mori, E. Murari, G. P. Sancassani, S. Sartori, and A. Zanzotto.** 2000. Regione Veneto e flavescenza dorata (The Veneto and flavescence dorée). L'Informatore agrario **56**(30**)**:56-59.

77. **Bertaccini, A., M. Borgo, M. Martini, N. Mori, E. Murari, G. Posenato, P. Sancassani, S. Sartori, and M. Vibio.** 1998. Continuano le epidemie di giallumi (The epidemics of yellows continue). L'Informatore agrario **54**(15):85-90.

78. **Bertaccini, A., M. Borgo, M. Pondrelli, E. Murari, S. Sartori, and A. Bonetti.** 2000. Efficiency of molecular tests to control phytoplasma elimination, p. 116-117. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

79. **Bertaccini, A., S. Botti, M. Martini, R. Colla, G. Mazzali, P. Mazio, M. Pozza, S. Meglioraldi, and M. Vingione.** 2000. La Flavescenza dorata in Emilia: caratterizzazione molecolare del ceppo in fase di diffusione (Flavescence dorée in Emilia: molecular characterization of stock in the phase of diffusion). L'Informatore agrario **56**(47):97-100.

80. **Bertaccini, A., S. Botti, A. Tonola, C. Milano, P. Braccini, and A. Sfalanga.** 2003. Identificazione di fitoplasmi di flavescenza dorata in un vigneto della Toscana (Identification of flavescence dorée phytoplasmas in a vineyard in Tuscany). L'Informatore agrario **59**(21):65-67.

81. **Bertaccini, A. and M. Martini.** 1999. Ribosomal and non-ribosomal primers for sensitive detection and identification of phytoplasmas. Petria **9**:89-92.

82. **Bertaccini, A., N. Mori, S. Botti, A. Castiglioni, G. Cavallini, and A. Malossi.** 2003. Survey on Bois noir phytoplasmas spreading in vineyards of Modena province (Italy), p. 104-105. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

83. **Bertaccini, A., E. Vallillo, E. Murari, and M. Martini.** 1999. Presenza di legno nero in Molise (Presence of blackwood in Molise). L'Informatore agrario **55**(2):62-63.

84. **Bertamini, M., K. Muthuchelian, and N. Nedunchezhian.** 2004. Effect of grapevine leafroll on the photosynthesis of field grown grapevine plants (*Vitis vinifera* L. cv. Lagrein). Journal of Phytopathology **152**:145-152.

85. **Bertamini, M. and N. Nedunchezhian.** 2001. Effects of phytoplasma [stolbur subgroup (bois noir-BN)] on photosynthetic pigments, saccharides, ribulose 1,5-bisphosphate caboxylase, nitrate and nitrite reductases, and photosynthetic activities in field-grown grapevine (*Vitis vinifera* L. cv.Chardonnay) leaves. Photosynthetica **39**:119-122.

86. **Bertamini, M. and N. Nedunchezhian.** 2003. Phytoplasma [stolbur-subgroup (Bois noir-BN)] induced changes on pigments, RuBPC and electron transport activities in field grown grapevine (*Vitis vinifera* L.cv. Chardonnay, p. 79-80. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

87. **Bertamini, M., N. Nedunchezhian, F. Tomasi, and M. S. Grando.** 2002. Phytoplasma [Stolbur subgroup (Bois noir)] infection inhibits photosynthetic pigments, ribulose-1,5-bisphosphate carboxylase and photosynthetic activities in field grown grapevine (*Vitis vinifera* L. cv.Chardonnay) leaves. Physiological and Molecular Plant Pathology **61**:357-366.

88. **Bertazzon, N. and E. Angelini.** 2004. Advances in the detection of *Grapevine leafroll-associated virus 2* variants. Journal of Plant Pathology **86** (Special issue):283-290.

89. **Bertazzon, N., E. Angelini, and M. Borgo.** 2002. Detection of *Grapevine leafroll-associated virus-2* (GLRaV-2) by ELISA and RT-PCR. Journal of Plant Pathology **84**:175.

90. **Bertazzon, N., E. Angelini, and M. Borgo.** 2003. Molecular polymorphism in three open reading frames from *Grapevine leafroll-associated virus 2* variants detected by heteroduplex mobility assay (HMA), p. 36-37. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

91. **Bessis, R.** 2000. OGM et culture de la vigne. Chant contrechant (GMO and viticulture). Progrès Agricole et Viticole **117**:36-38.

92. **Bianco, P.A., A. Alma, P. Casati, G. Scattini, and A. Arzone.** 2001. Transmission of 16SrV phytoplasmas by *Scaphoideus titanus* Ball in northern Italy. Plant Protection Science **37**(2):49-56.

93. **Bianco, P.A. and P. Casati.** 2000. Fitoplasmi riscontrati in vigneti dell'Oltrepò pavese (Phytoplasmas encountered in vineyards of the Oltrepò pavese). Vignevini **27**(9):60-62.

94. **Bianco, P.A. and P. Casati.** 2000. Problemi metodologici relativi alla diagnosi di fitoplasmi in vite (Methodological problems related to the diagnosis of phytoplasmas in grapevine). Petria **10**:171-172.

95. **Bianco, P.A., P. Casati, M. Ciampitti, G. Scattini, and A. Zorloni.** 2002. Distribuzione della Flavescenza dorata e del Legno nero in vigneti lombardi (Distribution of flavescence dorée and bois noir in Lombard vineyards). Petria **12**:407-408.

96. **Bianco, P.A., P. Casati, and N. Marziliano.** 2004. Detection of phytoplasmas associated with grapevine flavescence dorée disease using real-time PCR. Journal of Plant Pathology **86**:257-261.

97. **Bianco, P.A., P. Casati, N. Marziliano, and G. Belli.** 2002. Detection of phytoplasmas associated to grapevine Flavescence dorée disease by a specific 5' nuclease assay (TaqMan), p. 209. In Proceedings of the 14th Meeting of I.O.M., Vienna, July 7-12, 2002.

98. **Bianco, P.A., P. Casati, and G. Scattini.** 1999. Further data on the presence and spread of grapevine yellows in Lombardia (Northern Italy). Journal of Plant Pathology **81**:228.

99. **Bianco, P.A., F. Faggioli, C. Marzachi, and A. Minafra.** 2002. Armonizzazione dei protocolli di dagnosi molecolare per il rilevamento dei virus, dei viroidi e dei fitoplasmi sogetti a norme fitosanitarie (Harmonization of molecular diagnosis protocols for viruses, viroids and phytoplasmas subject to quarantine measures). Informatore Fitopatologico **52**(11):59-61.

100. **Bianco, P.A., A. Fortusini, G. Scattini, P. Casati, S. Carraro, and G. C. Torresin.** 2000. Prove di risanamento di materiale viticolo affetto da Flavescenza dorata mediante termoterapia (Experiments on heat therapy on dormant wood of grapevines affected by Flavescence dorée). Informatore Fitopatologico **50**(4):43-49.

101. **Bianco, P.A., A. Frosini, P. Casati, and G. De Bellis.** 2003. Identification of phytoplasmas infecting grapevine by ligase detection reaction and universal array, p. 55. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

102. **Bianco, P.A., R. Osler, and M. Barba.** 2002. I giallumi della vite: evoluzione delle malattie dalla loro comparsa in Italia (Grapevine yellows: evolution of the diseases since their outbreak in Italy). Petria **12**:399-404.

103. **Bianco, P.A., F. Quaglino, P. Casati, and M. Calvi.** 2003. Genetic variability and distribution of grapevine phytoplasmas of group 16SrV in Lombardia (northern Italy), p. 84. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

104. **Bianco, P.A., G. Scattini, P. Casati, and A. Fortusini.** 2000. Thermotherapy of grapevine cuttings for flavescence dorée eradication, p. 162-163. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

105. **Bica, D., E. Nicolosi, A. Costa, A. Colombo, and A. Buonocore.** 2002. Indagine sulla presenza dei principali virus e nematodi della vite in Sicilia (Surveys on viruses and nematodes of grapevine present in Sicily). Informatore Fitopatologico **52**(1):64-67.

106. **Bisognin, C., E. Mescalchin, M. Chemolli, and M. S. Grando.** 2002. Identificazione e distribuzione geografica dei giallumi della vite in Trentino (Identificaton an geographical distribution of grapevine yellows in Trentino). Petria **12**:433-435.

107. **Bisognin, C., E. Mescalchin, M. Chemolli, and M. S. Grando.** 2003. Identificazione e distribuzione dei giallumi della vite in Trentino (Identification and distribution of grapevine yellows in Trentino). L'Informatore agrario **59**(17):77-80.

108. **Bisognin, C., E. Mescalchin, and M. S. Grando.** 2002. Monitoraggio della diffusione dei giallumi della vite in Trentino (Monitoring the diffusion of grapevine yellows in Trentino), p. 583-584. *In* A. Brunelli and A. Canova (ed.), Atti Giornate fitopatologiche, Baselga di Piné, Trento, Italy, April 2002 (Vol.II). University of Bologna, Bologna (Italy).

109. **Bleyer, G., H. H. Kassemeyer, and P. Bohnert.** 2002. Virosen - Schutz im Rahmen der Rebenpflanzgutverordnung (Control of virus diseases in the frame of the regulations on grapevine planting material). Der Badische Winzer (11):30-32.

110. **Boidron, R.** 1998. Sélection sanitaire, sélection génétique de la vigne: le point de vue du sélectionneur (Sanitary selection, genetic selection: the point of view of the selector). Progrès Agricole et Viticole **115**:253-256.

111. **Bonfiglioli, R.** 2000. Grapevine viruses and nursery certification: putting the research work into the commercial world, p. 164. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

112. **Bonfiglioli, R., F. Edwards, and A. Pantaleo.** 2003. Molecular studies on a graft incompatibility syndrome in New Zealand vineyards yields another probable variant of *Grapevine leafroll-associated virus 2*, p. 141. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

113. **Bonfiglioli, R., N. Habili, C. Rosa, and B. Symons.** 1999. Viognier:Its viruses and its clonal identification. The Australian Grapegrower and Winemaker (424):23-26.

114. **Bonfiglioli, R., N. Hoskins, M. Kelly, F. Edwards, and G. Thorpe.** 2003. Introduction of a private certification scheme into an unregulated national industry: the New Zealand experience, p. 152. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

115. **Bonfiglioli, R.G., N. Habili, M. Green, L. F. Schliefert, and R. H. Symons.** 1998. The hidden problem - Rugose wood associated viruses in Australian viticulture. The Australian Grapegrower and Winemaker (410):9-13.

116. **Bongiovanni, M. and C. Nicolosi Asmundo.** 2003. Influenza del complesso dell'accartocciamento fogliare della vite sulla componente aromatica dei vini (Influence of the grapevine leafroll complex on the aromatic components of the wines). Vignevini **30**(10):83-86.

117. **Borgo, M.** 1998. Riconoscimento di viti affette da malattie da fitoplasmi (Symptoms of phytoplasma diseases of grapevine). L'Informatore agrario **54**(24):51-63.

118. **Borgo, M.** 2001. Evoluzione dei sistemi di diagnosi per le malattie da virus e virus-simili della vite ai fini della selezione clonale in Italia (Evolution of diagnosis methods for virus and virus-like diseases of grapevine in relation with clonal selection in Italy). Quad. Vitic. Enol. Univ. Torino **25**:27-37.

119. **Borgo, M.** 2004. Accertamenti virali per la selezione clonale della vite (Virological assessments for grapevine clonal selection), p. 1-11. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

120. **Borgo, M. and E. Angelini.** 2002. Influence de l'enroulement foliaire GLRaV3 sur les paramètres de production du Merlot (Influence of grapevine leafroll (GLRaV3) on Merlot cv. grape production). Bulletin de l'O. I. V. **75**:611-622.

121. **Borgo, M. and E. Angelini.** 2002. Diffusione della flavescenza dorata della vite in Italia e relazioni con vitigni, pratiche agronomiche e materiali di propagazione (Diffusion of flavescence dorée of grapevine in Italy and relation to cultivars, agronomic practice and propagation material), p. 35-50. *In* Atti Giornate fitopatologiche 2002.

122. **Borgo, M., E. Angelini, N. Bertazzon, and I. Bazzo.** 2004. Protocol for the assessments of grapevine virus infections. Journal of Plant Pathology **86** (Special issue):310.

123. **Borgo, M., E. Angelini, and L. Bertotto.** 2001. Fitoplasmi della vite in Provincia di Treviso: diagnosi e diffusione territoriale (Grapevine phytoplasms in the province of Treviso: diagnosis and diffusion in vineyards). Quad. Vitic. Enol. Univ. Torino **25**:125-136.

124. **Borgo, M., E. Angelini, and L. Bertotto.** 2002. Diffusione della flavescenza dorata nel Veneto - La situazione nella Provicia di Treviso (Flavescence dorée in Venetia - The situation in the province of Treviso). L'Informatore agrario **58**(24):8-9.

125. **Borgo, M., E. Angelini, and R. Flamini.** 2003. Effetti del virus GLRaV-3 dell'accartocciamento fogliare sulle produzioni di tre vitigni (Effects of GLRaV-3 on the production of three vineyards). L'Enologo **(3)**:99-110.

126. **Borgo, M., G. Ferroni, G. Salvi, and G. Scalabrelli.** 2000. Clonal selection of "Vermentino" grapevine in Tuscany. Acta Horticulturae (528):757-764.

127. **Borgo, M. and C. Michielini.** 2000. Diffusione naturale di accartocciamento fogliare su varietà e biotipi di *Vitis vinifera* (Natural spread of grapevine leafroll on varieties and biotypes of *Vitis vinifera*). Rivista di viticoltura e di enologia **54**(4):3-13.

128. **Borgo, M., E. Murari, S. Sartori, A. Zanzotto, P. Sancassani, and A. Bertaccini.** 1999. Termoterapia per eliminare i fitoplasmi da vite (Heat therapy for eliminating phytoplasmas from grapevines). L'Informatore agrario **55**(24):47-51.

129. **Boscia, D. and L. Demarinis.** 1998. Un'indagine sulla cv. Victoria rivela la presenza di un virus nuovo per l'Italia (A survey on cv. Victoria reveals the presence of a virus, new for Italy). Vignevini **25**(10):87-93.

130. **Boscia, D., M. Digiaro, M. Safi, R. Garau, Z. Zhou, A. Minafra, N. Abou Ghanem-Sabanadzovic, G. Bottalico, and O. Potere.** 2001. Production of monoclonal antibodies to Grapevine virus D and contribution to the study of its aetiological role in grapevine diseases. Vitis **40**:69-74.

131. **Boscia, D., M. Digiaro, V. Savino, and G. P. Martelli.** 2000. Grapevine leafroll-associated virus 6 and *Vitis vinifera* cv. Cardinal: an intriguing association, p. 21-22. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

132. **Boscia, D., M. Digiaro, V. Savino, and G. P. Martelli.** 2000. Indagine sulla diffusione del closterovirus 6 associato all'accartocciamento fogliare della vite in Puglia e Abruzzo e suoi rapporti con la cv. Cardinal (Survey on the distribution of grapevine leafroll-associated virus 6 in Apulia and Abruzzo and its association with cv. Cardinal). Vignevini **27**(10):92-95.

133. **Boselli, M.** 1999. Spatial distribution and severity of grapevine yellows on Albarola and Vermentino grapevine (*Vitis vinifera* L.) cultivars in eastern Liguria (northern Italy). Advances in Horticultural Science **13**:41-45.

134. **Bottalico, G., A. Campanale, P. La Notte, C. Pirolo, and V. Savino.** 2003. Sanitation of wine grape selection from central and southern Italy, p. 256. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13 -17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

135. **Bottalico, G., V. Savino, and A. Campanale.** 2000. Improvements in grapevine sanitation protocols, p. 167. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12 -17 March 2000. University of Adelaide, Adelaide, Australia.

136. **Botti, S. and A. Bertaccini.** 2003. Molecular variability in Flavescence dorée phytoplasmas as marker for the disease outbreaks in vineyards, p. 62-63. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

137. **Boubals, D.** 2000. Compte-rendu de la Journée de réflexion sur les OGM. Application à la vigne et au vin. O.I.V., 8 novembre 1999, Paris (Report on a discussion on genetically modified organisms. Applications to grapevine and wine. O.I.V., 8 November 1999, Paris). Progrès Agricole et Viticole **117**:29-35.

138. **Boubals, D.** 2000. Le dépérissement de la Syrah. Compte-rendu de la réunion du Groupe de Travail National (Syrah decline. Report of the meeting of the National Working Group). Progrès Agricole et Viticole **117**:137-141.

139. **Boudon-Padieu, E.** 1999. Grapevine phytoplasmas, p. 1-11. *In* First Internet conference on phytopathogenic mollicutes. http://www.Uniud.it/phytoplasma/pap/boud8290.Html.

140. **Boudon-Padieu, E.** 2000. Recent advances on grapevine yellows: detection, etiology, epidemiology and control strategies, p. 87-88. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

141. **Boudon-Padieu, E.** 2000. La cicadelle vectrice de la Flavescence dorée, *Scaphoideus titanus* Ball 1932 (*Scaphoideus titanus* Ball 1932, leafhopper vector of flavescence dorée), p. 110-120. *In* Ravageurs de la vigne. Editions Féret, Bordeaux.

142. **Boudon-Padieu, E.** 2003. The situation of grapevine yellows and current research directions: distribution, diversity, vectors, diffusion and control, p. 47-53. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

143. **Boudon-Padieu, E., A. Béjat, D. Clair, J. Larrue, M. Borgo, L. Bertotto, and E. Angelini.** 2003. Grapevine yellows: Comparison of different procedures for DNA extraction and amplification with PCR for routine diagnosis of phytoplasmas in grapevine. Vitis **42**:141-149.

144. **Boudon-Padieu, E., M. Fuchs, and S. Grenan.** 2003. 14ème Congrès de l'I.C.V.G. (14th Meeting of I.C.V.G.). Progrès Agricole et Viticole **120**:553-558.

145. **Boudon-Padieu, E. and M. Maixner.** 1998. Grapevine Yellows: current knowledge and control methods. Jaunisses de la vigne: état des connaissances et des méthodes de lutte. Bulletin de l'O. I. V. **71**:572-606.

146. **Bouquet, A.** 2000. Les OGM en question: Quel avenir pour les vignes transgéniques? (The genetically modified organisms called into question: what future for transgenic grapevines?). Progrès Agricole et Viticole **117**:431-437.

147. **Bouquet, A., Y. Danglot, L. Torregrosa, M. Bongiovanni, P. Castagnone-Sereno, D. Esmenjaud, and A. Dalmasso.** 2000. Breeding rootstocks resistant to grape fanleaf virus spread, using *Vitis x Muscadinia* hybridization. Acta Horticulturae (528):517-526.

148. **Bouquet, A., G. Marck, D. Pistagna, and L. Torregrosa.** 2003. Transfer of grape fanleaf virus coat protein gene through hybridization with *Xiphinema index* resistant genotypes to obtain rootstoocks resistant to virus spread. Acta Horticulturae (603):325-334.

149. **Bouquet, A., L. Torregrosa, and P. Chatelet.** 2003. Combinaison des méthodes conventionnelles et biotechnologiques dans la sélection de porte-greffes présentant une résistance durable à la transmission de la maladie du court-noué (Combination of conventional and biotechnological methods for selecting rootstocks showing a durable resistance to court-noué disease). Progrès Agricole et Viticole **120**:507-512 and 528-532.

150. **Bouquet, A., L. Torregrosa, and P. Chatelet.** 2004. Combinaison des approches biotechnologiques et conventionnelles dans la sélection de porte-greffes présentant une résistance durable à la transmission de la maladie du court-noué (Combination of biotechnological and conventional approaches to the selection of rootstocks presenting a sustainable resistance to grapevine fanleaf disease transmission). Bulletin de l'O. I. V. **77**:362-376.

151. **Bourquin, L., A. Schmid, J. De Meyer, O. Cazelles, M. E. Ramel, and P. Gugerli.** 2000. Confirmation of the presence of stolbur type yellows in Swiss vineyards by molecular diagnosis of grapevine, p. 111-112. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

152. **Bouyahia, H., D. Boscia, V. Savino, P. La Notte, C. Pirolo, M. A. Castellano, A. Minafra, and G. P. Martelli.** 2004. Is grapevine vein necrosis a reaction to *Grapevine rupestris stem pitting-associated virus*? Journal of Plant Pathology **86** (Special issue):301.

153. **Bouyahia, H., O. Potere, and D. Boscia.** 2003. Sampling method for the detection of *Grapevine fanleaf virus* by ELISA, p. 204-205. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

154. **Bovey, R.** 1999. The viroses and virus-like diseases of grapevine. Bibliographic report 1985-1997. Options Méditerranéennes, Série B (29B):1-172.

155. **Bovey, R. and P. Gugerli.** 2003. A short history of ICVG, p. 1-2. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

156. **Braccini, P. and F. Pavan.** 2000. Indagine sulla presenza di auchenorrhynchi in vigneti della Toscana centrale (Investigtions on the presence of auchennorrhyncha in vineyards of central Tuscany). Petria **10**:181-182.

157. **Braccini, P. and F. Pavan.** 2000. Auchennorrinchi potenziali vettori di fitoplasmi associati a giallumi della vite (Auchenorrynchs potential vectors of phytoplasms associated with grapevine yellows). L'Informatore agrario **56**(47):103-107.

158. **Braccini, P., A. Sfalanga, S. Botti, A. Malossi, and A. Bertaccini.** 2002. Prime osservazioni su indagini epidemiologiche in alcuni vigneti della Toscana centrale colpiti dal Legno nero (First observations on epidemiological investigations in some vineyards of central Tuscany affected with bois noir). Petria **12**:437-439.

159. **Braccini, P., A. Sfalanga, M. Pondrelli, M. Martini, and A. Bertaccini.** 2000. Diffusione di fitoplasmi in vigneti della Toscana centrale (Diffusion of phytoplasmas in vineyards of central Tuscany). Petria **10**:177-178.

160. **Brandone, C.** 2002. La flavescenza dorata in Piemonte (Flavescence dorée in Piedmont). Vignevini **29**(6):55-57.

161. **Bressan, A., S. Spiazzi, C. Capuzzo, V. Girolami, and E. Boudon-Padieu.** 2003. Seasonal probability of flavescence dorée phytoplasma transmission in relation to abundances of leafhopper vectors and source for acquisition, p. 107-108. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy.

162. **Bruno, C., P. Arce, and P. D. Valenzuela.** 2003. RNA interference as a novel strategy for resistance against *Grapevine fanleaf virus*, p. 229. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

163. **Buciumeanu, E. and E. Visoiu.** 1999. Selectia sanitara, deviroszarea si certificarea materialului saditor viticol la S.C.P.V.V. Stefanesti-Arges (Sanitary selection, recovery and certification of grapevine propagation material at the Station of Stefanesti-Arges). Protectia Plantelor **9**(35):66-77.

164. **Buciumeanu, E. and E. Visoiu.** 2000. Elimination of grapevine viruses in *Vitis vinifera* L. cultivars, p. 165-166. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

165. **Buciumeanu, E., E. Visoiu, and C. F. Popescu.** 2003. Certification of grapevine planting material at Research Station for Viticulture Stefanesti, Romania, p. 161. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

166. **Burger, J.T., M. Engelbrecht, and C. Van Eeden.** 2003. The construction of gene silencing vectors for the introduction of multiple virus resistance in grapevines, p. 226-227. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

167. **Burger, J.T. and K. L. Wilsen.** 2000. Towards the introduction of a broad-spectrum antiviral mechanism into grapevine, p. 55-56. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

168. **Buzkan, N., A. Minafra, P. Saldarelli, M. A. Castellano, M. Dell'Orco, G. P. Martelli, R. Gölles, and M. Laimer da Camara Machado.** 2001. Heterologous encapsidation in non-transgenic and transgenic *Nicotiana* plants infected by *Grapevine viruses A* and *B*. Journal of Plant Pathology **83**:37-43.

169. **Buzkan, N., A. Minafra, P. Saldarelli, M. A. Castellano, and G. P. Martelli.** 2000. Heteroencapsidation in transgenic and non transgenic *Nicotiana* plants infected by grapevine viruses A and B, p. 38. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

170. **Buzkan, N., P. Saldarelli, A. Minafra, L. Martinelli, A. Perl, and G. P. Martelli.** 2000. Tolerance to grapevine viruses A and B in *Nicotiana* plants transformed with sense and antisense movement protein genes, p. 57-58. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

171. **Buzkan, N. and A. Walker.** 2004. A small scale procedure for extracting nucleic acids from grapevine dormant cuttings infected with GFLV. Asian Journal of Plant Science **3**:387-390.

172. **Cabaleiro, C., A. Piñeiro, O. Rosende, and J. Garcia.** 2003. Changes in grapevine leafroll viruses associated to the disease in the north-west of Spain, p. 118. *In* 8th International Congress of Plant Pathology, 2-7 February 2003, Christchurch, New Zealand, vol.2.

173. **Cabaleiro, C. and A. Segura.** 2003. Monitoring the spread of *Grapevine leafroll-associated virus 3* for 12 years, p. 216-217. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

174. **Cabaleiro, C., A. Segura, and J. J. Garcia-Berrios.** 1999. Effects of grapevine leafroll-associated virus 3 on the physiology and must of *Vitis vinifera* L. cv. Albariño following contamination in the field. American Journal of Enology and Viticulture **50**:40-44.

175. **Cao, X., Y. Zhang, W. Cai, H. Guan, and K. Mang.** 1999. Preparation of GFLV CP-gene cDNA probe labelled by photosensitive biotin and its application in detection of GFLV. Chinese Journal of Biotechnology **15**:65-70.

176. **Cardoso, F., C. Baptista, E. Sousa, and C. Novo.** 2003. New monoclonal antibodies developed against dsRNA for diagnostic in grapevine and fruit tree viruses, p. 191. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

177. **Carraro, L., R. Osler, and E. Refatti.** 2000. Storia dei giallumi della vite nei Friuli-Venezia Giulia (History of grapevine yellows in Friuli-Venezia Giulia), p. 23-27. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

178. **Carstens, R.** 2000. Improved procedure for the isolation of double stranded RNA from virus-infected grapevine, p. 144. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

179. **Casati, P. and P. A. Bianco.** 1999. Possible improvement in phytoplasma detection. Petria **9**:93-96.

180. **Casati, P., A. Minafra, A. Rowhani, and P. A. Bianco.** 2003. Further data on molecular characterization of *Grapevine rupestris stem pitting associated virus*, p. 130. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

181. **Casati, P., F. Quaglino, and P. A. Bianco.** 2004. RSI-PCR (Restriction site insertion-PCR) as a molecular tool for the specific identification of phytoplasmas in grapevine. Journal of Plant Pathology **86** (Special issue):312.

182. **Castellano, M.A., N. Abou-Ghanem, E. Choueiri, and G. P. Martelli.** 2000. Ultrastructure of *grapevine leafroll-associated virus 2* and *7* infections. Journal of Plant Pathology **82**:9-15.

183. **Cavagna, B., M. Celè, A. M. Masiello, and M. Perucca.** 2002. Flavescenza dorata nelle aree viticole lombarde: monitoraggio, fitomappe e controllo del materiale di propagazione (Flavescence dorée in viticultural areas of Lombardy: survey, disease maps and check of propagation material). Petria **12**:453.

184. **Cavallini, G., A. Castiglioni, P. Bortolotti, N. Mori, R. Nicoli Aldini, S. Botti, A. Malossi, and A. Bertaccini.** 2003. Flavescenza dorata e legno nero in vigneti del Modenese (Flavescence dorée and bois noir in vineyards of the Modena region, Italy). L'Informatore agrario **59**(21):69-71.

185. **Cavanni, P.** 2001. Flavescenza dorata della vite. La nuova malattia che minaccia i vigneti. (Flavescence dorée of grapevine. The new disease that threats vineyards). Agricoltura **29**(3):65-79.

186. **Chabbouh, N., S. Bouhachem, S. M'hirsi, N. Mahfoudhi, N. Marzouki, and M. Marrakchi.** 2003. Occurrence of grapevine yellows and potential vectors in Tunisia, p. 103. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

187. **Chabbouh, N. and M. Marrakchi.** 1998. Contribution à l'étude de l'écorce liégeuse dans le vignoble tunisien (Contribution to the study of Corky bark in the Tunisian vineyards). Bulletin de l'O. I. V. **71**:929-943.

188. **Chabbouh, N., M. Marrakchi, and Z. Bel Falah.** 2000. Investigations on the aetiology of corky bark: role of GVB, p. 47. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

189. **Chiron, M.F., B. Herlemont, and J. M. Trespaille-Barrau.** 2004. Latest developments in the mandatory control of grapevine flavescence doree. Phytoma - La Défense des Végétaux (576):18-21.

190. **Choueiri, E., F. Jreijiri, S. El Zammar, E. Verdin, P. Salar, J. L. Danet, J. Bové, and M. Garnier.** 2002. First report on grapevine "bois noir" disease and a new phytoplasma infecting solanaceous plants in Lebanon. Plant Disease **86**:697.

191. **Choueiri, E., S. Jreijiri, S. El Zammar, E. Verdin, P. Salar, J. L. Danet, J. Bové, and M. Garnier.** 2003. Grapevine "Bois noir"disease in Lebanon, p. 101-102. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

192. **Christov, I.K., D. Stefanov, V. N. Goltsev, and P. Abracheva.** 2001. Effects of grapevine fanleaf and stem pitting viruses on the photosynthetic activity of grapevine plants grown *in vitro*. Russian Journal of Plant Physiology **48**:473-477.

193. **Ciampitti, M., R. Tonesi, G. Belli, and P. Cravedi.** 2002. Studio del deperimento vegeto-produttivo della vite dovuto alla Flavescenza dorata (Study of grapevine vegetation and production decline due to flavescence dorée). Petria **12**:409.

194. **Ciampolini, M. and A. Guarnone.** 2003. Pullulazioni su vigneti di *Partholecanium corni* (Pullulation of *Parthenolecanium corni* in vineyards). L'Informatore agrario **59**(17):81-85.

195. **Ciccotti, A., D. de Sutter, D. Gurioli, E. Mescalchin, and M. E. Vindimian.** 2003. Bois noir in Trentino vineyards: twelve years visual observations and research about roots analysis, p. 106. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

196. **Cid, M., C. Cabaleiro, and A. Segura.** 2003. Detection of *Grapevine leafroll-associated virus-3* in rootstocks, p. 41. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

197. **Cigsar, I., M. Digiaro, K. Gokalp, N. Abou Ghanem-Sabanadzovic, A. De Stradis, D. Boscia, and G. P. Martelli.** 2003. Grapevine deformation virus, a novel nepovirus from Turkey. Journal of Plant Pathology **85**:183-191.

198. **Cigsar, I., M. Digiaro, and G. P. Martelli.** 2002. Sanitary status of grapevines in south-eastern and central Anatolia (Turkey). Bulletin OEPP/EPPO Bulletin **32**:471-475.

199. **Cigsar, I. and M. A. Yilmaz.** 2000. Detection of grapevine viruses by serological methods in south-east of Turkey, p. 143. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

200. **Clair, D., A. Frelet, G. Aubert, E. Collin, and E. Boudon-Padieu.** 2000. Improved detection of flavescence dorée and related phytoplasma in the elm yellows group in difficult material, with specific PCR primers that amplify a variable non ribosomal DNA fragment, p. 101-102. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

201. **Clair, D., J. Larrue, G. Aubert, J. Gillet, G. Cloquemin, and E. Boudon-Padieu.** 2003. Direct sensitive diagnosis of Flavescence dorée and Bois noir using a multiplex nested-PCR assay and its use in field surveys, p. 82-83. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

202. **Clair, D., J. Larrue, G. Aubert, J. Gillet, G. Cloquemin, and E. Boudon-Padieu.** 2003. A multiplex nested-PCR assay for sensitive and simultaneous detection and direct identification of phytoplasma in the Elm yellows group and Stolbur group and its use in survey of grapevine yellows in France. Vitis **42**:151-157.

203. **Clair, D., J. Larrue, and E. Boudon-Padieu.** 2001. Evaluation of vectoring ability of phytoplasmas by *Metcalfa pruinosa* Say (Homoptera: Flatidae) recently introduced in Europe. IOBC/wprs Bulletin **24**(7):195-197.

204. **Clingeleffer, P.R. and L. R. Krake.** 2002. Light (minimal) pruning enhances expression of higher yield from clones of Vitis vinifera L. cv. Sultana following thermotherapy for virus attenuation. Australian Journal of Grape and Wine Research **8**(2):95-100.

205. **Cloquemin, G., G. Blaszczyk, D. Herold, and J. Gillet.** 1998. Laboratoire national de la protection des végétaux. Unité de virologie et de phytoplasmologie vigne de Colmar (National laboratory of plant protection. Grapevine virology and phytoplasmology unit of Colmar). Progrès Agricole et Viticole **115**:59-67.

206. **Cohen, D. and R. van den Brink.** 2000. Improved sensitivity for ELISA detection of GLRaV-1 and GLRaV-3, p. 146-147. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

207. **Cohen, D., R. van den Brink, and N. Habili.** 2003. Leafroll virus movement in newly infected grapevines, p. 39-40. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

208. **Colla, R.** 2004. Flavescenza dorata, battaglia su piu fronti (Flavescence dorée, a battle on several fronts). Vignevini **31**(15):36-38.

209. **Constable, F. and B. Symons.** 1999. Seasonal detection of phytoplasmas in Australian grapevines. The Australian Grapegrower and Winemaker (429):49-53.

210. **Constable, F., J. Whiting, and B. Symons.** 2000. A new grapevine phytoplasma from the Ovens Valley of Victoria, Australia, p. 92-93. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

211. **Constable, F.E.** 2002. The biology and epidemiology of Australian grapevine phytoplasmas. PhD thesis, University of Adelaide, Department of Plant Science, Adelaide, Australia.

212. **Constable, F.E. and E. Boudon-Padieu.** 2003. Genomic diversity of the flavescence dorée phytoplasma, p. 81. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

213. **Constable, F.E., K. S. Gibb, J. R. Moran, and Y. M. Wilson.** 1998. Incidence of phytoplasma associated with yellows, restricted spring growth and late season leaf curl symptoms in grapevines. The Australian Grapegrower and Winemaker (409):19-20.

214. **Constable, F.E., K. S. Gibb, J. W. Randles, and R. H. Symons.** 2003. Biology and epidemiology of Australian grapevine phytoplasmas, p. 58-59. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

215. **Constable, F.E., K. S. Gibb, and R. H. Symons.** 2003. Seasonal distribution of phytoplasmas in Australian grapevines. Plant Pathology **52**:267-276.

216. **Constable, F.E., J. Jones, K. S. Gibb, Y. M. Chalmers, and R. H. Symons.** 2004. The incidence, distribution and expression of Australian grapevine yellows, restricted growth and late season leaf curl diseases in selected Australian vineyards. Annals of applied Biology **144**:205-218.

217. **Constable, F.E. and R. H. Symons.** 2004. Genetic variability amongst isolates of Australian grapevine phytoplasmas. Australasian Plant Pathology **33**:115-119.

218. **Constable, F.E., J. R. Whiting, K. S. Gibb, and R. H. Symons.** 2002. A new grapevine yellows phytoplasma from the Buckland Valley of Victoria. Vitis **41**:147-153.

219. **Constable, F.E., J. R. Whiting, J. Jones, K. S. Gibb, and R. H. Symons.** 2003. The distribution of grapevine yellows disease associated with the Buckland Valley grapevine yellows phytoplasma. Journal of Phytopathology **151**:65-73.

220. **Conti, M.** 2001. Giallumi della vite (Grapevine yellows). Informatore Fitopatologico **51**(4):35-40.

221. **Conti, M.** 2001. Fitoplasmosi della vite: aspetti epidemiologici (Phytoplasma diseases of grapevine: epidemiological aspects). Quad. Vitic. Enol. Univ. Torino **25**:101-107.

222. **Conti, M.** 2003. Grapevine virus vectors and epidemiology, p. 206-207. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13- 17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

223. **Cordeau, J.** 1998. Création d'un vignoble. Greffage de la vigne et porte-greffes. Elimination des maladies à virus (Creation of a vineyard. Grafting the vine and rootstocks. Virus disease elimination). Editions Féret, Mérignac cedex, France.

224. **Cornuet, P., P. Andret, E. Vigne, and M. Fuchs.** 2003. Identification and characterization of a putative new ampelovirus species associated to grapevine leafroll, p. 34. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

225. **Cortêz, I., E. Marinho, C. Santos, M. T. Santos, O. Sequeira, G. Nolasco, and A. N. Pereira.** 2003. Looking for conserved regions for primer design in *Grapevine leafroll-associated virus 3* and *Grapevine virus A*, p. 196. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

226. **Cravedi, P.** 2001. Flavescenza dorata: il vettore e le strategie di difesa (Flavescence dorée: the vector and the strategies of control), p. 73-76. *In* F. Pasini (ed.), Le emergenze fitosanitarie della vite. Notiziario tecnico N.63. Centro Ricerche Produzioni Vegetali, CRPV, Faenza, Italy.

227. **Cravedi, P.** 2001. Flavescenza dorata della vite. Il pericolo arriva dallo *Scaphoideus titanus* (Flavescence dorée of grapevine. The danger is due to *Scaphoideus titanus*). Agricoltura **29**(3):73-75.

228. **Cravedi, P., E. Mazzoni, and R. Pontiroli.** 2002. Studio del deperimento vegeto-produttivo della vite dovuto a Flavescenza dorata: esperienze di controllo del vettore (Study of grapevine vegetation and production decline due to flavescence dorée: experiments for vector control). Petria **12**:451-452.

229. **Cravedi, P. and R. Nicoli Aldini.** 2000. Lo *Scaphoideus titanus*, vettore della flavescenza dorata della vite in Oltrepò pavese (*Scaphoideus titanus*, vector of flavescence dorée of grapevine in the Oltrepò pavese). Vignevini **27**(9):56-60.

230. **Credi, R.** 2001. Malattie infettive latenti e semilatenti della vite (Latent and semi-latent infectious diseases of grapevine). Quad. Vitic. Enol. Univ. Torino **25**:15-25.

231. **Credi, R., F. Terlizzi, R. Bissani, and C. Poggi Pollini.** 2001. Presenza e diffusione dei fitoplasmi del legno nero e della flavescenza dorata della vite in Emilia-Romagna (Presence and distribution of grapevine bois noir and flavescence dorée phytoplasmas in Emilia-Romagna). Vignevini **28**(12):107-110.

232. **Credi, R., F. Terlizzi, L. Cricca, and D. Dradi.** 2002. Studi epidemiologici sul Legno nero della vite in Emilia- Romagna (Epidemiological studies on bois noir of grapevine in Emilia-Romagna). Petria **12**:441-443.

233. **Credi, R., F. Terlizzi, L. Cricca, and D. Dradi.** 2004. Epidemiologia del legno nero della vite (Epidemiology of grapevine black wood disease). L'Informatore agrario **60**(7):72-75.

234. **Credi, R., F. Terlizzi, G. Stimilli, S. Nardi, and R. Lagnese.** 2002. Flavescenza dorata della vite nelle Marche (Flavescence dorée of grapevine in the Marches). L'Informatore agrario **58**(22):61-63.

235. **Credi, R., F. Terlizzi, L. Valenti, A. R. Babini, and M. Cardoni.** 2004. Incidenza di nove virus in popolazioni di svariati vitigni italiani (Incidence of nine viruses in populations of diverse Italian vineyards), p. 1-7. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

236. **Credi, R., L. Valenti, A. R. Babini, F. Bellini, and M. Cardoni.** 2003. Incidence of nine viruses in clonal selections of Italian V.vinifera cultivars, p. 261. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

237. **Credi, R. and V. Vicchi.** 2001. Flavescenza dorata. Come si riconoscono i sintomi dell'avversità (Flavescence dorée. How to recognize the symptoms of the disease). Agricoltura **29**(3):66-69.

238. **Crespan, M., I. Gribaudo, and R. Velasco.** 2004. Progress report on grape biotechnologies in Italy: methodologies, goals, results. Bulletin de l'O. I. V. **77**:377-388.

239. **Crocker, J., G. Fletcher, H. Waite, and P. Wright.** 2001. Australian advances in hot water treatment research. The Australian Grapegrower and Winemaker (447):97-99.

240. **Crocker, J., P. Wright, P. Deverell, and H. Waite.** 2003. Australian advances in hot water treatment reseach, p. 71-72. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

241 **Curkovic Perica, M., M. Seruga, B. Kozina, M. Krajacic, and D. Skoric.** 2003. Grapevine yellows - spread of the disease in Croatia, p. 95. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

242. **Curkovic Perica, M., D. Skoric, M. Seruga, B. Kozina, and M. Krajacic.** 2001. Recent progress in phytoplasma research in Croatian vineyards. Agriculturae Conspectus Scientificus **66**(1):65-69.

243. **D'Ascenzo, D., S. Botti, S. Paltrinieri, R. Di Giovanni, D. Di Silvestro, and A. Bertaccini.** 2003. Identification of phytoplasmas associated with grapevine yellows in Abruzzo region (Italy), p. 89-90. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

244. **Dani, M.** 1999. Evoluzione dei giallumi della vite in vitigni del Veneto occidentale (Evolution of grapevine yellows in western Venetia). PhD thesis, Università di Padova, Istituto di Entomologia, Padova, Italy.

245. **Darimont, H. and M. Maixner.** 2000. Übertragungseffizienz der Vektoren von Rebphytoplasmosen (Efficiency of grapevine phytoplasma disease vectors). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (376):371-372.

246. **Darimont, H. and M. Maixner.** 2001. Actual distribution of *Hyalesthes obsoletus* Signoret (Auchenorrhyncha: Cixiidae) in German viticulture and its significance as vector of Bois noir. IOBC/wprs Bulletin **24**(7):199-202.

247. **Darimont, H. and M. Maixner.** 2002. Einfluss standortspezifischer Faktoren auf den Infektionsdruck durch die Schwarzholzkrankheit der Rebe (Influence of site-specific parameters on the infection pressure by grapevine yellows). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (390):228-229.

248. **Davis, R.E. and E. L. Dally.** 2001. Revised subgroup classification of group 16SrV phytoplasmas and placement of *flavescence dorée*-associated phytoplasmas in two distinct subgroups. Plant Disease **85**:790-797.

249. **Davis, R.E., R. Jomantienne, E. L. Dally, and T. K. Wolf.** 1998. Phytoplasmas associated with grapevine yellows in Virginia belong to group 16SrI, subgroup A (tomato big bud phytoplasma subgroup), and group 16SrIII, new subgroup I. Vitis **37**:131-137.

250. **Davis, R.E., R. Jomantienne, E. L. Dally, and T. K. Wolf.** 1998. Grapevine yellows in Virginia: phytoplasma subgroups iii-i and i-a in cultivated grapevines and subgroup i-a in wild grapevines. Phytopathology **88(**Supplement**)**:S 129.

251. **De La Roque, B.** 2003. Flavescence dorée: réglementation dépoussiérée (Flavescence dorée: the dust brushed off from the regulations). Phytoma - La Défense des Végétaux (565):22-23.

252. **De Luca, F., A. Agostinelli, S. Fatemi, and F. Lamberti.** 2003. Molecular characterization of *Xiphinema index* populations by PCR-RFLP and sequences analyses of the ITS region, p. 220. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

253. **De Meyer, J., M. Gaudin, L. Bourquin, G. Jakab, P. Malnoe, and P. Gugerli.** 2000. New primers for the molecular identification and detection of grapevine virus A (GVA), p. 138-140. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

254. **De Sousa, E., F. Cardoso, P. Casati, P. A. Bianco, M. Guimarães, and V. Pereira.** 2003. Detection and identification of phytoplasmas belonging to 16SrV- D in *Scaphoideus titanus* adults in Portugal, p. 78. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

255. **Delibasic, G., M. Babovic, and D. Jakovljevic.** 2000. The appearance and distribution of grapevine fanleaf virus and arabis mosaic virus in Yugoslavia, p. 72-73. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

256. **Dell'Orco, M., P. Saldarelli, A. Minafra, D. Boscia, and D. Gallitelli.** 2002. Epitope mapping of *Grapevine virus A* capsid protein. Archives of Virology **147**:627-634.

257. **Demangeat, G., V. Komar, P. Cornuet, D. Esmenjaud, and M. Fuchs.** 2004. Sensitive and reliable detection method of grapevine fanleaf virus in a single *Xiphinema index* nematode vector. Journal of Virological Methods **122**:79-86.

258. **Demangeat, G., R. Voisin, J. C. Minot, N. Bosselut, M. Fuchs, and D. Esmenjaud.** 2003. Survival of *Xiphinema index* and retention of *Grapevine fanleaf virus* in a nematode population from a naturally GFLV- infected vineyard, p. 208. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

259. **Dianese, E.C., D. B. Lopes, M. A. S. V. Ferreira, T. V. M. Fajardo, and C. R. F. Martins.** 2004. Variabilidade genetica do gene do capsideo de isolados de *Grapevine leafroll-associated virus 3* provenientes do submedio do Vale de São Francisco (Genetic variability of the grapevine leafroll-associated virus 3 coat protein gene of isolates from São Francisco Valley). Fitopatologia Brasileira **29** (Suplemento):S51.

260. **Digiaro, M., N. Abou Ghanem-Sabanadzovic, I. Cigsar, K. Gokalp, A. De Stradis, D. Boscia, and G. P. Martelli.** 2003. Two hitherto undescribed nepoviruses from Turkisch grapevines, p. 14-15. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

261. **Digiaro, M., D. Boscia, V. Savino, and V. Simeone.** 2000. Sanitary status of table grape varieties newly introduced in Apulia (Southern Italy), p. 168-169. In R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

262. **Digiaro, M., D. Boscia, V. Simeone, and V. Savino.** 1998. Gravi casi di accartocciamento fogliare su cultivar ad uva da tavola di recente introduzione in Puglia (Severe cases of leafroll disease in table grape cultivars recently introduced in Apulia). Informatore Fitopatologico **48** (1-2):76-79.

263. **Digiaro, M., R. Garau, and V. Savino.** 1999. Closteroviruses and grapevine diseases: a review of the situation before the establishment of the network. Options Méditerranéennes, Série B (29A):67-81.

264. **Digiaro, M., G. P. Martelli, and V. Savino.** 1999. Phloem-limited viruses of the grapevine in the Mediterranean and Near East: a synopsis. Options Méditerranéennes, Série B (29A):83-92.

265. **Digiaro, M., G. P. Martelli, and V. Savino.** 2000. Phloem-limited viruses of the grapevine in the Mediterranean and Near East, p. 75-76. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

266. **Digiaro, M., V. Simeone, D. Boscia, and V. Savino.** 2000. Stato sanitario delle varietà ad uva da tavola di recente introduzione in Puglia (Sanitary state of recently introduced table grape vaieties in Apulia). Informatore Fitopatologico **50**(7/8):54-58.

267. **Doucleff, M., Y. Jin, and M. A. Walker.** 2003. Mapping *Xiphinema index* resistance in *V.rupestris* x *M. rotundifolia* hybrids. Acta Horticulturae (603):79-81.

268. **Dovas, C.I. and N. I. Katis.** 2003. Application of a spot multiplex nested PCR for the simultaneous detection of viruses associated to rugose wood and leafroll grapevine diseases, p. 192-193. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

269. **Dovas, C.I. and N. I. Katis.** 2003. A spot multiplex nested RT-PCR for the simultaneous and generic detection of viruses involved in the aetiology of grapevine leafroll and rugose wood of grapevine. Journal of Virological Methods **109**:217-226.

270. **Dovas, C.I. and N. I. Katis.** 2003. A spot nested RT-PCR method for the simultaneous detection of members of the *Vitivirus* and *Foveavirus* genera in grapevine. Journal of Virological Methods **107**:99-106.

271. **Dovas, C.I., N. Leventakis, H. Spinthiropoulou, A. O. Stavrakakkis, and N. I. Katis.** 2002. Problems concerning clonal selection of grapevine associated with viral infection. Phytopathologia mediterranea **41**:192.

272. **Dovas, C.I., H. Spinthiropoulou, M. N. Stavrakakis, and N. I. Katis.** 2003. Sanitary status of wine grape varieties (*Vitis vinifera* L.) in northern Greece originating from clonal selection for preservation, p. 169-170. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

273. **Dovas, C.I., C. Vovlas, G. Papazis, and N. J. Katis.** 2003. Sanitary status of self rooted and grafted Debina and Vlachiko wine grape varieties in Epirus Greece, p. 156. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

274. **Duduk, B., S. Botti, M. Ivanovic, A. Dukic, and A. Bertaccini.** 2003. Molecular characterization of a flavescence dorée phytoplasma infecting grapevine in Serbia, p. 91-92. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

275. **Duduk, B., S. Botti, M. Ivanovic, B. Krstic, N. Dukic, and A. Bertaccini.** 2004. Identification of phytoplasmas associated with grapevine yellows in Serbia. Journal of Phytopathology **152**:575-579.

276. **Duduk, B., M. Ivanovic, N. Dukic, S. Botti, and A. Bertaccini.** 2003. First report of an Elm yellows subgroup 16SrV-C phytoplasma infecting grapevine in Serbia. Plant Disease **87**:599.

277. **Ebel, R., A. Schnabel, G. M. Reustle, G. Krczal, and T. Wetzel.** 2003. Molecular characterization of two German *Raspberry ringspot virus* isolates infecting grapevine and construction of full length infectious clones, p. 16. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

278. **Ebel, R., A. Schnabel, G. M. Reustle, G. Krczal, and T. Wetzel.** 2003. Complete nucleotide sequence of an isolate of the nepovirus raspberry ringspot virus from grapevine. Virus Research **97**:141-144.

279. **El Beaino, T., S. Sabanadzovic, M. Digiaro, N. Abou Ghanem-Sabanadzovic, A. Rowhani, P. E. Kyriakopoulou, and G. P. Martelli.** 2001. Molecular detection of Grapevine fleck virus-like viruses. Vitis **40**:65-68.

280. **Elleuch, A., H. Fakhfakh, L. Jendoubi, N. Bessaies, and M. Marrakchi.** 2003. Comparative analysis of techniques for detection of grapevine and citrus viroids in Tunisia. Bulletin OEPP/EPPO Bulletin **33**:369-374.

281. **Elleuch, A., H. Fakhfakh, M. Pelchat, P. Landry, M. Marrakchi, and J. P. Perreault.** 2002. Sequencing of *Australian Grapevine Viroid* and *Yellow Speckle Viroid* isolated from a Tunisian grapevine without passage in an indicator plant. European Journal of Plant Pathology **108**:815-820.

282. **Elleuch, A., M. Marrakchi, J. P. Perreault, and H. Fakhfakh.** 2003. First report of Australian grapevine viroid from the Mediterranean region. Journal of Plant Pathology **85**:53-57.

283. **Engel, E., V. Arredondo, R. Martinez, N. Fiore, L. O. Burzio, and P. D. Valenzuela.** 2003. Isolation, sequencing and expression of genes of Chilean isolates of *Grapevine fanleaf virus*, p. 24. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

284. **Esmenjaud, D.** 2001. Les nématodes vecteurs des virus du court-noué et les méthodes de lutte (The nematodes vectors of the fanleaf degeneration virus and control methods). Progrès Agricole et Viticole **118**:335-337.

285. **Espacio, J., P. Martinez-Culebras, C. Jorda, and A. Hermoso de Mendoza.** 2001. Prospeccion de la Flavescencia dorada y de sus vectores (Hemiptera, Cicadellide) en la zona de viñedo de Requena (Valencia)(Prospection of flavescence dorée and of its vectors (Hemiptera, Cicadellidae) in the vineyard area of Requena (Valencia). Boletin de Sanidad Vegetal, Plagas **27**:519-526.

286. **Espinha, L.M., J. O. Gaspar, H. Kuniyuki, and L. E. A. Camargo.** 2003. Molecular detection of *Rupestris stem pitting-associated virus* in grapevines in Brazil. Fitopatologia Brasileira **28**:206.

287. **Fajardo, T.V.M., M. Eiras, C. Santos, O. Nickel, and G. B. Kuhn.** 2004. Detecção e caracterizacão biological e molecular de *Rupestris stem pitting-associated virus* e seu efeito na fotosintese de videiras (Biological and molecular detection and characterization of *Rupestris stem pitting-associated virus* and its effect on photosynthesis of grapevines). Fitopatologia Brasileira **29**:209-214.

288. **Fajardo, T.V.M., M. Eiras, P. G. Schenato, O. Nickel, and G. B. Kuhn.** 2004. Detecção e caracterização molecular partial do *Grapevine fleck virus* em videiras (Detection and partial molecular characterization of grapevine fleck virus in grapevines). Fitopatologia Brasileira **29**:460.

289. **Fajardo, T.V.M., G. B. Kuhn, M. Eiras, and O. Nickel.** 2000. Caracterização parcial de um isolado do *Grapevine fanleaf virus* (Partial characterization of an isolate of grapevine fanleaf virus). Fitopatologia Brasileira **25**:505-511.

290. **Fajardo, T.V.M., G. B. Kuhn, M. Eiras, and O. Nickel.** 2002. Detecção de *Closterovirus* em videira e caracterização parcial de um isolado do *grapevine leafroll-associated virus 3* (Detection of *Closterovirus* in grapevine and partial characterization of an isolate of *Grapevine leafroll-asssociated virus 3*). Fitopatologia Brasileira **27**:58-64.

291. **Fajardo, T.V.M., O. Nickel, M. Eiras, and G. B. Kuhn.** 2003. Detecção de um isolado do *Grapevine virus A* e caracterização do gene da proteina capsidial (Detection of an isolate of GVA and characterization of its casid protein gene). Fitopatologia Brasileira **28**:521-527.

292. **Fajardo, T.V.M., O. Nickel, and G. B. Kuhn.** 2002. Economically important viruses in the Brazilian viticulture. Virus Reviews & Research **1** (Supplement):42-43.

293. **Fajardo, T.V.M., P. G. Schenato, O. Nickel, and G. B. Kuhn.** 2004. Detecção de três virus em videiras com sondas não radioativas (Retection of three viruses of grapevine with non radioactive probes). Fitopatologia Brasileira **29** (Supplement):594.

294. **Faoro, F., G. Scattini, S. Sant, and P. Gugerli.** 2000. UIGV and GLRaV-1 interactions in mixed infection of grapevine, p. 80-81. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

295. **Farkas, E., L. Palkovics, J. Mikulas, and E. Balazs.** 1999. High incidence of hop stunt viroid in Hungarian grapevines. Acta Phytopathologica et Entomologica Hungarica **34**:7-11.

296. **Fattouch, S., H. Acheche, S. M'hirsi, N. Chabbouh, N. Mellouli, M. Marrakchi, and N. Marzouki.** 2000. The N-terminal region of a Tunisian GFLV-coat protein sequence: cloning, sequence analysis, and expression in *E.coli*, p. 74. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

297. **Fattouch, S., S. M'hirsi, H. Acheche, M. Marrakchi, and N. Marzouki.** 2001. RNA oligoprobe capture RT-PCR, a sensitive method for the detection of *Grapevine fanleaf virus* in Tunisian grapevines. Plant Molecular Biology Reporter **19**:234-244.

298. **Fazeli, C.F., N. Habili, and M. A. Rezaian.** 1998. Efficient cloning of cDNA from grapevine leafroll-associated virus 4 and demonstration of probe specificity by the viral antibody. Journal of Virological Methods **70**:201-211.

299. **Fazeli, C.F. and M. A. Rezaian.** 2000. Nucleotide sequence and organization of ten open reading frames of the grapevine leafroll-associated virus 1 genome, p. 9-11. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

300. **Fazeli, C.F. and M. A. Rezaian.** 2000. Nucleotide sequence and organization of ten open reading frames in the genome of Grapevine leafroll-associated virus 1 and identification of three subgenomic RNAs. Journal of General Virology **81**:605-615.

301. **Fernandez, I., T. Candresse, O. Le Gall, and J. Dunez.** 1999. The 5' noncoding region of grapevine chrome mosaic nepovirus RNA- 2 triggers a necrotic response on three *Nicotiana* spp. Molecular Plant Microbe Interaction **12**:337-344.

302. **Firrao, G., G. Malossini, S. Palmano, A. Carpanelli, I. Tomada, M. Dazzan, R. Benedetti, and C. Scarponi.** 2000. Diagnosi molecolare dei giallumi della vite: la quadriennale esperienza in Friuli-Venezia Giulia (Molecular diagnosis of grapevine yellows diseases: quadrennial experiment in Friuli- Venezia Giuliana), p. 51-54. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

303. **Firrao, G., S. Palmano, G. Malossini, I. Tomada, A. Carpanelli, M. Dazzan, and C. Frausin.** 2000. Monitoring grapevine yellows in north-eastern Italy. Journal of Plant Pathology **82**:70.

304. **Fischer, R. and S. Schillberg.** 2003. Engineering durable resistance in grapevines:a novel strategy for integrated disease management to overcome environmental impact of pesticides, p. 224. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

305. **Frausin, C.** 2000. Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia (Flavescence dorée and blackwood of grapevine in Friuli- Venezia Giulia). L'Informatore agrario **56**(28):65-72.

306. **Frausin, C.** 2002. Resoconto di tre anni di attività per l'eradicazione della Flavescenza dorata della vite dal Friuli (Report on three years of work in view to eradicating Flavescence dorée of grapevine from Friuli). Petria **12**:313-316.

307. **Frausin, C., B. Antoni, G. Baldessin, and *et al.*.** 2000. Indagine pluriennale sulla situazione epidemiologica dei Giallumi della vite in Friuli-Venezia Giulia (Long-term research on the epidemiology of grapevine yellows in Friuli-Venezia Giulia), p. 55-70. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

308. **Frausin, C., A. Gregoris, and F. Anaclerio.** 2000. Verifica di pratica utilizzazione della tecnica di termoterapia in aqua calda per il risanamento di talee di vite affette da giallume (GY) (Practical results of using hot water treatment for the recovery of grapevine plants affected with bois noir), p. 85-90. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

309. **Frausin, C., A. Ortez, A. Gregoris, C. Coiutti, D. Mucignat, and A. Zanoli.** 2000. Il vivaismo viticolo del Friuli-Venezia Giulia e la flavescenza dorata della vite: situazione attuale, preoccupazioni, azioni di prevenzione (Grapevine nurseries of Friuli-Venezia Giulia and flavescence dorée: present situation, concern, prevention), p. 79-84. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

310. **Freeman, B.** 2000. Spring growth disorders in grapevine. The Australian Grapegrower and Winemaker (426a):61-65.

311. **Frosini, A., P. Casati, P. A. Bianco, R. Bordoni, C. Consolandi, B. Castiglioni, A. Mezzelani, E. Rizzi, C. Battaglia, G. Belli, L. Rossi Bernardi, and G. De Bellis.** 2002. Ligase detection reaction and universal array as a tool to detect grapevine infecting phytoplasms. Minerva Biotecnologica **14**:265-267.

312. **Fuchs, M.** 2003. Transgenic resistance: state of the art and perspectives, p. 221-223. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

313. **Fuchs, M. and S. Grenan.** 2000. 13e Congrès de l'I.C.V.G.(Groupe International d'Etude des Virus de la Vigne) (13th Congress of ICVG). Progrès Agricole et Viticole **117**:312-314.

314. **Fuchs, M., B. Walter, and L. Pinck.** 2000. Evaluation of transgenic grapevine rooststocks expressing the coat protein gene of grapevine fanleaf virus under vineyard conditions, p. 50-51. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

315. **Gaire, F.** 1998. Implication du système endomembranaire dans la réplication du virus du court-noué de la vigne (GFLV): rôle de la protéine 2A dans la réplication du RNA2. (Implication of endomembrane system in the replication of grapevine fanleaf virus (GFLV): role of protein 2A in RNA2 replication). PhD thesis, Université Louis Pasteur, Strasbourg, France.

316. **Gaire, F., C. Schmitt, C. Stussi-Garaud, L. Pinck, and C. Ritzenthaler.** 1999. Protein 2A of grapevine fanleaf nepovirus is implicated in RNA2 replication and colocalizes to the replication site. Virology **264**:25-36.

317. **Gajardo, A., S. Botti, J. Montealegre, N. Fiore, and A. Bertaccini.** 2003. Survey of phytoplasmas identified in Chilean grapevines, p. 85-86. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

318. **Galiakparov, N., D. E. Goszczynski, X. B. Che, O. Batuman, M. Bar-Joseph, and M. Mawassi.** 2003. Two classes of subgenomic RNA of grapevine virus A produced by internal controller elements. Virology **312**:434-448.

319. **Galiakparov, N., E. Tanne, M. Mawassi, R. Gafny, and I. Sela.** 2003. ORF5 of grapevine virus A encodes a nucleic acid-binding protein and affects pathogenesis. Virus Genes **27**:257-262.

320. **Galiakparov, N., E. Tanne, I. Sela, and R. Gafny.** 1999. Infectious RNA transcripts from grapevine virus A cDNA clone. Virus Genes **19**:235-242.

321. **Galiakparov, N., E. Tanne, I. Sela, and R. Gafny.** 2003. Functional analysis of the *Grapevine virus A* genome, p. 120. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

322. **Galiakparov, N., E. Tanne, I. Sela, and R. Gafny.** 2003. Functional analysis of the grapevine virus A genome. Virology **306**:42-50.

323. **Gangl, H., G. Leitner, W. Renner, and W. Tiefenbrunner.** 2002. Rebschädigende Viren, Bakterien und bodenbürtige Vektoren in der österreichischen Weinbauregion Steiermark (Grapevine damaging viruses, bacteria and soil-borne vectors in the Austrian winegrowing region Styria). Mitteilungen Klosterneuburg **52**:54-62.

324. **Gangl, H., G. Leitner, and W. Tiefenbrunner.** 2000. Die Verbreitung rebschädigender Viren, Bakterien und bodenbürtiger Vektoren in den österreichischen Weinbaugebieten Thermenregion und Mittelburgenland (Occurrence of grapevine damaging viruses, bacteria and soil-borne vectors in the Austrian winegrowing regions Thermenregion and Mittelburgenland). Mitteilungen Klosterneuburg **50**:119-130.

325. **Gangl, H., G. Leitner, and W. Tiefenbrunner.** 2000. Die Bedeutung von Rebvirosen im Weinbau (The significance of grapevine virus diseases in viticulture). Der Winzer **56**(7):20-23.

326. **Gangl, H., G. Leitner, and W. Tiefenbrunner.** 2001. Rebschädigende Viren, Bakterien und bodenbürtige Vektoren im österreichischen Weinbaugebiet Carnuntum (Grapevine damaging viruses, bacteria and soil-borne vectors in the Austrian winegrowing region Carnuntum). Mitteilungen Klosterneuburg **51**:123-132.

327. **Gangl, H., G. Leitner, and W. Tiefenbrunner.** 2003. Rebschädigende Viren, Bakterien un bodenbürtige Vektoren in den österreischischen Weinbaugebieten Wachau und Südburgenland (Grapevine damaging viruses, bacteria and soil-borne vectors in the Austrian viticultural areas of Wachau and Südburgenland). Mitteilungen Klosterneuburg **53**:77-85.

328. **Gangl, H. and W. Tiefenbrunner.** 2000. Methoden zum Nachweis von Viren und ihren Überträgern (Methods for detection of viruses and of their vectors). Der Winzer **56**(10):20-23.

329. **Garau, R., V. A. Prota, G. Tolu, M. P. M. Mungianu, A. Sechi, and U. Prota.** 2003. Sul miglioramento sanitario della vite in Sardegna (Sanitary improvement of grapevine in Sardinia). Informatore Fitopatologico **53**(12):41-44.

330. **Garau, R., V. A. Prota, G. Tolu, and A. Sechi.** 2004. Preliminary observations on the productive response of cvs Vermentino and Chardonnay affected by "Bois noir" in Sardinia. Journal of Plant Pathology **86** (Special issue):320.

331. **Garau, R., A. Sechi, G. Tolu, V. A. Prota, A. Lentini, and U. Prota.** 2004. *Goniagnathus guttulinervis* (Kirschbaum), new natural host of the stolbur subgroup 16SrXII-A phytoplasma in Sardinia. Journal of Plant Pathology **86**:179.

332. **Garau, R., G. Tolu, V. Prota, A. Sechi, M. P. M. Mungianu, and U. Prota.** 2002. Osservazioni sul Bois noir della vite in Sardegna (Observations on Bois noir of grapevine in Sardinia). Petria **12**:445-446.

333. **Garau, R., G. Tolu, V. A. Prota, and A. Sechi.** 2004. Differential reactivity of grapevine cultivars to "Bois noir" infections in Sardinia. Journal of Plant Pathology **86** (Special issue):320.

334. **Garnier, M.** 2000. Le phytoplasme du stolbur: un agent ubiquiste (The stolbur phytoplasma: an ubiquitous agent). Comptes rendus des séances de l'Académie d'agriculture de France **86**:27-33.

335. **Gatineau, F., J. Larrue, D. Clair, F. Lorton, M. Richard-Molard, and E. Boudon-Padieu.** 2001. A new natural planthopper vector of stolbur phytoplasmas in the genus *Pentastiridius* (Hemiptera: Cixiidae). European Journal of Plant Pathology **107**:263-271.

336. **Gazel, M. and N. Onelge.** 2003. First report of grapevine viroids in the east Mediterranean region of Turkey. Plant Pathology **52**:405.

337. **Ge, Q. and M. Maixner.** 2003. An internal positive control in PCR-tests for the detection of phytoplasma in plants and insects, p. 77. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari Italy.

338. **Ge, Q. and M. Maixner.** 2003. Comparative experimental transmission of grapevine yellows phytoplasmas to plants and artificial feeding medium, p. 109-110. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

339. **Ge, Q., M. Maixner, and F. J. Wen.** 2004. [The adaptability of an artificial medium in the screening of phytoplasma insect vectors]. Acta Phytophylacica Sinica **31**:276-282.

340. **Geoffrion, R.** 1998. Eau chaude contre phytoplasmes. La thermothérapie contre la Flavescence dorée et le Bois noir en Anjou (Hot water against phytolasmas. Thermotherapy against flavescence dorée and bois noir in Anjou). Phytoma - La Défense des Végétaux (509):38-39.

341. **Geuna, F., H. Hartings, and A. Scienza.** 1998. A new method for rapid extraction of high quality RNA from recalcitrant tissues of grapevine. Plant molecular biology reporter **16**:61-67.

342. **Gibb, K.S., F. E. Constable, J. R. Moran, and A. C. Padovan.** 1999. Phytoplasmas in Australian grapevines - detection, differentiation and associated diseases. Vitis **38**:107-114.

343. **Gibb, K.S., B. Schneider, and A. C. Padovan.** 1998. Differential detection and genetic relatedness of phytoplasmas in papaya. Plant Pathology **47**:325-332.

344. **Gilge, U., P. Schwappach, J. V. Herrmann, and M. Maixner.** 2004. Feldstudie zum Vorkommen der Schwartzholzkrankheit in Franken und Methoden zu ihrer Bestimmung (Field studies on the occurrence of blackwood disease in Germany and detection methods). Obst- und Weinbau **140**(19):10-13.

345. **Girgis, S.M., F. Bem, P. E. Kyriakopoulou, C. I. Dovas, A. P. Sklavounos, A. Avgelis, N. Katis, S. Tzortzakaki, and M. Tsagris.** 2000. A new *Ilarvirus* isolated from grapevine in Greece. Plant Disease **84**:1345.

346. **Girgis, S.M., F. P. Bem, P. E. Kyriakopoulou, C. I. Dovas, A. Avgelis, and N. I. Katis.** 2003. The etiology of a new virus disease: grapevine angular mosaic, p. 19. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

347. **Girolami, V.** 2000. Vettori e problemi aperti sui giallumi della vite (Vectors and unresolved problems concerning grapevine yellows). Petria **10**:167-170.

348. **Gokalp, K., M. Digiaro, I. Cigsar, N. Abou Ghanem-Sabanadzovic, A. De Stradis, D. Boscia, and G. P. Martelli.** 2003. Properties of a previously undescribed nepovirus from South East Anatolia. Journal of Plant Pathology **85**:35-41.

349. **Golino, D., S. Sim, and A. Rowhani.** 2000. Identification of the latent viruses associated with young vine decline in California, p. 85-86. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

350. **Golino, D., S. T. Sim, R. Gill, and A. Rowhani.** 2002. California mealybugs can spread grapevine leafroll disease. California Agriculture **56**:196-201.

351. **Golino, D.A.** 2000. Grapevine clean stock and certification: local, national, and world-wide perspectives, p. 45. *In* Technical abstracts of the 50th Anniversary Meeting of the American Society for Enology and Viticulture, Seattle, Washington, 19-23 June 2000.

352. **Golino, D.A.** 2000. Trade in grapevine plant materials: local, national, and worldwide perspectives, p. 216-221. *In* Proceedings of the 50th Anniversary Meeting of the American Society for Enology and Viticulture, Seattle, Washington, June 19-23, 2000.

353. **Golino, D.A.** 2003. Emerging grapevine diseases, p. 136-138. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

354. **Golino, D.A., S. Sim, R. Gill, and A. Rowhani.** 1999. Four species of California mealybugs can transmit leafroll virus. American Journal of Enology and Viticulture **50**:367-368.

355. **Golino, D.A., S. Sim, and A. Rowhani.** 1999. Vine failure can be caused by latent viruses. American Journal of Enology and Viticulture **50**:376.

356. **Golino, D.A., S. Sim, and A. Rowhani.** 2000. Experimental transmission of grapevine leafroll associated viruses by mealybugs, p. 19-20. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

357. **Golino, D.A., S. Sim, and A. Rowhani.** 2003. The role of rootstock genotype in the effects of single and mixed infections of grapevine viruses, p. 246-247. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

358. **Golino, D.A., S. T. Sim, R. Gill, and A. Rowhani.** 1998. Transmission studies of grapevine closteroviruses by four species of mealybugs. Phytopathology **88** (Supplement):S32.

359. **Golino, D.A., S. T. Sim, W. Grzegorczyk, and A. Rowhani.** 1998. Optimizing tissue culture protocols used for virus elimination in grapevines. American Journal of Enology and Viticulture **49**:451-452.

360. **Golino, D.A., S. T. Sim, and A. Rowhani.** 2000. The role of GLRV-2 and GVB in virus-induced rootstock decline in California grapevines. Phytopathology **90** (Supplement):S28.

361. **Gomes, S., A. M. Pereira, O. Pinto-Carnide, O. A. de Sequeira, and J. C. Sequeira.** 2004. Effect of the culture medium on meristem differentiation and plant regeneration in *Vitis vinifera* L. Acta Horticulturae (652):425-432.

362. **Gomez Talquenca, G.S., O. Gracia, S. Garcia Lampasona, and O. Grau.** 2003. A survey for closteroviridae family members in Argentinean vineyards, p. 43-44. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

363. **Gomez Talquenca, G.S., O. Gracia, S. Garcia Lampasona, and O. Grau.** 2003. A young grafted vine decline syndrome in Argentina vineyards, p. 146. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

364. **Gonsalves, D.** 2000. Progress towards understanding the genomic organization and expression of grapevine closteroviruses, p. 6-7. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

365. **Good, X. and J. Monis.** 2001. Partial genome organization, identification of the coat protein gene, and detection of *Grapevine leafroll-associated virus-5*. Phytopathology **91**:274-281.

366. **Goszczynski, D.E. and A. E. C. Jooste.** 2002. The application of single-strand conformation polymorphism (SSCP) technique for the analysis of molecular heterogeneity of grapevine virus A. Vitis **41**:77-82.

367. **Goszczynski, D.E. and A. E. C. Jooste.** 2003. Identification of grapevines infected with divergent variants of *Grapevine virus A* using variant-specific RT-PCR, p. 131-132. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

368. **Goszczynski, D.E. and A. E. C. Jooste.** 2003. Shiraz disease (SD) is transmitted by mealybug *Planococcus ficus* and associated with grapevine virus A, p. 219. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

369. **Goszczynski, D.E. and A. E. C. Jooste.** 2003. Identification of divergent variants of *Grapevine virus A*. European Journal of Plant Pathology **109**:397-403.

370. **Goszczynski, D.E. and A. E. C. Jooste.** 2003. Identification of grapevines infected with divergent variants of Grapevine virus A using variant-specific RT-PCR. Journal of Virological Methods **112**:157-164.

371. **Gotta, P. and C. Morone.** 2001. Flavescenza dorata in Piemonte: gli interventi sul territorio (Flavescence dorée in Piedmont: control measures). L'Informatore agrario **57**(17):89-90.

372. **Gotta, P. and C. Morone.** 2004. La Flavescenza dorata nel Piemonte (Flavescence dorée in Piedmont), p. 1-6. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

373. **Gotta, P., C. Morone, G. Bosio, and A. Rossi.** 2001. Esperienze di contenimento dell'epidemia di flavescenza dorata in Piemonte (Attempts to stop the epidemic of flavescence dorée in Piedmont). Quad. Vitic. Enol. Univ. Torino **25**:119-124.

374. **Goumas, D.E. and E. A. Tzortzakakis.** 1998. Reproduction of *Xiphinema index* and *Meloidogyne* species and infection of *Agrobacterium vitis* on grapevine rootstocks. Phytopathologia mediterranea **37**:22-27.

375. **Gölles, R., A. da Camara Machado, A. Minafra, N. Buzkan, I. Gribaudo, P. Saldarelli, V. Savino, G. P. Martelli, H. Katinger, and M. Laimer da Camara Machado.** 2000. Pathogen-derived virus resistance in grapevine: expression of viral coat protein genes in transgenic *Vitis* sp, p. 53-54. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

376. **Gölles, R., A. da Camara Machado, A. Minafra, I. Gribaudo, V. Savino, P. Saldarelli, G. P. Martelli, H. Katinger, and M. Laimer da Camara Machado.** 2000. Fighting grapevine fanleaf disease and the rugose wood complex by transgenic expression of viral sequences, p. 93. *In* K. A. Roubelakis-Angelakis (ed.), 6th International Symposium on Grapevine Physiology and Biotechnology, June 11-16, 2000. Heraklion, Crete, Greece.

377. **Gölles, R., R. Moser, H. Pühringer, H. Katinger, M. Laimer da Camara Machado, A. da Camara Machado, A. Minafra, V. Savino, P. Saldarelli, and G. P. Martelli.** 2000. Transgenic grapevines expressing coat protein gene sequences of grapevine fanleaf virus, arabis mosaic virus, grapevine virus A and grapevine virus B. Acta Horticulturae (528):305-311.

378. **Gracia, O., G. S. Gomez Talquenca, E. Vega, and P. A. Worlock.** 2003. Present status of grapevine sanitary selection in Argentina, p. 154. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

379. **Grammatikaki, G. and A. Avgelis.** 2000. Does *in vitro* micropropagation reveal new possibilities for grapevine leafroll indexing? p. 12-13. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

380. **Grammatikaki, G. and A. Avgelis.** 2003. Evaluation of *in-vitro*-stress inducing as a method for leafroll indexing, p. 45-46. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

381. **Grancini, P.** 2000. E possibile trasmettere a *Catharanthus roseus* l'agente di un giallume della vite mediante trasfusione forzata di linfa? (Is it possible to transmit a grapevine yellows agent to *Catharanthus roseus* through forced lymph diffusion?). Petria **10**:153-154.

382. **Green, M.J., D. A. Thompson, and D. J. Mackenzie.** 1999. Easy and efficient DNA extraction from woody plants for the detection of phytoplasmas by polymerase chain reaction. Plant Disease **83**:482-485.

383. **Gregoris, A., F. Pavan, G. Stasi, C. Coiutti, and A. Ortez.** 2000. Indagine sulla presenza di auchenorrinchi possibili vettori di fitoplasmi in vigneti del Friuli-Venezia Giulia (Survey on the presence of Auchenorrhyncha possibly vectors of phytoplasms in vineyards of Friuli-Venezia Giulia), p. 45-49. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

384. **Greif, C.** 2003. Les virus de la vigne et les schémas de sélection et de certification phytosanitaire. *Avis d'un pathologiste.* (Grapevine viruses, selection and sanitary certifiction schemes. *Advice of a pathologist*). Progrès Agricole et Viticole **120**:14-15.

385. **Grenan, S.** 2000. Jaunisses de la vigne. Bilan et perspectives de la recherche agronomique (Grapevine yellows. Results and prospects of agronomic research). Progrès Agricole et Viticole **117**:151-155.

386. **Grenan, S., R. Boidron, and A. Bonnet.** 1998. Bilan et réflexions sur 35 années de sélection sanitaire en France (Assessment and reflections on 35 years of sanitary selection in France). Progrès Agricole et Viticole **115**:406-414.

387. **Grenan, S., A. Bonnet, and R. Boidron.** 2000. Results and thoughts on 35 years of sanitary selection in France. Acta Horticulturae (528):713-721.

388. **Gribaudo, I., J. Bondaz, D. Cuozzo, and G. Gambino.** 2003. Elimination of *Grapevine leafroll-associated virus-3* from the grapevine Müller-Thurgau (*Vitis vinifera* L.) through somatic embryogenesis, p. 240-241. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

389. **Gribaudo, I., A. Lisa, R. Lenzi, and F. Mannini.** 1999. Comportamento *in vitro* di un biotipo di *Vitis vinifera cv. Albarola*, affetto da virosi (GLRaV 1 e 3, GVA) e risanato (*In vitro* proliferation and rooting of a *Vitis vinifera cv. Albarola* biotype, when virus infected (GLRaV 1 and 3, GVA) and sanitized. Rivista di viticoltura e di enologia **52**(2):3-7.

390. **Gribaudo, I., F. Mannini, D. Cuozzo, M. Gobetto, R. Lenzi, and R. Credi.** 2002. Risanamento da malattie virali e virus-simili di cloni di vite *(Vitis vinifera L.)* (Elimination of virus and virus-like diseases from grapevine clones). Quad. Vitic. Enol. Univ. Torino **25**:39-50.

391. **Gribaudo, I., V. Scariot, G. Gambino, A. Schubert, R. Gölles, and M. Laimer.** 2003. Transformation of *Vitis vinifera* L. cv Nebbiolo with the coat protein gene of grapevine fanleaf virus (GFLV). Acta Horticulturae (603):309-314.

392. **Griffiths, H.M., W. A. Sinclair, E. Boudon-Padieu, X. Daire, I. M. Lee, A. Sfalanga, and A. Bertaccini.** 1999. Phytoplasmas associated with elm yellows: molecular variability and differentiation from related organisms. Plant Disease **83**:1101-1104.

393. **Grillini, P., M. Cifelli, R. Cornale, A. D'Anniballe, P. Fini, G. Ghermandi, F. Rizzoli, and V. Vicchi.** 2004. Primo reinvenimento della flavescenza dorata nelle province centro-orientali dell'Emilia-Romagna (First report of flavescence dorée in central-eastern Emilia-Romagna). Atti Giornate Fitopatologiche **2**:345-346.

394. **Guadagnini, M., N. Mori, S. Alberghini, E. Carturan, V. Girolami, and A. Bertaccini.** 2000. Molecular evidence of phytoplasma transmission to grapevine by *Metcalfa pruinosa* (Say) in Italy, p. 99-100. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

395. **Guan, H., W. Cai, and K. Mang.** 1996. The cloning, sequence analysis and expression in *Escherichia coli* of coat protein gene of grapevine fanleaf virus. Chinese Journal of Biotechnology **12**:124-128.

396. **Gugerli, P.** 2000. Diagnosis of grapevine virus diseases: an overview and a practical implementation, p. 121-123. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

397. **Gugerli, P.** 2000. Detection of grapevine leafroll associated viruses by chemiluminometric enzyme-linked immunosorbent assay (lumino-ELISA), p. 134-136. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

398. **Gugerli, P.** 2003. Grapevine leafroll and related viruses, p. 25-31. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

399. **Gugerli, P., O. Cazelles, M. Genini, S. Emery, and L. Colombi.** 2002. Maladie du bois noir de la vigne en Suisse romande et au Tessin (Bois noir disease of grapevine in French-speaking Switzerland and in Tessin). Revue suisse de viticulture,arboriculture,horticulture **34**:15-17.

400. **Guidoni, S., F. Mannini, A. Ferrandino, N. Argamante, and R. Di Stefano.** 2000. Effect of virus status on leaf and berry phenolic compounds in two wine grapevine *Vitis vinifera* cultivars. Acta Horticulturae (526):445-452.

401. **Gutoranov, G.P., I. J. Tsvetkov, V. M. Colova-Tsolova, and A. I. Atanassov.** 2001. Genetically engineered grapevines carrying GFLV coat protein and antifreeze genes. Agriculturae Conspectus Scientificus **66**:71-76.

402. **Habili, N., A. Afsharifar, and R. H. Symons.** 2003. First detection of an ampelovirus, a maculavirus and two vitiviruses in Iranian table grapes, p. 162-163. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

403. **Habili, N., R. Bonfiglioli, and B. Symons.** 1998. The trouble with Merlot. The Australian Grapegrower and Winemaker (414a):29-32.

404. **Habili, N., R. G. Bonfiglioli, and R. H. Symons.** 1998. Rupestris stem pitting associated virus in Australia - does it pose a threat to the viticultural industry? The Australian Grapegrower and Winemaker (417):38-39.

405. **Habili, N., D. Cohen, and R. H. Symons.** 2001. First detection of Grapevine leafroll virus types 2 and 5 in New Zealand by Waite Diagnostics. The Australian and New Zealand Grapegrower and Winemaker (459):23-27.

406. **Habili, N., A. J. W. Ewart, C. F. Fazeli, N. S. Scott, L. R. Krake, and M. A. Rezaian.** 1998. Virus types associated with leafroll disease in Australia. The Australian Grapegrower and Winemaker (390a):25-28.

407. **Habili, N. and J. W. Randles.** 2002. Developing a standardised sampling protocol for consistent detection of grapevine viruses by the PCR assay. The Australian and New Zealand Grapegrower and Winemaker (464):88-92.

408. **Habili, N., J. W. Randles, and A. Rowhani.** 2003. Evidence for the apparent spread of *Grapevine virus A* and *Grapevine leafroll-associated virus 9* in a research vineyard in Australia, p. 213-214. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

409. **Habili, N. and A. Rowhani.** 2002. First detection of a new virus, Grapevine leafroll-associated virus type 9, in a popular clone of Cabernet Sauvignon in Australia. The Australian and New Zealand Grapegrower and Winemaker (461a):102-103.

410. **Habili, N., A. Rowhani, and R. H. Symons.** 2001. Grapevine fanleaf virus - A potential threat to the viticultural industry. The Australian Grapegrower and Winemaker (449a):141-145.

411. **Habili, N. and L. Schliefert.** 2001. The increasing threat of Grapevine virus A and its association with Restricted Spring Growth in Australia. The Australian Grapegrower and Winemaker (455):22-26.

412. **Habili, N., L. Schliefert, and R. H. Symons.** 2000. Viruses and phytoplasmas in neighboring grapevines showing or not showing symptoms: visual assessment versus diagnostic assay. The Australian Grapegrower and Winemaker (438a):156-158.

413. **Habili, N. and R. H. Symons.** 1999. Nested PCR, a highly sensitive technique for the detection of grapevine virus B. The Australian Grapegrower and Winemaker (429):58-59.

414. **Habili, N. and R. H. Symons.** 2000. Grapevine viruses detected by Waite Diagnostics in Australia, p. 124-126. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

415. **Habili, N. and R. H. Symons.** 2001. Update on Australian grapevine yellows in Australian vineyards. The Australian Grapegrower and Winemaker (452):45-49.

416. **Habili, N. and R. H. Symons.** 2001. A destructive virus from Red Globe table grape. The Australian Grapegrower and Winemaker (447):17-19.

417. **Habili, N. and R. H. Symons.** 2001. Virus and phytoplasma content of major grapevine varieties in Australia. The Australian Grapegrower and Winemaker (451):18-22.

418. **Herrera, M.G. and V. M. Madariaga.** 2001. Presencia e incidencia de virus de la vid en la zona central de Chile (Presence and incidence of grapevine viruses in the central zone of Chile). Agricultura Tecnica **61**:393-400.

419. **Hübschen, J., L. Kling, U. Ipach, V. Zinkernagel, N. Bosselut, D. Esmenjaud, D. J. F. Brown, and R. Neilson.** 2004. Validation of the specificity and sensitivity of species-specific primers that provide a reliable molecular diagnostic for *Xiphinema diversicaudatum, X.index* and *X.vuittenezi*. European Journal of Plant Pathology **110**:779-788.

420. **Hübschen, J., L. Kling, U. Ipach, V. Zinkernagel, D. J. F. Brown, and R. Neilson.** 2004. Development and validation of species-specific primers that provide a molecular diagnostic for virus-vector longidorid nematodes and related species in German viticulture. European Journal of Plant Pathology **110**:883-891.

421. **Ioannou, N.** 2000. Sanitary selection of the grapevine in Cyprus, p. 155. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

422. **Ioannou, N., A. Hadjinicolis, and A. Hadjinicoli.** 1999. Mealybug transmission and natural spread of grapevine closterovirus in Cyprus. Options Méditerranéennes,Série B (29A):93-101.

423. **Ioannou, N., A. Hadjinikolis, and A. Hadjinikoli.** 2000. Transmission of grapevine leafroll-associated virus 3 (GLRaV-3) by two mealybug species, *Planococcus ficus* and *P.citri*. Phytopathologia mediterranea **39**:317-318.

424. **Ioannou, N., N. Roumbos, A. Emmanuel, and A. Hadjinicolis.** 2001. Clonal and sanitary selection of traditional grapevine varieties in Cyprus. Phytopathologia mediterranea **40**:77.

425. **Ipach, U., L. Kling, and D. Lesemann.** 2003. First record of *Cherry leaf roll virus* on grapevine in Germany, p. 17-18. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

426. **Ipach, U., L. Kling, and M. Rüdel.** 2000. Transmission of grapevine fanleaf virus by *Xiphinema index* to different newly bred rootstocks in greenhouse and field trials, p. 66. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

427. **Ipach, U., L. Kling, and M. Rüdel.** 2000. Übertragung des *Grapevine fanleaf virus* durch *Xiphinema index* in Gewächshaus- und Freilandversuchen auf verschiedene Unterlagen-Neuzüchtungen im Weibau (Transmission of grapevine fanleaf virus by *Xiphinema index* to different newly bred rootstocks in greenhouse and field trials). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (376):374-375.

428. **Isogai, M., Y. Saitou, N. Takahashi, T. Itabashi, M. Terada, H. Satoh, and N. Yoshikawa.** 2003. The 50-kDa protein of apple chlorotic leaf spot virus interferes with intracellular and intercellular targeting and tubule-inducing activity of the 39-kDa protein of grapevine berry inner necrosis virus. Molecular Plant Microbe Interactions **16**:188-195.

429. **Izadpanah, K., M. Zaki-Aghl, and A. Rowhani.** 2003. Non-*Vitis* hosts of *Grapevine fanleaf virus* and their possible epidemiological significance, p. 210. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

430. **Izadpanah, K., M. Zaki-Aghl, Y. P. Zhang, S. D. Daubert, and A. Rowhani.** 2003. Bermuda grass as a potential reservoir host for *Grapevine fanleaf virus.* Plant Disease **87**:1179-1182.

431. **James, D., W. Jelkmann, and C. Upton.** 2000. Nucleotide sequence and genome organization of cherry mottle leaf virus and its relationship to members of the Trichovirus genus. Archives of Virology **145**:995-1007.

432. **Jardak-Jamoussi, R., B. Bouamama, G. Krczal, A. Mliki, T. Wetzel, G. M. Reustle, and A. Ghorbel.** 2003. Regeneration of Tunisian transgenic grapevine plants and evaluation of the gene construct for *Grapevine fanleaf virus* resistance, p. 230. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

433. **Jardak-Jamoussi, R., B. Bouamama, T. Wetzel, A. Mliki, G. M. Reustle, and A. Ghorbel.** 2003. Evaluation of different gene constructs for production of resistant grapevines against grapevine fanleaf and arabis mosaic viruses. Acta Horticulturae (603):315-323.

434. **Johnson, R.C.** 2003. Grapevine certification and the importation of grapevines into the member countries of the North American Plant Protection Organization (NAPPO), p. 147-148. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

435. **Johnson, R.C.** 2003. Virus testing and the Canadian plant protection export certification program for grapevine nursery stock (PPECP), p. 171-172. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

436. **Karasev, A.V.** 2000. Genetic diversity and evolution of closteroviruses. Annual Review of Phytopathology **38**:293-324.

437. **Kaserer, H., W. Leonhardt, A. Grahsl, and H. Gangl.** 2003. Report on an efficient scheme to develop certified clonal propagating material in Austria. Acta Horticulturae (603):127-129.

438. **Kelly, M., F. Constable, and M. Malipatil.** 1998. Identifying the vector of Australian grapevine yellows phytoplasma. The Australian Grapegrower and Winemaker (412):18-20.

439. **Kim, H.R.** 2003. [Effects of Grapevine leafroll-associated virus 3 infection on the growth and fruit quality in "Kyoho" grapevine]. Journal of the Korean Society for Horticultural Science **44**:335-339.

440. **Kim, H.R., Y. M. Choi, B. C. Lee, M. S. Yiem, J. D. Chung, K. R. Kim, J. W. Park, and M. R. Cho.** 2000. Occurrence of grapevine leafroll-associated 3 *closterovirus* in South Korea and analysis of its molecular biological characteristics, p. 24. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

441. **Klein, M., P. Weintraub, M. Davidovich, L. Kuznetsova, T. Zahavi, A. Ashanova, S. Orenstein, and E. Tanne.** 2001. Monitoring phytoplasma-bearing leafhoppers/planthoppers in vineyards in the Golan Heights, Israel. Journal of Applied Entomology **125**:19-23.

442. **Koklu, G.** 1999. Production of antisera to grapevine leafroll associated virus 2 and evaluation of the serological diagnosis of infected plants. Journal of Turkish Phytopathology **28**(3):119-131.

443. **Koklu, G. and S. Baloglu.** 2000. Determination of incidence of grapevine leafroll associated viruses in some grapevine varieties grown in Thrace region. Journal of Turkish Phytopathology **29**(2/3):85-94.

444. **Koklu, G., M. Digiaro, S. Sabanadzovic, and V. Savino.** 1999. Natural infections by Cucumber mosaic virus in Turkish grapevines. Phytopathologia mediterranea **38**:33-36.

445. **Koklu, G., M. Digiaro, and V. Savino.** 1998. A survey of grapevine viruses in Turkish Thrace. Phytopathologia mediterranea **37**:140-142.

446. **Kominek, P.** 2002. Selection of RNA isolation method for molecular detection of grapevine viruses. Plant Protection Science **38**:267-270.

447. **Kominek, P.** 2003. Improved detection of *Arabis mosaic virus* in grapevine and hop plants, p. 92. *In* 8th International Congress of Plant Pathology, 2-7 February 2003, Christchurch, New Zealand, Vol.2. Australasian Plant Pathology Society,

448. **Kominek, P., M. Bryxiova, and M. Glasa.** 2004. Partial molecular characterization of a Czech isolate of Grapevine leafroll-associated virus 3. Journal of Phytopathology **152**:427-431.

449. **Kominek, P. and V. Holleinova.** 2003. Evaluation of sanitary status of grapevines in the Czech Republic. Plant, Soil and Environment **49**:63-66.

450. **Kominek, P., V. Holleinova, O. Jandurova, and P. Pavlousek.** 2003. Occurrence of grapevine viruses in the Czech Republic, p. 182. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

451. **Kominek, P., P. Pavlousek, and J. Polak.** 2000. Detection of grapevine fanleaf virus in the Czech Republic, p. 51. *In* Biodiversity in Plant Pathology. 5th Congress of the European Foundation for Plant Pathology, Taormina-Giardini Naxos, September 2000.

452. **Kominek, P., P. Svoboda, and N. Abou Ghanem-Sabanadzovic.** 2003. Improved detection of arabis mosaic virus in grapevine and hop plants. Acta virologica **47**:199-200.

453. **Konup, L., N. Limanskaja, I. Zhunko, and B. Milkus.** 2003. The production of grapevine certified planting material in the Ukraine, p. 164. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

454. **Kovacs, L.G., H. Hanami, M. Fortenberry, and M. L. Kaps.** 2000. Latent infection by phloem-limited viruses is linked to lower fruit quality in French-American hybrid grapevines, p. 158-159. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

455. **Kovacs, L.G., H. Hanami, M. Fortenberry, and M. L. Kaps.** 2001. Latent infection by leafroll agent GLRaV-3 is linked to lower fruit quality in French-American hybrid grapevines Vidal blanc and St. Vincent. American Journal of Enology and Viticulture **52**:254-259.

456. **Kölber, M., I. Ember, K. Varga, S. Botti, M. Martini, J. Lazar, and A. Bertaccini.** 2003. Six-year survey of grapevine yellows distribution in Hungary, p. 99-100. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

457. **Krake, L. and N. Scott.** 2002. Merlot: The health of our planting material, p. 24-27. *In* Merlot, the challenge, Proceedings, ASVO Seminar. Australian Society of Viticulture and Oenology, Adelaide, Australia.

458. **Krake, L. and N. S. Scott.** 1999. Managing viruses and virus-like organisms starts with the facts. Australian Viticulture **3**(6):10-13.

459. **Krake, L.R., N. Steele Scott, M. A. Rezaian, and R. H. Taylor.** 1999. Graft-transmitted diseases of grapevines. CSIRO Publishing, Collingwood, Vic 3066, Australia.

460. **Krastanova, S., K. S. Ling, H. Y. Zhu, B. Xue, T. Burr, and D. Gonsalves.** 1998. Development of transgenic grape rootstocks with genes from grapevine fanleaf virus and grapevine leafroll associated closteroviruses 2 and 3. Phytopathology **88**(Supplement):S 49.

461. **Krastanova, S., K. S. Ling, H. Y. Zhu, B. Xue, T. J. Burr, and D. Gonsalves.** 2000. Development of transgenic grapevine rootstocks with genes from grapevine fanleaf virus and grapevine leafroll associated closteroviruses 2 and 3. Acta Horticulturae (528):367-372.

462. **Kuhn, G.B. and O. Nickel.** 1998. Viroses e sua importância na viticultura brasileira (Viroses and their importance in Brazilian viticulture). Informe Agropecuario (Belo Horizonte) **19**(194):85-91.

463. **Kuhn, G.B. and O. Nickel.** 1998. Obtenção, manutenção e multiplicação de material propagativo de videira (Obtention, maintenance and multiplication of propagation material of grapevine). Fitopatologia Brasileira **23** (Supplemento):318.

464. **Kuniyuki, H., J. A. Betti, and V. A. Yuki.** 1998. Detecção de viroses e de doenças atribuidas a virus em videira atraves de enxertia de folha (Detection of diseases attributed to viruses in grapevine by leaf graft). Summa Phytopathologica **24**:105-107.

465. **Kuniyuki, H., J. O. Gaspar, and J. A. M. Rezende.** 2003. Occorência do *Grapevine leafroll-associated virus 6* em vinhedos do Brazil (Occurrence of *Grapevine leafroll-associated virus 6* in Brazilian vineyards). Summa Phytopathologica **29**:288-289.

466. **Kuniyuki, H., J. O. Gaspar, and J. A. M. Rezende.** 2004. Incidência do lenho estriado de Rupestris em vinhedos do Estado de São Paulo (Incidence of Rupestris stem pitting disease in vineyards of the State of São Paulo). Fitopatologia Brasileira **29** (Suplemento):S37.

467. **Kuniyuki, H., J. A. M. Rezende, E. W. Kitajima, V. A. Yuki, and J. A. Betti.** 2000. Detecção do *Grapevine virus B* em videiras com a doença fendilhamento cortical (Detection of *Grapevine virus B* in grapevines indexed positive for corky bark disease). Fitopatologia Brasileira **25** (Supplemento):443.

468. **Kuniyuki, H., J. A. M. Rezende, S. M. M. Scagliusi, J. Vega, and V. A. Yuki.** 2002. Incidência de *Grapevine leafroll-associated virus 1, 2 e 3* em vinhedos do Estado de São Paulo (Incidence of *Grapevine leafroll- associated viruses 1, 2 and 3* in vineyards of São Paulo State). Summa Phytopathologica **28**:311-314.

469. **Kuniyuki, H., J. A. M. Rezende, V. A. Yuki, and J. A. Betti.** 2002. Identificação serologica do virus do mosaio das nervuras da videira no Brasil (Serological identification of grapevine fleck virus in Brazil). Fitopatologia Brasileira **27**:635-638.

470. **Kuniyuki, H., J. A. M. Rezende, V. A. Yuki, and J. A. Betti.** 2003. Deteccão serologica do virus A da videira em vinhedos do Estado de São Paulo (Serological detection of grapevine virus A in vineyards of the State of São Paulo). Fitopatologia Brasileira **28**:323.

471. **Kuniyuki, H., V. A. Yuki, and J. A. Betti.** 1998. Porta-enxerto R99: uma indicatora diferencial para isolados do virus das nervuras da videira (R99 rootstock: a differential indicator for grapevine fleck virus isolates). Summa Phytopathologica **24**:57.

472. **Kuniyuki, H., V. A. Yuki, J. A. Betti, C. V. Pommer, and F. P. Martins.** 1999. Alta incidência de viroses e de doenças atribuidas em três porta-enxertos tropicais para videira (High incidence of virus and virus-like diseases in three tropical grapevine rootstocks). Summa Phytopathologica **25**:27.

473. **Kunugi, Y., S. Asari, Y. Terai, and A. Shinkai.** 2000. Studies on the grapevine berry inner necrosis virus disease. 2.Transmission of *grapevine berry inner necrosis virus* by the grape erineum mite *Colomerus vitis* in Yamanashi. Bulletin of the Yamanashi Fruit Tree Experiment Station **67**(10):57-63.

474. **Kuzmanovic, S., C. I. Dovas, N. I. Katis, M. Starovic, M. Tosic, and S. Rajkovic.** 2003. Contribution to the study of grapevine virus diseases in Serbia, p. 180-181. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

475. **Kuzmanovic, S., M. Starovic, M. Tosic, S. Stojanovic, and T. Tomic.** 2003. Phytoplasmas on grapevine in Serbia, p. 93-94. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

476. **La Notte, P., M. Digiaro, G. Bottalico, C. Pirolo, A. Campanale, D. Boscia, and V. Savino.** 2003. Stato sanitario e risanamento di varietà ad uva in Puglia (Sanitary state and recovery of table grape grape varieties in Apulia). Rivista di Frutticoltura e di Ortofloricoltura **65**:42-50.

477. **La Notte, P., G. Romanazzi, T. Amenduni, F. Capocasa, S. Virgili, B. Mezzetti, B. M. Branzanti, O. Silvestroni, and V. Savino.** 2002. Sanitary status of stone fruits and grapevine in Marche region. First contribution. Journal of Plant Pathology **84**:184.

478. **Lacombe, T., J. M. Boursiquot, and L. Audeguin.** 2004. Prospection, conservation et évaluation des clones de vigne en France (Prospection, conservation and evaluation of grapevine clones in France). Bulletin de l'O. I. V. **77**:799-809.

479. **Laimer, M.** 2003. Virus resistance breeding in grapevine, p. 225. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

480. **Lammers, A.H., R. F. Allison, and D. C. Ramsdell.** 1999. Cloning and sequencing of peach rosette mosaic virus RNA1. Virus Research **65**:57-73.

481. **Langer, M., H. Darimont, and M. Maixner.** 2003. Characterization of isolates of Vergilbungskrankheit-phytoplasma by RFLP-analysis and their association with grapevine, herbaceous host plants and vectors, p. 66-67. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

482. **Langer, M., H. Darimont, and M. Maixner.** 2003. Control of phytoplasma vectors in organic viticulture. IOBC/wprs Bulletin **26**(8):197-202.

483. **Langer, M. and M. Maixner.** 2004. Molecular characterization of grapevine yellows associated phytoplasmas of the stolbur-group based on RFLP-analysis of non-ribosomial DNA. Vitis **43**:191-199.

484. **Langer, M. and M. Maixner.** 2004. Charakterisierung von mit der Schwarzholzkrankheit assoziierten Isolaten des Stolbur-Phytoplasma (Characterization of stolbur phytoplasma isolates associated with bois noir). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (396):521.

485. **Langer, M. and M. Maixner.** 2004. Laborzucht der Zikade *Hyalesthes obsoletus*, des Vektors der Schwarzholzkrankheit der Rebe (Laboratory rearing of the leafhopper *Hyalesthes obsoletus* vector of grapevine Bois noir disease). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (396):521.

486. **Laporte, C.** 2003. Caractérisation et fonctions des composants viraux et cellulaires au cours de la réplication et du mouvement du grapevine fanleaf virus (GFLV) dans les plantes hôtes (Characterization and functions of viral and cellular components of grapevine fanleaf virus (GFLV) in host plants). PhD Thesis, Université Louis Pasteur, Strasbourg, France.

487. **Laporte, C., C. Ritzenthaler, G. Vetter, A. M. Loudes, D. G. Robinson, S. Hillmer, and C. Stussi-Garaud.** 2003. *Grapevine fanleaf virus* movement protein traffics along the secretory pathway and the cytoskeleton for its proper targeting to plasmodesmata, p. 12. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari, Italy.

488. **Laporte, C., G. Vetter, A. M. Loudes, D. G. Robinson, S. Hillmer, C. Stussi-Garaud, and C. Ritzenthaler.** 2003. Involvement of the secretory pathway and the cytoskeleton in intracellular targeting and tubule assembly of *Grapevine fanleaf virus* movement protein in tobacco BY-2 cells. The Plant Cell **15**:2058-2075.

489. **Larrue, J., A. Caudwell, and E. Boudon-Padieu.** 2000. Occurrence and symptom expression of bois noir in Burgundy over a 15 years period, p. 118. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

490. **Laviña, A., J. Sabaté, M. Garcia, and A. Batlle.** 2003. Seasonal fluctuation and detection of stolbur phytoplasma in grapevine, p. 115. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

491. **Lazar, J.** 2003. Sanitary aspects and results of the Hungarian grape breeding. Acta Horticulturae (603):755-762.

492. **Lazar, J., J. Mikulas, G. Farkas, and M. Kölber.** 2002. Certification programme for production of virus-free propagation material of grapevine and its results in Hungary. International Journal of Horticultural Science **8**(3/4):39-43.

493. **Lazar, J., J. Mikulas, E. Hajdu, M. Kölber, and S. Szynegi.** 2000. Grapevine virus diseases and clean grape stock program in Hungary, p. 172-173. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

494. **Lecocq, R.** 1999. Flavescence dorée. La lutte obligatoire s'étend (Flavescence dorée. The obligatory control measures are extended). Viti (240):34-35.

495. **Lee, I.M., D. E. Gundersen, and A. Bertaccini.** 1998. Phytoplasma: ecology and genomic diversity. Phytopathology **88**:1359-1366.

496. **Lee, I.M., D. E. Gundersen-Rindal, R. E. Davis, and I. M. Bartoszyk.** 1998. Revised classification scheme of phytoplasmas based on RFLP analyses of 16SrDNA and ribosomal protein gene sequences. International Journal of Systematic Bacteriology **48**:1153-1169.

497. **Lee, I.M., M. Martini, and C. Marcone.** 2002. Classificazione molecolare dei fitoplasmi del gruppo "elm yellows"(16SrV) basata sui geni del 16SrRNA e delle proteine ribosomali (Molecular classification of phytoplasms of the group "elm yellows" (16SrV) based on the genes of 16SrRNA and of ribosomial proteins). Petria **12**:223-224.

498. **Lee, I.M., M. Martini, C. Marcone, and S. F. Zhu.** 2004. Classification of phytoplasma strains in the elm yellows group (16SrV) and proposal of 'Candidatus Phytoplasma ulmi' for the phytoplasma associated with elm yellows. International Journal of Systematic and Evolutionary Microbiology **54**:337-347.

499. **Leonhardt, W., C. Wawrosch, A. Auer, and B. Kopp.** 1998. Monitoring of virus diseases in Austrian grapevine varieties and virus elimination using *in vitro* thermotherapy. Plant Cell,Tissue and Organ Culture **52**:71-74.

500. **Lessio, F. and A. Alma.** 2004. Dispersal patterns and chromatic response of *Scaphoideus titanus* Ball (Homoptera Cicadellidae), vector of the phytoplasma agent of grapevine flavescence dorée. Agricultural and Forest Entomology **6**:121-127.

501. **Lessio, F., S. Palermo, R. Tedeschi, and A. Alma.** 2003. Presence of grapevine yellows phytoplasmas vectors (Homoptera, Auchenorrhyncha) in northwestern Italy, p. 75-76. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

502. **Lherminier, J., R. G. Bonfiglioli, X. Daire, R. H. Symons, and E. Boudon-Padieu.** 1999. Oligodeoxynucleotides as probes for *in situ* hybridization with transmission electron microscopy to specifically localize phytoplasma in plant cells. Molecular and Cellular Probes **13**:41-47.

503. **Li, H.Y., L. G. Chen, and X. P. Zhou.** 2003. Cloning and sequence analysis of P38 gene of Grapevine fanleaf virus Hangzhou isolate. Journal of Zhejiang University Agriculture and Life Sciences **29**(1):34-38.

504. **Liefting, L.W., A. C. Padovan, K. S. Gibb, R. E. Beever, M. T. Andersen, R. D. Newcomb, D. L. Beck, and R. L. S. Forster.** 1998. '*Candidatus* Phytoplasma australiense' is the phytoplasma associated with Australian grapevine yellows, papaya dieback and *Phormium* yellow leaf diseases. European Journal of Plant Pathology **104**:619-623.

505. **Lima, M.F., R. Alkowni, D. Golino, J. K. Uyemoto, and A. Rowhani.** 2004. Characterization of two new strains of grapevine rupestris stem pitting associated virus. Phytopathology **94** (Supplement):S61.

506. **Lima, M.F., R. Alkowni, A. Rowhani, J. K. Uyemoto, D. A. Golino, and A. S. Renault-Spilmont.** 2003. Genomic study of two *Grapevine rupestris stem pitting-associated virus*-like isolates, p. 125. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

507. **Ling, K.S., T. Krastanova, B. Xue, H. Y. Zhu, B. Meng, and D. Gonsalves.** 2000. Complete genome sequence of grapevine leafroll virus-3 and development of transgenic plants expressing its genes, p. 52. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

508. **Ling, K.S., H. Y. Zhu, R. F. Drong, J. L. Slightom, J. R. Mcferson, and D. Gonsalves.** 1998. Nucleotide sequence of the 3'-terminal two-thirds of the grapevine leafroll-associated virus-3 genome reveals a typical monopartite closterovirus. Journal of General Virology **79**:1299-1307.

509. **Ling, K.S., H. Y. Zhu, and D. Gonsalves.** 2004. Complete nucleotide sequence and genome organization of Grapevine leafroll-associated virus 3, type member of the genus Ampelovirus. Journal of General Virology **85**:2099-2102.

510. **Ling, K.S., H. Y. Zhu, Z. Y. Jiang, and D. Gonsalves.** 2000. Effective application of DAS-ELISA for detection of grapevine leafroll associated closterovirus-3 using a polyclonal antiserum developed from recombinant coat protein. European Journal of Plant Pathology **106**:301-309.

511. **Ling, K.S., H. Y. Zhu, N. Petrovic, and D. Gonsalves.** 2001. Comparative effectiveness of ELISA and RT-PCR for detecting grapevine leafroll-associated closterovirus-3 in field samples. American Journal of Enology and Viticulture **52**:21-27.

512. **Little, A., C. F. Fazeli, and M. A. Rezaian.** 2000. Hypervariable genes in grapevine leafroll-associated virus 1, p. 25-27. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

513. **Little, A., C. F. Fazeli, and M. A. Rezaian.** 2001. Hypervariable genes in Grapevine leafroll associated virus 1. Virus Research **80**:109-116.

514. **Little, A. and M. A. Rezaian.** 2003. Gene function analysis and improved detection of *Grapevine leafroll-associated virus 1*, p. 35. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

515. **Little, A. and M. A. Rezaian.** 2003. Grapevine viroids, p. 195-206. *In* A. Hadidi, R. Flores, J. W. Randles, and J. S. Semancik (ed.), Viroids. CSIRO Publishing, Collingwood, Australia.

516. **Liu, X., D. Boscia, T. Raimondi, M. Broggio, J. Chen, H. W Li, J. H. Wang, and J. J. Liu.** 2004. [Field investigation and serological detection of grapevine viruses in Sichuan province]. Southwest China Journal of Agricultural Sciences **17**(1):52-56.

517. **Lopez, M.A., R. Ocete, A. Gallardo, A. Troncoso, and I. Gomez.** 2004. Ecological aspects and conservation of wild grapevine populations in the S.W. of the Iberian Peninsula. Acta Horticulturae (652):81-86.

518. **Lucchi, A., F. Cosci, V. Mazzoni, and L. Santini.** 2000. Preoccupante diffusione di *Scaphoideus titanus* Ball (*Homoptera Cicadellidae*) in vigneti della Liguria meridionale e della Toscana litoranea (Worrying diffusion of *Scaphoideus titanus* Ball (*Homoptera Cicadellidae*) in southern Ligurian and northern coastal Tuscan vineyards (Italy). Petria **10**:183-185.

519. **M'hirsi, S., H. Acheche, S. Fattouch, G. Boccardo, M. Marrakchi, and N. Marzouki.** 2004. First report of phytoplasmas in the aster yellows group infecting grapevine in Tunisia. Plant Pathology **53**:521.

520. **M'hirsi, S., S. Fattouch, H. Acheche, M. Marrakchi, and N. Marzouki.** 2001. Detection of *Grapevine A vitivirus* in Tunisian grapevines. Bulletin OEPP/EPPO Bulletin **31**:509-513.

521. **Magarey, P. and M. W. Maixner.** 2003. Australian grapevine yellows: source and spread, p. 305. *In* 8th International Congress of Plant Pathology, 2-7 February 2003, Christchurch, New Zealand, vol.2.

522. **Magnien, C.** 1998. La lutte contre le Court-noué. La dévitalisation des ceps avant l'arrachage: une mesure préventive d'un grand intérêt (The control of court-noué disease. The devitalization of vines before uprooting them is a preventive measure of a great interest). Phytoma - La Défense des Végétaux (510):44-45.

523. **Mahfoudhi, N., M. Digiaro, V. Savino, and B. Di Terlizzi.** 1998. Viruses and virus diseases of grapevine in Tunisia. Bulletin OEPP/EPPO Bulletin **20**:197-204.

524. **Maixner, M.** 1998. Teilnahme an der 12. Tagung des "International Council for the Study of Virus- and Viruslike Diseases of the Grapevine"(ICVG) in Lissabon/Portugal (Taking part in the 12th meeting of the ICVG, Lisbon/Portugal). Nachrichtenblatt des Deutschen Pflanzenschutzdienstes **50**:210-211.

525. **Maixner, M.** 2002. Zikaden als Schaderreger und Vektoren im Weinbau - aktuelle Probleme und potentielle Risiken (Leafhoppers as pests and vectors in viticulture - current problems and potential risks). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (390):327.

526. **Maixner, M. and H. Darimont.** 2000. Verbreitung rebpathogener Phytoplasmen und ihrer Vektoren in den deutschen Weinbaugebieten (Occurrence of grapevine phytoplasmas and their vectors in German viticultural areas). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (376):374.

527. **Maixner, M., H. Darimont, and H. D. Mohr.** 2001. Studies on the transmission of bois noir to weeds and potential ground-cover plants by *Hyalesthes obsoletus* Signoret (Auchenorhyncha: Cixiidae). IOBC/wprs Bulletin **24**(7):249-251.

528. **Maixner, M., H. Darimont, and W. Reinert.** 2000. Course of infestation by grapevine yellows in vinyards after replanting, p. 109-110. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

529. **Maixner, M., J. Lüers, and H. Darimont.** 2002. Prognose der Flugaktivität von *Hyalesthes obsoletus* und Einfluss klimatologischer Faktoren auf die Phänologie der Reben (Prognosis of the flight activity of *Hyalesthes obsoletus* and the influence of climatological parameters on grapevine phenology). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (390):555.

530. **Maixner, M. and W. Reinert.** 1998. Vergilbungskrankheiten der Rebe (Yellows diseases of grapevine). Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft Berlin-Dahlem (349):47-87.

531. **Maixner, M. and W. Reinert.** 1999. *Oncopsis alni* (Schrank)(Auchenorrhyncha:Cicadellidae) as a vector of the alder yellows phytoplasma of *Alnus glutinosa* (L.) Gaertn. European Journal of Plant Pathology **105**:87-94.

532. **Maixner, M. and W. Reinert.** 2000. Monitoring of planthopper vectors in vineyards: an aid for grapevine yellows management decisions. IOBC/wprs Bulletin **23**:123-124.

533. **Maixner, M., W. Reinert, and H. Darimont.** 2000. Transmission of an elm yellows group grapevine phytoplasma by *Oncopsis alni*, p. 89-90. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

534. **Maixner, M., W. Reinert, and H. Darimont.** 2000. Transmission of grapevine yellows by *Oncopsis alni* (Schrank)(Auchnorrhynca: Macropsinae). Vitis **39**:83-84.

535. **Maixner, M. and A. Weber.** 1999. Klimabedingte Änderungen des Auftretens und der Aktivität der Vektoren von Rebkrankheiten (Changes in the occurrence and activity of vectors of grape diseases due to climate). Berichte über Landwirtschaft **77**(1):121-123.

536. **Malausa, J.C.** 2004. Les grands principes et strategies de la lutte biologique: application au cas de la cicadelle vectrice de la flavescence dorée, *Scaphoideus titanus* (Principles and strategies of biological control: the case of the leafhopper vector of flavescence dorée, *Scaphoideus titanus*). Progrès Agricole et Viticole **122**:41-44.

537. **Malausa, J.C., B. Nusillard, and L. Giuge.** 2003. Lutte biologique contre la cicadelle vectrice de la flavescence dorée (Biological control of the leafhopper vector of flavescence dorée). Phytoma - La Défense des Végétaux (565):24-27.

538. **Malossini, G., I. Roncador, A. M. Ciccotti, M. Bertamini, and N. Nedunchezhian.** 2003. Grapevine viruses (GLRaV-1+GVA) inhibits pigments, RuBPC and photosynthetic activities in field grown grapevine(*Vitis vinifera* L. cv. Marzemino) leaves, p. 254-255. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

539. **Malossini, U., A. M. Cicotti, P. Bragagna, M. E. Vindimian, S. Moser, G. Versini, and G. Nicolini.** 2003. Changes in agronomical and oenological performances of clones of the grapevine cv Gewürztraminer after *Grapevine fanleaf virus* elimination by heat therapy, p. 252-253. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

540. **Mannini, F.** 2000. Clonal selection in grapevine: interactions between genetic and sanitary strategies to improve propagation material. Acta Horticulturae (528):703-712.

541. **Mannini, F.** 2001. Effetti del risanamento da virus sulle attitudini di cloni di vite (Effects of virus sanitation on performances of grapevine clones). Informatore Fitopatologico **51**(4):25-30.

542. **Mannini, F.** 2003. Grapevine clonal and sanitary selection: the point of view of E.U. selectors, p. 150. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

543. **Mannini, F.** 2003. Virus elimination in grapevine and crop performance, p. 234-239. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

544. **Mannini, F., N. Argamante, and R. Credi.** 1999. Contribution des infections virales à la variabilité de quelques cépages de *Vitis vinifera* L. (Contribution of virus infections to clonal variability of some *Vitis vinifera* L. cultivars). Bulletin de l'O. I. V. **72**:145-160.

545. **Mannini, F., N. Argamante, and R. Credi.** 2000. Leaf morphological modifications induced by different viruses in clones of *Vitis vinifera* cultivars. Acta Horticulturae (528):765-768.

546. **Mannini, F., N. Argamante, V. Gerbi, and A. Ferrandino.** 2001. Interazione tra gestione del vigneto e malattie virali (Interactions between vineyard management and virus diseases). Quad. Vitic. Enol. Univ. Torino **25**:51-65.

547. **Mannini, F., N. Argamante, and S. Guidoni.** 2003. Effetto delle virosi della vite sull'accumulo di polifenoli nelle bacchie (Effect of grapevine virus diseases on the accumulation of polyphenol compounds in berries). Quad. Vitic. Enol. Univ. Torino **26**:43-59.

548. **Mannini, F. and R. Credi.** 2000. Appraisal of agronomic and enological modifications in the performances of grapevine clones after virus eradication, p. 151-154. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

549. **Mannini, F., D. Cuozzo, S. Piano, and M. Gobetto.** 1999. Prime risultanze dello studio sul comportamento agronomico e produttivo di un clone di "Moscato bianco" dopo risanamento dalla virosi dell'accartocciamento fogliare (First results of a study on the agronomic and production performances of a clone of White muscat after elimination of leafroll disease). Quad. Vitic. Enol. Univ. Torino **23**:139-144.

550. **Mannini, F., V. Gerbi, and R. Credi.** 1998. Heat-treated v. virus-infected grapevine clones: agronomical and enological modifications. Acta Horticulturae (473):155-163.

551. **Mannini, F. and I. Gribaudo.** 1999. Risanamento da virus per migliorare il materiale di moltiplicazione viticolo (Virus elimination for improving grapevine propagaton material). L'Informatore agrario **55**(13):69-72.

552. **Mannini, F. and I. Gribaudo.** 2004. Risanamento da virus e fitoplasmi nella vite e suoi effetti (Healing grapevine of virus and phytoplasma diseases and results), p. 1-13. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

553. **Mannini, F., I. Gribaudo, D. Cuozzo, S. Tronfi, and F. Bonanimi.** 2003. Virus-free grapevines may contribute to safeguard and exploit the viticulture in the difficult environment of the 5 Terre (north-west Italy), p. 245. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

554. **Mannini, F., L. Rolle, and S. Guidoni.** 2003. Vineyard management to optimize grape quality in virus-free clones of *Vitis vinifera* L. Acta Horticulturae (603):121-126.

555. **Mansinho, A., M. Teixeira Santos, Z. Sequeira, C. Sequeira, P. K. Correia, O. A. Sequeira, and G. Nolasco.** 1999. Detection of grapevine viruses by RT-PCR of double stranded RNA templates. Petria **9**:183-186.

556. **Manuel de Borbon, C., O. Gracia, and G. S. Gomez Talquenca.** 2004. Mealybugs and grapevine leafroll-associated virus 3 in vineyards of Mendoza, Argentina. American Journal of Enology and Viticulture **55**:283-285.

557. **Marcone, C., A. Ragozzino, I. Camele, G. L. Rana, and E. Seemüller.** 2001. Updating and extending genetic characterization and classification of phytoplasmas from wild and cultivated plants in southern Italy. Journal of Plant Pathology **83**:133-138.

558. **Marcone, C., G. Scaglione, I. Camele, A. Ragozzino, and G. L. Rana.** 2002. Presenza di giallumi della vite negli impianti di "Falangina" nel beneventano e di altri vitigni in Basilicata (Occurrence of yellows diseases of grapevine in vineyards of "Falangina" in the province of Benvento and in other vineyards in the Basilicate region). Petria **12**:447-448.

559. **Marcone, C., G. Scaglione, and A. Ragozzino.** 2000. Aspetti epidemiologichi delle fitoplasmosi delle drupacee e della vite in Campania (Epidemiological aspects of phytoplasma diseases of drupaceae and grapevine in Campania). Informatore Fitopatologico **50**(1-2):58-62.

560. **Martelli, G.P.** 1999. Presentation of the Mediterranean Network on Grapevine Closteroviruses (MNGC) and report of activity 1992-1997. Options Méditerranéennes,Série A no 29:13-29.

561. **Martelli, G.P.** 1999. Infectious diseases and certification of grapevine. Options Méditerranéennes, Série B (29A):47-64.

562. **Martelli, G.P.** 1999. The impact of propagation material on vine health - a European perspective, p. 197-207. *In* Proceedings of the tenth Australian Wine Industry Technical Conference, Sydney 1998. The Australian Wine Research Institute, Glen Osmond, Australia.

563. **Martelli, G.P.** 2000. Major graft-transmissible diseases of grapevine: nature, diagnosis, and sanitation, p. 231-236. *In* Proceedings of the 50th Anniversary Meeting of the American Society for Enology and Viticulture, Seattle, Washington, June 19-23, 2000.

564. **Martelli, G.P.** 2000. Grapevine virology highlights 1997-99, p. 1-5. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, 12-17 March 2000, Adelaide, Australia. University of Adelaide, Adelaide.

565. **Martelli, G.P.** 2000. Genus closterovirus, p. 946-949. *In* Van Regenmortel M.H.V.*et al.* (ed.), Virus Taxonomy. Seventh Report of the International Committee on Taxonomy of Viruses. Academic Press, New York.

566. **Martelli, G.P.** 2001. Le principali virosi della vite (The main virus diseases of grapevine). Quad. Vitic. Enol. Univ. Torino **25**:5-14.

567. **Martelli, G.P.** 2002. Le principali virosi della vite oggi (The main virus diseases of grapevine today). Informatore Fitopatologico **52(4)**:18-27.

568. **Martelli, G.P.** 2003. Grapevine virology highlights 2000-2003, p. 3-10. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari(Italy).

569. **Martelli, G.P.** 2004. Virosi della vite: scenario italiano ed europeo (Grapevine virus diseases: Italian and European scenario), p. 1-9. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

570. **Martelli, G.P., A. A. Agranovski, M. Bar-Joseph, D. Boscia, T. Candresse, R. H. A. Coutts, V. V. Dolja, B. W. Falk, D. Gonsalves, W. Jelkmann, A. V. Karasev, A. Minafra, S. Namba, H. J. Vetten, G. C. Wisler, and N. Yoshikawa.** 2002. The family Closteroviridae revised. Archives of Virology **147**:2039-2044.

571. **Martelli, G.P. and W. Jelkmann.** 1998. *Foveavirus*, a new plant virus genus. Archives of Virology **143**:1245-1249.

572. **Martelli, G.P. and W. Jelkmann.** 2000. *Genus Foveavirus*, p. 985-989. *In* M. H. V. Van Regenmortel (ed.), Seventh report of the International Committee on taxonomy of viruses. Academic Press, New York, USA.

573. **Martelli, G.P. and U. Prota.** 1999. Selezione e sanità della vite (Selection and health of grapevine). Vignevini **26**(5):51-58.

574. **Martelli, G.P., S. Sabanadzovic, N. Abou Ghanem-Sabanadzovic, M. C. Edwards, and T. Dreher.** 2002. The family *Tymoviridae*. Archives of Virology **147**:1837-1846.

575. **Martelli, G.P., S. Sabanadzovic, N. Abou Ghanem-Sabanadzovic, and P. Saldarelli.** 2002. *Maculavirus*, a new genus of plant viruses. Archives of Virology **147**:1847-1853.

576. **Martelli, G.P. and B. Walter.** 1998. Virus certification of grapevines, p. 261-276. *In* A. Hadidi, R. K. Khetarpal, and H. Koganezawa (ed.), Plant Virus Disease Control. American Phytopathological Society, St.Paul, Minnesota, 55121, USA.

577. **Martin, R.R., K. Eastwell, A. Wagner, I. E. Tzanetakis, and S. Lamprecht.** 2002. Survey for viruses of grapevine in Oregon and Washington. Phytopathology **92** (Supplement):S52.

578. **Martinelli, L., E. Candioli, D. Costa, and A. Minafra.** 2002. Stable insertion and expression of the movement protein gene of Grapevine Virus A (GVA) in grape (*Vitis rupestris* S.). Vitis **41**:189-193.

579. **Martinelli, L., D. Costa, V. Poletti, S. Festi, N. Buzkan, A. Minafra, P. Saldarelli, G. P. Martelli, and P. Avi.** 2000. Genetic transformation of tobacco and grapevine for resistance to viruses related to rugose wood disease complex. Acta Horticulturae (528):321-327.

580. **Martini, M., S. Botti, C. Marcone, C. Marzachi, P. Casati, P. A. Bianco, R. Benedetti, and A. Bertaccini.** 2002. Genetic variability among Flavescence dorée phytoplasmas from different origins in Italy and France. Molecular and Cellular Probes **16**:197-208.

581. **Martini, M., E. Murari, M. Guadagnini, N. Mori, M. Borgo, and A. Bertaccini.** 2000. Indagini sulla diffusione di due tipi di fitoplasmi associati a Flavescenza dorata della vite in Veneto (Research on the diffusion of two types of phytoplasmas associated with flavescence dorée of grapevine in Veneto). Petria **10**:175-176.

582. **Martini, M., E. Murari, N. Mori, and A. Bertaccini.** 1999. Identification and epidemic distribution of two *flavescence dorée*-related phytoplasmas in Veneto (Italy). Plant Disease **83**:925-930. (Abstract)

583. **Marzachi, C., A. Alma, M. D'Aquilio, G. Minuto, and G. Boccardo.** 1999. Detection and identification of phytoplasmas infecting cultivated and wild plants in Liguria (Italian Riviera). Journal of Plant Pathology **81**:127-136.

584. **Marzachi, C., E. Angelini, M. Barba, P. A. Bianco, G. Firrao, G. Pasquini, and A. Bertaccini.** 2002. Armonizzazione della diagnosi della Flavescenza Dorata della vite (FD): risultati di un secondo anno di prove comparative (Harmonization of the diagnosis of flavescence dorée of grapevine [FD]: results from a second year of comparative analyses). Petria **12**:449-450.

585. **Marzachi, C. and A. Boarino.** 2002. Diagnosi molecolare delle malattie da fitoplasmi della vite (Molecular diagnosis of grapevine phytoplasma diseases). Informatore Fitopatologico **52**(10):36-41.

586. **Marzachi, C., A. Boarino, A. Vischi, S. Palermo, C. Morone, A. Loria, and G. Boccardo.** 2001. Flavescenza dorata, legno nero e giallume dell'astro in vitigni del Piemonte sud orientale (Flavescence dorée, blackwood and aster yellows in vineyards of south-eastern Piedmont). Informatore Fitopatologico **51**(9):58-63.

587. **Marzachi, C. and L. Galetto.** 2004. Le fitoplasmosi della vite (Phytoplasma diseases of grapevine), p. 1-7. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

588. **Marzachi, C., L. Galetto, and D. Bosco.** 2000. Real-time PCR detection of Bois noir and Flavescence dorée from field collected symptomatic grapevines, p. 56-57. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

589. **Marzachi, C., S. Palermo, A. Boarino, F. Veratti, M. D'Aquilio, A. Loria, and G. Boccardo.** 2001. Optimization of a one-step PCR assay for the diagnosis of Flavescence dorée-related phytoplasmas in field-grown grapevines and vector populations. Vitis **40**:213-217.

590. **Marzachi, C., F. Veratti, M. D'Aquilio, A. Vischi, M. Conti, and G. Boccardo.** 2000. Molecular hybridization and PCR amplification of non-ribosomal DNA to detect and differentiate stolbur phytoplasma isolates from Italy. Journal of Plant Pathology **82**:201-212.

591. **Masri, S., H. Rast, R. Johnson, and A. Rowhani.** 2003. Detection of fragmented *Grapevine rupestris stem pitting- associated virus* genome in *Vitis rupestris* "St.George"rootstock using a modified PCR method, p. 124. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

592. **Materazzi, A. and E. Triolo.** 2003. Sanitary status of 7 varieties of wine grapevine in some regions of central Italy, p. 174-175. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

593. **Materazzi, A., E. Triolo, and A. Lucchi.** 1998. No evidence for the transmission of three grapevine viruses by *Metcalfa pruinosa* (Say) (Homoptera, Fulgoroidea). Journal of Plant Pathology **80**:175.

594. **Materazzi, A., E. Triolo, and D. Luvisi.** 2004. Il Sagrantino a Montefalco e l'Aleatico all'Elba: due casi difficili per la selezione sanitaria (The cvs Sagrantino at Montefalco and Aleatico in the Island of Elba: two difficult cases for sanitary selection), p. 1-7. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

595. **Matousek, J., L. Orctova, J. Patzak, P. Svoboda, and I. Ludvikova.** 2003. Molecular sampling of hop stunt viroid (HSVD) from grapevines in hop production areas in the Czech Republic and hop protection. Plant, Soil and Environment **49**:168-175.

596. **Matsumoto, T. and S. T. Ohki.** 1998. A possible new necrotic disease of grapevine associated with small isometric particles and novel membrane bound particles. Annals of the Phytopathological Society of Japan **64**:560-564.

597. **Mauro, M.C., P. Coutos-Thévenot, M. Boulay, L. Valat, P. Barbier, B. Walter, and L. Pinck.** 2000. Analysis of 41 B *(Vitis vinfera x Vitis Berlandieri)* grapevine rootstocks for grapevine fanleaf resistance. Acta Horticulturae (528):313-319.

598. **Mavric, I., M. Virscek Marn, D. Koron, and I. Zezlina.** 2003. First report of *Raspberry bushy dwarf virus* on Red Raspberry and Grapevine in Slovenia. Plant Disease **87**:1148.

599. **Mavric, I., M. Virscek Marn, and I. Zezlina.** 2003. *Raspberry bushy dwarf virus* infection of grapevine in Slovenia, p. 20. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

600. **Mazzini, F. and T. Galassi.** 2001. Flavescenza dorata della vite. Come combattere l'insetto-vettore (Flavescence dorée of grapevine. How to control the insect vector). Agricoltura **26**(3):76-78.

601. **Mazzoni, E., R. Colla, B. Chiusa, M. Ciampitti, and P. Cravedi.** 2003. Experiences for vector control of grape golden flavescence in Lombardia and Emilia Romagna (Northern Italy) vineyards. IOBC/wprs Bulletin **26**(8):221-225.

602. **Mazzoni, V., F. Cosci, A. Lucchi, and L. Santini.** 2001. Leafhoppers and planthoppers vectors in Ligurian and Tuscan vineyards. IOBC/wprs Bulletin **24**(7):263-266.

603. **McKenry, M.V., J. O. Kretsch, and S. A. Anwar.** 2001. Interactions of selected rootstocks with ectoparasitic nematodes. American Journal of Enology and Viticulture **52**:304-309.

604. **McKenry, M.V., D. Luvisi, S. A. Anwar, P. Schrader, and S. Kaku.** 2004. Eight-year nematode study from uniformly designed rootstock trials in fifteen table grape vineyards. American Journal of Enology and Viticulture **55**:218-227.

605. **Melamed, S., E. Tanne, R. Ben-Haim, O. Edelbaum, D. Yogev, and I. Sela.** 2003. Construction of phytoplasmal genomic librairies and characterization of phytoplasmal genes, p. 54. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13 -17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

606. **Melamed, S., E. Tanne, R. Ben-Haim, O. Edelbaum, D. Yogev, and I. Sela.** 2003. A novel approach to studying the phytoplasma genome, p. 114. In Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13 -17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

607. **Meng, B.** 1999. Rupestris stem pitting of grapevines: insights on etiology, and development of reverse transcription-polymerase chain reaction and immunoassays for diagnosis. PhD thesis, Cornell University, Ithaca, New York, USA.

608. **Meng, B., R. Credi, N. Petrovic, and D. Gonsalves.** 2000. Serological detection of RSPaV in grapes as compared to RT-PCR and indicator indexing, p. 131-132. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12 -17 March 2000. University of Adelaide, Adelaide, Australia.

609. **Meng, B., R. Credi, N. Petrovic, I. Tomazic, and D. Gonsalves.** 2003. Antiserum to recombinant virus coat protein detects *Rupestris stem pitting associated virus* in grapevines. Plant Disease **87**:515-522.

610. **Meng, B., D. E. Goszczynski, and D. Gonsalves.** 2000. Detection of rupestris stem pitting associated virus-1 in the indicator *Vitis rupestris* "St. George" and sequence analysis, p. 43-44. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

611. **Meng, B., D. E. Goszczynski, H. Y. Zhu, K. S. Ling, and D. Gonsalves.** 2000. The 5'sequence of grapevine leafroll associated closterovirus-2 genome, p. 28-29. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

612. **Meng, B., R. Johnson, S. Peressini, P. L. Forsline, and D. Gonsalves.** 1999. Rupestris stem pitting associated virus-1 is consistently detected in grapevines that are infected with rupestris stem pitting. European Journal of Plant Pathology **105**:191-199.

613. **Meng, B., H. Y. Zhu, and D. Gonsalves.** 1999. Rupestris stem pitting associated virus-1 consists of a family of sequence variants. Archives of Virology **144**:2071-2085.

614. **Meng, B.Z. and D. Gonsalves.** 2003. *Rupestris stem pitting associated virus* of grapevines: genome structure, genetic diversity, detection, and phylogenetic relationship to other plant viruses. Current Topics in Virology **3**:125-135.

615. **Meng, B.Z., S. Z. Pang, P. L. Forsline, J. R. Mcferson, and D. Gonsalves.** 1998. Nucleotide sequence and genome structure of grapevine rupestris stem pitting associated virus-1 reveal similarities to apple stem pitting virus. Journal of General Virology **79**:2059-2069.

616. **Milkus, B. and L. Konup.** 2004. Phytosanitary selection in Ukraine, p. 64. *In* II Balkan Symposium of Viticulture and Enology - Symposium Proceedings. Institute of viticullture and enology, Pleven, Bulgaria.

617. **Milkus, B.N.** 2000. Incidence of nepoviruses in Missouri vineyards, p. 77. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

618. **Milkus, B.N.** 2001. Incidence of four NEPO viruses in Missouri vineyards. American Journal of Enology and Viticulture **52**:56-57.

619. **Milkus, B.N., J. D. Avery, and V. N. Pinska.** 2000. Elimination of grapevine viruses by heat treatment and meristem shoot tip culture, p. 174. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. Univesity of Adelaide, Adelaide, Australia.

620. **Milkus, B.N. and R. N. Goodman.** 1999. A survey of Missouri vineyards for the presence of five grape viruses. American Journal of Enology and Viticulture **50**:133-134.

621. **Milkus, B.N., R. N. Goodman, and J. D. Avery.** 2000. Detection of viruses in grapevines imported in Missouri from Eastern European countries. Phytopathologia mediterranea **39**:310-312.

622. **Minafra, A.** 2000. Rugose wood of grapevines, p. 30-34. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

623. **Minafra, A., N. Boonham, P. Saldarelli, M. Digiaro, P. La Notte, and I. Barker.** 2003. Toward a multiplex and generic detection of phloem-limited grapevine viruses: application of oligonucleotide array and PCR- hybridization, p. 201-202. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

624. **Minafra, A. and D. Boscia.** 2003. An overview of rugose wood-associated viruses: 2000-2003, p. 116-119. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

625. **Minafra, A., P. Casati, V. Elicio, A. Rowhani, P. Saldarelli, V. Savino, and G. P. Martelli.** 2000. Serological detection of Grapevine rupestris stem pitting- associated virus (GRSPaV) by a polyclonal antiserum to recombinant virus coat protein. Vitis **39**:115-118.

626. **Minafra, A., R. Gölles, A. da Camara Machado, P. Saldarelli, N. Buzkan, V. Savino, G. P. Martelli, H. Katinger, and M. Laimer da Camara Machado.** 1998. Expression of the coat protein genes of grapevine virus A and B in *Nicotiana* species and evaluation of the resistance conferred on transgenic plants. Journal of Plant Pathology **80**:197-202.

627. **Minafra, A., P. La Notte, P. Saldarelli, M. Digiaro, and G. P. Martelli.** 1999. Use of spot-PCR for the detection of grapevine phloem-limited viruses. Petria **9**:179-182.

628. **Minafra, A., P. Saldarelli, A. Rowhani, R. H. Symons, N. Habili, P. Gugerli, G. Nolasco, R. Johnson, H. H. Kassemeyer, T. Wetzel, U. Ipach, J. Monis, C. Greif, M. Kölber, and M. Digiaro.** 2000. Ring-test for the harmonization of molecular detection of some grapevine phloem-limited viruses: preliminary results, p. 145. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

629. **Mliki, A., B. Bouamama, R. Jardak, G. Reustle, and A. Ghorbel.** 2000. Regeneration and genetic transformation of Tunisian grapevines using protoplasts and somatic embryos, p. 59. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

630. **Monier, C., P. Barbier, and B. Walter.** 2000. Protection against grapevine fanleaf virus in transgenic tobacco containing non-translatable sequences. Acta Horticulturae (528):379-383.

631. **Monis, J.** 2000. Development of monoclonal antibodies reactive to a new grapevine leafroll-associated closterovirus. Plant Disease **84**:858-862.

632. **Monis, J., A. H. Lammers, and X. Good.** 1999. Improved sensitivity for the detection of grapevine associated viruses. American Journal of Enology and Viticulture **50**:377-378.

633. **Moreira, A.E., J. O. Gaspar, L. E. A. Camargo, and H. Kuniyuki.** 2004. Caracterização do gene da protein capsidial de dois isolados, patologicamente distintos e serologicamente semelhantes, do *Grapevine virus B* em videiras no Estado de São Paulo (Characterization of the capsid protein gene of two isolates, pathologically distinct and serologically similar, of GVB in grapevines in the State of São Paulo*)*. Fitopatologia Brasileira **29**:75-78.

634. **Moreira, A.E., J. O. Gaspar, L. E. A. Camargo, and H. Kuniyuki.** 2004. Caracterização do gene da proteina capsidial do *Grapevine virus A* em videiras afetadas pela acanaladura do lenho de Kober no Estado de São Paulo (Characterization of the coat protein gene of GVA from Kober stem grooving-affected grapevines in the State of São Paulo). Fitopatologia Brasileira **29**:205-208.

635. **Moretti, G. and F. Anaclerio.** 2000. Influenza del trattamento con acqua calda su talee di alcuni vitigni (*Vitis vinifera* L.). I. Indicazioni preliminari (Influence of hot-water treatments on some grapevine cuttings (*Vitis vinifera* L.). I. First results). Vignevini **27**(7/8):88-94.

636. **Moretti, G., F. Anaclerio, M. Gardiman, and L. Lovat.** 2002. Trattamento con acqua calda su legno di marze e su radici di barbatelle innestate di alcuni vitigni (*Vitis vinifera* L.). II. Effetti sull'innesto e sulla ripresa delle barbatelle (Hot-water treatment on dormant wood (scions) and roots of grafted vines. II. Influence on graft and grafted vine recovery in the vineyard). Vignevini **29**(9):84-91.

637. **Mori, N., A. Bressan, M. Martini, M. Guadagnini, V. Girolami, and A. Bertaccini.** 2002. Experimental transmission by *Scaphoideus titanus* Ball of two Flavescence dorée-type phytoplasmas. Vitis **41**:99-102.

638. **Mori, N., V. Girolami, G. Posenato, L. Tosi, and P. Sancassani.** 1999. Insetticidi per il controllo delle cicaline nei vigneti (Insecticides for the control of leafhoppers in vineyards). L'Informatore agrario **55**(24):93-97.

639. **Mori, N., M. Martini, A. Bressan, M. Guadagnini, V. Girolami, and A. Bertaccini.** 2000. Experimental transmission by *Scaphoideus titanus* Ball of two flavescence dorée-type phytoplasmas, p. 107-108. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

640. **Mori, N., M. Martini, V. Malagnini, P. Fontana, A. Bressan, V. Girolami, and A. Bertaccini.** 1999. Vettori dei giallumi della vite: diffusione e strategie di lotta (Vectors of grapevine yellows: diffusion and control strategies). L'Informatore agrario **55**(24):53-56.

641. **Morone, C., M. D'Aquilio, F. Veratti, and C. Marzachi.** 2004. Diagnosi di flavescenza dorata: sintomi ed analisi molecolare (Diagnosis of flavescence dorée: symptoms and molecular analysis). Informatore Fitopatologico **54**(4):20-24.

642. **Morone, C., P. Gotta, and G. Boccardo.** 2000. Sintomi di fitoplasmi in vitigni coltivati in Piemonte (Symptoms of phytoplasma disease in grapevines cultivated in Piedmont). L'Informatore agrario **56**(23):69-77.

643. **Morone, C., P. Gotta, and C. Marzachi.** 2001. Riconoscimento dei sintomi di inzio stagione della flavescenza dorata (Recognising early symptoms of flavescence dorée). L'Informatore agrario **57**(17):83-86.

644. **Muljukina, N., M. Tulaeva, and V. Chisnikov.** 2003. Sanitary selection and diagnostics of virus diseases in Ukraine, p. 155. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

645. **Murari, E., S. Sartori, M. Borgo, and A. Bertaccini.** 2000. Verifica molecolare dell'efficacia della termoterapia per eliminare i fitoplasmi dalla vite (Molecular verification of the efficiency of thermotherapy for eliminating phytoplasmas from grapevine). Petria **10**:179-180.

646. **Mutton, P., W. Boccalon, S. Bressan, C. Coassin, M. Colautti, D. Del Cont Bernard, A. Floreani, D. Zucchiatti, F. Pavan, D. Mucignat, C. Frausin, P. Antoniazzi, G. Stefanelli, and A. Villani.** 2002. Legno nero della vite in vigneti di Chardonnay del Friuli-Venezia Giulia (Blackwood of grapevine in vineyards of Chardonnay of Friuli-Venezia Giulia). Informatore Fitopatologico **52(1)**:52-59.

647. **Myrta, A., P. Ermacora, B. Stamo, and R. Osler.** 2003. First report of phytoplasma infections in fruit trees and grapevines in Albania. Journal of Plant Pathology **85**:63-65.

648. **Nakano, M., R. Nakaune, and S. Komazi.** 2003. Mealybug transmission of grapevine viruses in Japan, p. 218. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

649. **Nakaune, R. and M. Nakano.** 2003. RT-PCR diagnosis and diversity of grapevine viruses in Japan, p. 199-200. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

650. **Naraghi-Arani, P., S. Daubert, and A. Rowhani.** 2001. Quasispecies nature of the genome of *Grapevine fanleaf virus*. Journal of General Virology **82**:1791-1795.

651. **Naraghi-Arani, P. and A. Rowhani.** 1999. Analysis of GFLV RNA2 by RFLP analysis of the 1500 bp at the 3' end amplified by RT-PCR. Phytopathology **89** (Supplement):S55.

652. **Naraghi-Arani, P., A. Rowhani, and M. A. Walker.** 1999. Variation in coat protein sequences on passage of grapevine fanleaf virus through different hosts. American Journal of Enology and Viticulture **50**:378.

653. **Naraghi-Arani, P., A. Rowhani, and M. A. Walker.** 2000. RFLP analysis indicates that the genome of grapevine fanleaf virus is complex, p. 151. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

654. **Nassuth, A., E. Pollari, K. Helmeczy, S. Stewart, and S. A. Kofalvi.** 2000. Improved RNA extraction and one-tube RT-PCR assay for simultaneous detection of control plant RNA plus several viruses in plant extracts. Journal of Virological Methods **90**:37-49.

655. **Nickel, O., T. V. M. Fajardo, F. J. L. Aragão, C. M. Chagas, and G. B. Kuhn.** 2002. Deteccão e caracterização do gene da proteina capsidial de um isolado de *Grapevine virus B* de videiras do

Sul do Brazil com intumecimento dos ramos (Detection and caracterization of the gene of the capsidial protein of an isolate of *Grapevine virus B* from corky bark-affected grapevines in southern Brazil). Fitopatologia Brasileira **27**:279-284.

656. **Nicoli Aldini, R.** 2001. Cicaline della vite e del vigneto in Lombardia (Leafhoppers of grapevine and vineyards in Lombardy). Università Cattolica del Sacro Cuore, Milano, Italy.

657. **Nicoli Aldini, R., M. Ciampitti, and P. Cravedi.** 2003. Monitoring the leafhopper *Scaphoideus titanus* Ball and the planthopper *Hyalesthes obsoletus* Signoret in northern Italy. IOBC/wprs Bulletin **26**(8):233-236.

658. **Nicoli Aldini, R., M. C. Guardiani, and P. Cravedi.** 1998. Rilievi faunistici sugli Omotteri Auchenorrinchi in vigneti della provincia di Piacenza (Faunistic notes on the hoppers [Auchenorrhyncha, Homoptera] in vineyards of the province of Piacenza). Bolletino di Zoologia Agraria e di Bachicoltura **30**(1):61-68.

659. **Nishijima, T., Y. Terai, and Y. Kunugi.** 2000. Studies on the grapevine berry inner necrosis virus disease. 1.Symptoms on vines, varietal susceptibility and natural spread. Bulletin of the Yamanashi Fruit Tree Experiment Station **67**(10):47-56.

660. **Niu, J.X., P. Chen, and B. G. Ma.** 2004. [Studies on multiple RT-PCR detection technology of viral disease in grapevine]. Journal of Fruit Science **21**(2):120-123.

661. **Nolasco, G.** 2003. Diagnosis: recent developments and routine implementations, p. 184-187. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

662. **Nolasco, G.** 2004. Towards an integrated diagnosis of filamentous viruses affecting grapevine. Acta Horticulturae (652):377-382.

663. **Nolasco, G., A. Mansinho, M. T. Santos, C. Soares, Z. Sequeira, P. K. Correia, and O. A. Sequeira.** 2000. Performance of different primers in large scale detection of rupestris stem pitting associated virus 1, p. 127-128. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

664. **Nolasco, G., A. Mansinho, M. T. Santos, C. Soares, Z. Sequeira, C. Sequeira, P. K. Correia, and O. A. Sequeira.** 2000. Large scale evaluation of primers for diagnosis of rupestris stem pitting associated virus-1. European Journal of Plant Pathology **106**:311-318.

665. **Nolasco, G., Z. Sequeira, C. Soares, A. Mansinho, A. M. Bayley, and C. L. Nibblett.** 2002. Asymmetric PCR-ELISA: Increased sensitivity and reduced costs for the detection of plant viruses. European Journal of Plant Pathology **108**:293-298.

666. **Nölke, G., M. Orecchia, P. Cobanov, R. Fischer, and S. Schillberg.** 2003. Isolation and characterization of monoclonal antibodies and single chain antibody fragments specific to grapevine viruses, p. 190. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

667. **Nölke, G., M. Orecchia, P. Saldarelli, M. Dell'Orco, A. Minafra, G. P. Martelli, R. Fischer, and S. Schillberg.** 2003. Antibody-based resistance in grapevine: generation, characterization and expression of single chain antibody fragments specific to Grapevine leafroll-associated virus 3, p. 232bis. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

668. **Nusillard, B., J. -C. Malausa, L. Giuge, and P. Millot.** 2003. Assessment of a two years study of the natural enemy fauna of *Scaphoideus titanus* Ball in its north American native area. IOBC/wprs Bulletin **26**(8):237-240.

669. **Obreque, J., A. Minafra, C. Turturo, M. Dell'Orco, P. Saldarelli, D. Diaz, J. Vera, M. Jashes, H. Peña-Cortes, and G. P. Martelli.** 2003. Preliminary evidence of the presence of defective interfering RNAs in vitivirus-infected *Nicotiana* plants, p. 122-123. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

670. **Oosthuizen, W.T. and N. van Rensburg.** 2003. South African Vine Improvement Association (VIA) and the South African Certification Scheme, p. 153. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

671. **Orenstein, S., T. Zahavi, D. Nestel, R. Sharon, M. Barkalifa, and P. G. Weintraub.** 2003. Spatial dispersion patterns of potential leafhopper and planthopper (Homoptera) vectors of phytoplasmas in wine vineyards. Annals of applied Biology **142**:341-348.

672. **Orenstein, S., T. Zahavi, and P. Weintraub.** 2001. Distribution of phytoplasma in grapevines in the Golan Heights, Israel, and development of a new universal primer. Vitis **40**:219-223.

674. **Ortez, A., C. Frausin, and A. Prezza.** 2000. Il programma regionale pluriennale "Flavescenza dorata della vite"(The long-term regional programme "Flavescence dorée of grapevine", p. 9-11. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia.I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999.(Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia, 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

675. **Osler, R.** 2001. Ruolo del materiale di moltiplicazione della vite nella trasmissione dei giallumi (GY). Atti Giornata di Studio sui Giallumi della vite, Legnaro (Padova), 7th June 2001.

676. **Osler, R., L. Carraro, P. Ermacora, F. Ferrini, N. Loi, A. Loschi, M. Martini, P. B. Mutton, and E. Refatti.** 2003. Roguing: a controversial practice to eradicate grape yellows caused by phytoplasmas, p. 68. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

677. **Osler, R. and C. Frausin.** 2000. Conclusi generali (General conclusions), p. 91-92. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

678. **Osler, R. and E. Refatti.** 2002. Malattie da fitoplasmi della vite. Situazione nell'Italia settentrionale (Phytoplasma diseases of grapevine. Situation in northern Italy). Informatore Fitopatologico **52**(10):42-48.

679. **Osler, R., C. Zuchetto, L. Carraro, C. Frausin, F. Pavan, G. Vettorello, and V. Girolami.** 2002. Trasmissione di Flavescenza dorata e Legno nero e comportamento delle viti infette (Transmission of flavescence dorée and bois noir and performance of infected vines). L'Informatore agrario **58**(19):61-65.

680. **Osti, M. and E. Triolo.** 1999. Focolai di legno nero della vite in Toscana (Foci of black wood of grapevine in Tuscany). L'Informatore agrario **55**(18):77-78.

681. **Osti, M., E. Triolo, A. Lucchi, and L. Santini.** 2000. La flavescenza dorata nelle Cinque Terre (Flavescence dorée in the Cinque Terre region). L'Informatore agrario **56**(10):89-91.

682. **Padilla, V., I. Hita, B. Garcia, F. Benayas, and L. Velasco.** 2003. Grapevine insidious viruses in Spanish viticulture, p. 173. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

683. **Palermo, S., M. Elekes, S. Botti, I. Ember, A. Alma, A. Orosz, A. Bertaccini, and M. Kölber.** 2004. Presence of stolbur phytoplasmas in Cixiidae in Hungarian vineyards. Vitis **43**:201-203.

684. **Palermo, S., R. Tedeschi, C. Marzachi, and A. Alma.** 2003. Quick and reliable methods to detect flavescence dorée and bois noir phytoplasmas in field collected insect vectors, p. 111-112. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

685. **Panattoni, A., C. D'Anna, C. D'Onofrio, G. Scalabrelli, and E. Triolo.** 2004. On the morphology of *in vivo* and *in vitro*-grown, virus infected Kober 5BB. Journal of Plant Pathology **86** (Special issue):327-328.

686. **Panattoni, A. and E. Triolo.** 2003. Effect of antiviral drugs in *Vitis vinifera* infected plants, p. 244. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

687. **Paradies, F., M. Finetti Sialer, D. Gallitelli, M. A. Castellano, A. Di Franco, M. Digiaro, G. P. Martelli, and M. A. Yilmaz.** 2000. Partial characterization of *cucumber mosaic virus* isolates from citrus and grapevine. Journal of Plant Pathology **82**:133-145.

688. **Pavan, F. and G. Stefanelli.** 2000. Strategie di lotta contro *Scaphoideus titanus* e *Hyalesthes obsoletus* vettori di fitoplasmi associati ai giallumi della vite (Strategy for the control of *Scaphoideus titanus* and *Hyalesthes obsoletus* vectors of phytoplasms associated with grapevine yellows), p. 71-77. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence
dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

689. **Peake, B.K., A. E. Mackie, K. Sivasithamparam, N. Habili, and S. J. McKirdy.** 2004. First report of grapevine leafroll associated virus 9 (GLRaV-9) in Western Australia. Australasian Plant Pathology **33**:445-446.

690. **Petrovic, N., J. Boben, and M. Ravnikar.** 2004. [Laboratory testing of grapevine yellows in Slovenia indicates a widespread presence of Bois noir]. Acta Agriculturae Slovenica **83**:313-321.

691. **Petrovic, N., N. Jerai, and M. Ravnikar.** 2001. [The use of tissue culture for improved detection of phtoplasmas in grapevines], p. 489-492. *In* Proceedings of the 5th Slovenian Conference on Plant Protection, Catez ob Savi, Slovenia, 6-8-March 2001. National Institute of Biology, Vecna pot 111, Sl-1000 Ljubljana, Slovenia.

692. **Petrovic, N., N. Jeraj, and M. Ravnikar.** 2000. The use of tissue culture for improved detection of phytoplasma in grapevine, p. 119-120. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

693. **Petrovic, N., B. Meng, M. Ravnikar, I. Mavric, and D. Gonsalves.** 2001. First detection of Rupestris stem pitting associated virus particles in grapevine using the antibody to the recombinant coat protein. Phytopathology **92**:S71.

694. **Petrovic, N., B. Meng, M. Ravnikar, I. Mavric, and D. Gonsalves.** 2003. First detection of *Rupestris stem pitting associated virus* particles by antibody to a recombinant coat protein. Plant Disease **87**:510-514.

695. **Petrovic, N., B. Z. Meng, M. Ravnikar, I. Mavric, and D. Gonsalves.** 2003. First detection of *Rupestris stem pitting-associated virus* particles by antibody to a recombinant coat protein, p. 128-129. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

696. **Petrovic, N., B. Penev, T. Krastanova, B. Z. Meng, and D. Gonsalves.** 2000. Distribution of rupestris stem pitting associated virus in greenhouse and field grown *Vitis rupestris* St.George, p. 35-36. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

697. **Petrovic, N., G. Seljak, G. Matis, J. Miklavc, K. Beber, J. Boben, and M. Ravnikar.** 2003. The presence of grapevine yellows and their potential natural vectors in wine-growing regions of Slovenia, p. 97-98. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

698. **Petrovic, N., P. Soster, Z. Korosec-Koruza, M. Ravnikar, B. Meng, and D. Gonsalves.** 2000. First results on the use of laboratory methods for detection of rupestris stem pitting associated

virus 1 in grapevines in Slovenia, p. 137. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

699. **Petrovic, N., P. Soster, Z. Korosec-Koruza, M. Ravnikar, B. Z. Meng, and D. Gonsalves.** 2001. [First results on the use of laboratory methods for detection of rupestris stem pitting associated virus 1 in grapevines in Slovenia], p. 468-472. *In* Proceeding of the 5th Slovenian Conference on Plant Protection. Catez ob Savi, Slovenia, 6-8-March 2001. National Institute of Biology, Vecna pot 111, Sl-1000 Ljubljana, Slovenia.

700. **Pfeiffer, P., C. Ritzenthaler, F. Gaire, C. Schmitt, O. Rohfritsch, C. Laporte, L. Pinck, and C. Stussi-Garaud.** 2000. Generation of the viral replication compartment in cells infected with grapevine fanleaf virus, p. 63-64. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

701. **Pfeiffer, P., C. Ritzenthaler, C. Laporte, R. El Amawi, A. Tarasov, and C. Stussi-Garaud.** 2003. Shedding new light on *grapevine fanleaf virus* replication, p. 11. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology,University, Bari (Italy).

702. **Pietersen, G., U. Kellerman, W. T. Oosthuizen, and N. Spreeth.** 2003. Effect of roguing on natural spread of grapevine leafroll disease in two vineyards in South Africa, p. 301. *In* 8th International Congress of Plant Pathology, 2-7 February 2003, Christchurch, New Zealand, vol.2.

703. **Pinck, L.** 2000. The grapevine fanleaf nepovirus challenge: where do we stand? p. 60-62. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

704. **Pio Ribeiro, G., P. Saldarelli, N. Hong, B. Ch. Xiang, X. L. Zhang, G. P. Wang, and G. P. Martelli.** 2004. First record of three grapevine viruses in the Chinese Province of Sinkiang. Journal of Plant Pathology **86**:263-264.

705. **Poljuha, D., B. Sladonja, and D. Persuric.** 2004. Survey of five indigenous Istrian cultivars for the presence of six grape viruses. American Journal of Enology and Viticulture **55**:286-287.

706. **Ponti, I. and G. Zuppiroli.** 2001. Le misure di lota obbligatoria (Compulsory control measures), p. 77-79. *In* F. Pasini (ed.), Le Emergenze Fitosanitarie della Vite. Notiziario tecnico N.63. Centro Ricerche Produzioni Vegetali, CRPV, Faenza, Italy.

707. **Popescu, C.F., E. Buciumeanu, and E. Visoiu.** 2003. Somatic embryogenesis, a reliable method for *Grapevine fleck virus* free grapevine regeneration, p. 243. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

708. **Posenato, G., N. Mori, A. Bressan, V. Girolami, and G. P. Sancassani.** 2001. *Scaphoideus titanus* vettore della flavescenza dorata: conoscerlo per combatterlo (*Scaphoideus titanus*, vector of flavescence dorée: one has to know it in order to control it). L'Informatore agrario **57**(15):91-93.

709. **Possingham, J.V.** 1998. Varieties and clones used in Australian wine-grape vineyards. Acta Horticulturae (473):17-23.

710. **Pourrahim, R., A. Ahoonmanesh, S. Farzadfar, F. Rakhshandehro, and A. R. Golnaraghi.** 2004. Occurrence of arabis mosaic virus and grapevine leafroll associated virus-3 on grapevines in Iran. Plant Disease **88**:424.

711. **Pourrahim, R., F. Rakhshandehro, S. Farzadfar, and A. R. Golnaraghi.** 2004. Natural occurrence of tomato ringspot virus on grapevine in Iran. Plant Pathology **53**:237.

712. **Prodan, S., J. Montealegre, E. Aballay, A. M. Pino, P. Fernandez, R. Reyes, and N. Fiore.** 2003.Report of new viral diseases in Chilean grapevines, p. 145. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

713. **Prodan, S., J. Montealegre, and N. Fiore.** 2003. Aetiology of decline in Thompson seedless grafted table grape plants, p. 142-143. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

714. **Quartau, J.A., J. M. Guimarães, and G. André.** 2001. On the occurrence in Portugal of the nearctic *Scaphoideus titanus* Ball (Homoptera, Cicadellidae), the natural vector of the grapevine "Flavescence dorée" (FD). IOBC/wprs Bulletin **24**(7):273-276.

715. **Radian-Sade, S., A. Perl, O. Edelbaum, L. Kuznetsova, R. Gafny, I. Sela, and E. Tanne.** 2000. Transgenic *Nicotiana benthamiana* and grapevine plants transformed with grapevine virus A (GVA) sequences. Phytoparasitica **28**:79-86.

716. **Raifer, B.** 1999. Auftreten der Vergilbungskrankheit des Typs "Schwarzholz" an Reben in Südtirol (Occurrence of yellows of the "bois noir" type in grapevines in South Tyrol). Obstbau-Weinbau **36**:236-237.

717. **Refatti, E., L. Carraro, and R. Osler.** 2000. I giallumi della vite (Grapevine yellows), p. 13-21. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

718. **Refatti, E., L. Carraro, R. Osler, N. Loi, and F. Pavan.** 1998. Presenza di differenti tipi di giallumi della vite nell'Italia nord-orientale (Occurrence of different types of yellows diseases of grapevine in northeastern Italy). Petria **8**:85-97.

719. **Regner, F., R. Hack, H. Gangl, G. Leitner, K. Mandl, and W. Tiefenbrunner.** 2004. Genetic variability and incidence of systemic diseases in wild vines (*Vitis vinifera* ssp. *silvestris*) along the Danube. Vitis **43**:123-130.

720. **Regner, F., A. Stadlbauer, and C. Eisenheld.** 2000. Broad-range detection of different strawberry latent ring spot virus-isolates by immuno capture-PCR. Mitteilungen Klosterneuburg **50**:183-191.

721. **Reinert, W.** 1999. Detektion und Differenzierung rebpathogener Phytoplasmen (Mollicutes, Eubacteria) in Deutschland unter Berücksichtigung phytopathologischer Aspekte (Detection and differentiation of grape pathogen phytoplasmas (Mollicutes, Eubacteria) in Germany, considering phytopathogenic aspects). PhD thesis, Technische Universität Darmstadt (Germany).

722. **Reinert, W. and M. Maixner.** 1998. Die Thermotherapie als Mittel zur Heilung phytoplasmenverseuchten Vermehrsgut (Hot-water treatment as a curative measure for phytoplasma-infected propagation material). Viticultural and Enological Science **53**:107-113.

723. **Reinert, W. and M. Maixner.** 2000. Distribution and differentiation of grapevine phytoplasmas in Germany, p. 96-98. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

724. **Renault-Spilmont, A.S., S. Grenan, and D. Boubals.** 2003. Le dépérissement de la Syrah (Syrah decline). Progrès Agricole et Viticole **120**:247-252.

725. **Renault-Spilmont, A.S., S. Grenan, and J. M. Boursiquot.** 2003. Syrah decline in French vineyards, p. 144. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

726. **Renault-Spilmont, A.S., S. Grenan, and J. M. Boursiquot.** 2004. Le dépérissement de la Syrah. Compte rendu de la réunion du Groupe de Travail - 23 avril 2004 (Syrah dieback. Report on the meeting of the workshop - 23rd April 2004). Progrès Agricole et Viticole **121**:327-341.

727. **Reustle, G.M., R. Jardak-Jamoussi, R. Ebel, C. Burkhart, M. Becker, R. Wolf, T. Manthey, A. Bassler, T. Wetzel, A. Ghorbel, and G. Krczal.** 2003. Induction of silencing in transgenic tobacco (*N.benthamiana*) and grapevine (*Vitis* spp) plants, p. 228. *In* Extended abstracts 14th

Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

728. **Ritzenthaler, C., C. Laporte, F. Gaire, P. Dunoyer, C. Schmitt, S. Duval, A. Piéquet, A. M. Loudes, O. Rohfritsch, C. Stussi-Garaud, and P. Pfeiffer.** 2002. Grapevine fanleaf virus replication occurs on endoplasmic reticulum-derived membranes. Journal of Virology **76**:8808-8819.

729. **Romanazzi, G., S. Murolo, P. La Notte, S. Virgili, M. B. Branzanti, O. Silvestroni, and V. Savino.** 2003. Clonal and sanitary selection of the grapevine in the Marche, central-eastern Italy, p. 176-177. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

730. **Routh, G., Y. P. Zhang, P. Saldarelli, and A. Rowhani.** 1998. Use of degenerate primers for partial sequencing and RT-PCR-based assays of grapevine leafroll-associated viruses 4 and 5. Phytopathology **88**:1238-1243.

731. **Rowhani, A., L. Biardi, R. Johnson, P. Saldarelli, Y. P. Zhang, J. Chin, and M. Green.** 2000. Simplified sample preparation method and one-tube RT-PCR for grapevine viruses, p. 148. *In* R. H. Symons (ed.), Extended astracts 13 Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

732. **Rowhani, A., L. Biardi, G. Routh, S. Daubert, and D. Golino.** 1998. Development of a sensitive colorimetric-PCR assay for detection of viruses of woody plants. Plant Disease **82**:880-884.

733 **Rowhani, A., J. Chin, Y. P. Zhang, L. Biardi, and D. A. Golino.** 1999. Simplified extraction method for sample preparation for PCR and development of a colorimetric detection technique for analysis of PCR products of virus-infected grapevines. American Journal of Enology and Viticulture **50**:374.

734. **Rowhani, A., W. Grzegorczyk, and D. A. Golino.** 1999. Use of meristem culture for the elimination of Rupestris stem pitting associated virus. American Journal of Enology and Viticulture **50**:376-377.

735. **Rowhani, A., F. Osman, and D. A. Golino.** 2003. Development of a detection and quantification TaqMan assay method for grapevine viruses using real time one-step RT-PCR, p. 194. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

736. **Rowhani, A., Y. P. Zhang, J. Chin, A. Minafra, D. A. Golino, and J. K. Uyemoto.** 2000. Grapevine rupestris stem pitting associated virus: population diversity, titer in the host and possible transmission vector, p. 37. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

737. **Rowhani, A., Y. P. Zhang, and D. A. Golino.** 2002. Isolation and characterization of a new closterovirus from grapevine. Phytopathology **92** (Supplement):S71.

738. **Rowhani, A., Y. P. Zhang, D. A. Golino, and J. K. Uyemoto.** 1999. Diversity among different isolates of rupestris stem pitting associated virus. Phytopathology **89**:S66.

739. **Rowhani, A., Y. P. Zhang, D. A. Golino, and J. K. Uyemoto.** 2000. Isolation and partial characterization of two new viruses from grapevine, p. 82. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

740. **Roy, A.S.** 2003. EPPO certification scheme for grapevine, p. 149. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

741. **Rumbos, I.C., A. Avgelis, and A. I. Rumbou.** 2000. Certification scheme for production of virus-free grape propagation material in Greece, p. 156-157. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

742. **Rumbos, I.C., A. T. Sourri, A. I. Rumbou, and A. Chatzki.** 2003. Sanitary improvement of grapevine in Greece: creation of a genetic bank of Greek varieties *in vitro*, p. 159-160. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

743. **Rühl, E.H., H. Konrad, B. Lindner, and E. Bleser.** 2004. Quality criteria and targets for clonal selection in grapevine. Acta Horticulturae (652):29-33.

744. **Sabanadzovic, S., N. Abou Ghanem-Sabanadzovic, and G. P. Martelli.** 2003. 3'end-proximal genome organization of the three *grapevine fleck virus*-like viruses, p. 23. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

745. **Sabanadzovic, S., N. Abou Ghanem-Sabanadzovic, and A. Rowhani.** 2004. Detection and identification of a new marafivirus from grapevine. Phytopathology **94** (Supplement):S90.

746. **Sabanadzovic, S., N. Abou Ghanem-Sabanadzovic, P. Saldarelli, and G. P. Martelli.** 2001. Complete nucleotide sequence and genome organization of Grapevine fleck virus. Journal of General Virology **82**:2009-2015.

747. **Sabanadzovic, S., N. Abou-Ghanem, M. A. Castellano, M. Digiaro, and G. P. Martelli.** 2000. Grapevine fleck virus-like viruses in *Vitis*. Archives of Virology **145**:553-565.

748. **Sabanadzovic, S., N. Abou-Ghanem, M. A. Castellano, M. Digiaro, and G. P. Martelli.** 2000. Grapevines host a family of grapevine fleck virus-like viruses, p. 68-69. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

749. **Sabanadzovic, S., N. Abou-Ghanem, and A. Rowhani.** 2000. Molecular characterization of a new virus from grapevine. Phytopathology **90** (Supplement):S88.

750. **Sabanadzovic, S., N. Abou-Ghanem, P. Saldarelli, and G. P. Martelli.** 2000. Grapevine fleck virus as a possible type species of a possible new genus of plant viruses, p. 70. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide,Australia.

751. **Sabaté, J., A. Laviña, and A. Batlle.** 2003. Potential vectors of grapevine Bois noir phytoplasmas in Spain and evaluation of their transmission capacity, p. 113. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

752. **Saldarelli, P., M. Dell'Orco, and A. Minafra.** 2000. Infectious cDNA clones and transcripts of grapevine virus A and B, p. 39. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

753. **Saldarelli, P., M. Dell'Orco, and A. Minafra.** 2000. Infectious cDNA clones of two grapevine viruses. Archives of Virology **145**:397-405.

754. **Saldarelli, P., M. Dell'Orco, A. Minafra, D. Boscia, and D. Gallitelli.** 2000. Epitope mapping of the coat protein of two grapevine viruses, p. 133. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

755. **Saldarelli, P. and A. Minafra.** 2000. Immunodetection of the 20 kDa protein encoded by ORF 2 of *grapevine virus B*. Journal of Plant Pathology **82**:157-158.

756. **Saldarelli, P., A. Minafra, M. A. Castellano, and G. P. Martelli.** 2000. Immunodetection and subcellular localization of the proteins encoded by ORF 3 of grapevine viruses A and B. Archives of Virology **145**:1535-1542.

757. **Saldarelli, P., A. Minafra, M. A. Castellano, and G. P. Martelli.** 2000. Intracellular localization of putative movement proteins of grapevine viruses A and B, p. 40. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

758. **Saldarelli, P., A. Rowhani, G. Routh, A. Minafra, and M. Digiaro.** 1998. Use of degenerate primers in a RT-PCR assay for the identification and analysis of some filamentous viruses, with special reference to clostero- and vitiviruses of the grapevine. European Journal of Plant Pathology **104**:945-950.

759. **Salehi, M., K. Izadpanah, and A. A. Behjatnia.** 2000. Detection of phytoplasmas from Iran using polymerase chain reaction. Iranian Journal of Plant Pathology **36**(3/4):106-107.

760. **Sancassani, G.P., A. Bertaccini, M. Borgo, V. Girolami, and N. Mori.** 2004. Evoluzione della flavescenza dorata in Veneto (Evolution of flavescence dorée in Venetia), p. 1-9. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

761. **Sancassani, G.P. and G. Granata.** 2002. Interventi di difesa contro la flavescenza dorata della vite ed altri giallumi (Control of flavescence dorée and other grapevine yellows diseases). Informatore Fitopatologico **52**(10):53-56.

762. **Sancassani, G.P., E. Murari, M. Borgo, and F. Dal Molin.** 1999. Interventi per contenere la flavescenza dorata nel Veneto (Interventions for controlling flavescence dorée in Veneto). L'Informatore agrario **55**(24):41-44.

763. **Sano, T., T. Kobayashi, A. Ishiguro, and Y. Motomura.** 2000. Two types of grapevine yellow speckle viroid 1 isolated from commercial grapevine had the nucleotide sequence of yellow speckle symptom-inducing type. Journal of General Plant Pathology **66**:68-70.

764. **Sano, T., R. Mimura, and K. Ohshima.** 2001. Phylogenetic analysis of hop and grapevine isolates of hop stunt viroid supports a grapevine origin for hop stunt disease. Virus Genes **22**:53-59.

765. **Santinelli, C., M. Santoni, P. Braccini, S. Botti, and A. Bertaccini.** 2003. Trovato in Umbria *Scaphoideus titanus*, vettore della flavescenza dorata (*Scaphoideus titanus*, vector of flavescence dorée, has been found in Umbria). L'Informatore agrario **59**(15):81-82.

766. **Santini, L. and A. Lucchi.** 1998. Presenza in Toscana del ciccadellide *Scaphoideus titanus* (Presence in Tuscany of the cicadellid *Scaphoideus titanus*). L'Informatore agrario **54**(49):73-74.

767. **Santos, C., M. Santos, J. Reis, A. Perreira, I. Cortês, O. Sequeira, and O. Nolasco.** 2001. RT-PCR survey of grapevine viruses in Portugal, p. 10-12. *In* Proceedings 11th Congress of the Mediterranean Phytopathological Union.

768. **Santos, C., M. T. Santos, I. Cortêz, J. Boben, N. Petrovic, A. N. Pereira, O. A. Sequeira, and G. Nolasco.** 2003. Analysis of the genomic variability and design of an asymmetric PCR ELISA assay for the broad detection of *Grapevine stem pitting-associated virus*, p. 126-127. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Pathology and Applied Microbiology, University, Bari (Italy).

769. **Santos, C., M. T. Santos, A. N. Pereira, I. Cortêz, O. A. Sequeira, and G. Nolasco.** 2003. Survey of filamentous viruses in Portuguese vineyards, p. 167-168. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

770. **Santos, M.T., J. Cunha, J. E. J. Eiras-Dias, C. Santos, and G. Nolasco.** 2003. Detection of grapevine viruses by RT-PCR from dsRNA templates in three natural occurring Portuguese populations of *Vitis vinfera* ssp *sylvestris* (Gmeli) Hegi, p. 197-198. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

771. **Santos, M.T., A. Mansinho, P. K. Correia, O. A. Sequeira, and G. Nolasco.** 2000. Multiple detection of grapevine filamentous viruses in Portugal, by RT-PCR from DS-RNA templates, p. 129. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

772. **Santos, M.T., M. L. G. Rocha, J. M. S. Martins, and L. C. Carneiro.** 2003. Effect of *Grapevine fanleaf virus, Grapevine leafroll- associated virus 3* and *Grapevine fleck virus* on leaf morphology

of the Portuguese white variety Arinto by multivariate discriminant analysis, p. 21-22. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

773. **Savino, V., P. La Notte, G. Bottalico, A. Cardone, and G. P. Martelli.** 2001. Situazione sanitaria della vite in Italia centro-meridionale (Sanitary situation of grapevine in central and southern Italy). Quad. Vitic. Enol. Univ. Torino **25**:67-76.

774. **Scagliusi, S.M.M., J. Vega, and H. Kuniyuki.** 2002. Cytopathology of callus cells infected with *grapevine leafroll- associated virus 3*. Fitopatologia Brasileira **27**:384-388.

775. **Scalabrelli, G., G. Ferroni, C. D'Onofrio, M. Borgo, D. Porro, and M. Stefanini.** 2003. Clonal selection of Vermentino grapevine variety in the Tuscan coastal area. Acta Horticulturae (603):641-649.

776. **Scapin, I.** 2004. Il decreto di lotta obligatoria alla flavescenza dorata della vite: luci ed ombre (The decree of compulsory control of flavescence dorée of grapevine: light and shadow), p. 1-5. *In* La Vite - Convegno Nazionale, Torino (Italy), 2-3.12.2004.

777. **Scattini, G., P. A. Bianco, P. Casati, and G. Belli.** 2000. Gravi manifestazioni di Flavescenza dorata su "Sangiovese" in vigneti della Valtenesi (Lombardia) (Severe syptoms of flavescence dorée on "Sangiovese" in vineyards of Lombardia). Vignevini **27**(9):104-108.

778. **Scattini, G., A. Zorloni, and P. A. Bianco.** 2002. Risposte sintomatologiche ai giallumi delle diverse cultivar di vite in Lombardia (Symptoms of yellows on various cultivars of grapevine in Lombardy). Petria **12**:455-456.

779. **Schilder, A.M.C., J. M. Gillett, J. M. Byrne, and T. J. Zabadal.** 2003. First report of *Tobacco ringspot virus* in table grapes in Michigan. Plant Disease **87**:1149.

780. **Schmid, A. and S. Emery.** 2001. La maladie du bois noir dans le vignoble valaisan (Blackwood disease in the vineyard of Valais, Switzerland). IOBC/wprs Bulletin **24**(7):287-289.

781. **Schneider, B., K. S. Gibb, A. Padovan, R. I. Davis, and S. De La Rue.** 1999. Comparison and characterization of tomato big bud- and sweet potato little leaf-group phytoplasmas. Journal of Phytopathology **147**:31-40.

782. **Schneider, B., A. Padovan, S. De La Rue, R. Eichner, R. Davis, A. Bernuetz, and K. Gibb.** 1999. Detection and differentiation of phytoplasmas in Australia: an update. Australian Journal of Agricultural Research **50**:333-342.

783. **Seddas, A., M. M. Haidar, C. Greif, C. Jacquet, G. Cloquemin, and B. Walter.** 2000. Establishment of a relationship between grapevine leafroll closteroviruses 1 and 3 by use of monoclonal antibodies. Plant Pathology **49**:80-85.

784. **Seddas, A., G. Zeder-Lutz, B. Walter, C. Schwartz, and M. H. V. Van Regenmortel.** 2003. Use of biosensor technology (Biacore) in the production of monoclonal antibodies to grapevine viruses, p. 188-189. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

785. **Seemüller, E., C. Marcone, U. Lauer, A. Ragozzino, and M. Göschl.** 1998. Current status of molecular classification of the phytoplasmas. Journal of Plant Pathology **80**:3-26.

786. **Sefc, K.M., W. Leonhardt, and H. Steinkellner.** 2000. Partial sequence identification of grapevine-leafroll-associated virus-1 and development of a highly sensitive IC-RT-PCR detection method. Journal of Virological Methods **86**:101-106.

787. **Sela, I. and E. Tanne.** 2003. A solution to an enigma: why diseased grapevines react with antisera to potyviruses, p. 32. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

788. **Seljak, G.** 2003. Trsne rumenice **(**Bois noir of grapevine**)**. SAD, Revija za Sadjardsvo, Vinogradnistvo i Vinarstvo **14**(7/8):18-21.

789. **Seljak, G. and N. Petrovic.** 2001. **(**An overview on the presence of phytopasma diseases of grapevine and fruit trees in Slovenia**)**. Sodobno Kmetijstvo **34**:466-471.

790. **Seruga, M., M. Curkovic Perica, D. Skoric, B. Kozina, N. Mirosevic, A. Saric, A. Bertaccini, and M. Krajacic.** 2000. Geographical distribution of Bois Noir phytoplasmas infecting grapevines in Croatia. Journal of Phytopathology **148**:239-242.

791. **Seruga, M., D. Skoric, B. Kozina, M. Curkovic Perica, and M. Krajacic.** 2003. A comparison of stolbur phytoplasma isolates from Croatian grapevine by analyses of ribosomal gene regions, p. 96. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

792. **Seruga, M., D. Skoric, B. Kozina, S. Mitrev, M. Krajacik, and M. Curkovic Perica.** 2003. Molecular identification of a phytoplasma infecting grapevine in the Republic of Macedonia. Vitis **42**:181-184.

793. **Sfalanga, A., S. Botti, M. Guadagnini, C. Milano, E. Egger, P. Braccini, and A. Bertaccini.** 2001. Timore per i giallumi della vite in Toscana (Fear of grapevine yellows in Tuscani). Terra e Vita **42**(27):78-80.

794. **Sfalanga, A., P. Braccini, E. Murari, M. Martini, C. Parrini, and A. Bertaccini.** 1999. Presenza di legno nero in viti toscane (Presence of blackwood in vineyards of Tuscany). L'Informatore agrario **55**(11):99-102.

795. **Sforza, R.** 1998. Epidemiologie du Bois noir de la vigne; recherche d'insectes vecteurs et biologie de *Hyalesthes obsoletus* Sign. (Hemiptera: Cixiidae); évolution de la maladie et perspectives de lutte (Epidemiology of grapevine Bois noir. Search for insect vectors and biology of *Hyalesthes obsoletus* Sign.[Hemiptera:Cixiidae]. Evolution of the disease and prospects of control). PhD thesis, University of Paris, France.

796. **Sforza, R.** 2000. Les cochenilles sur la vigne: bio-éthologie, impact écologique, lutte et prophylaxie (Grapevine leafhoppers: bio-ethology, control and prevention), p. 130-147. *In* J. Stockel (ed.), Les ravageurs de la vigne. Editions Féret, Bordeaux (France).

797. **Sforza, R. and E. Boudon-Padieu.** 1998. Le principal vecteur de la maladie du Bois noir (The main vector of Bois noir disease). Phytoma - La Défense des Végétaux (510):33-37.

798. **Sforza, R., E. Boudon-Padieu, and C. Greif.** 2003. New mealybug species vectoring Grapevine leafroll-associated viruses-1 and -3 (GLRaV-1 and -3). European Journal of Plant Pathology **109**:975-981.

799. **Sforza, R. and T. Bourgoin.** 1998. Female genitalia and copulation of the planthopper *Hyalesthes obsoletus* Signoret (Hemiptera: Fulgomorpha: Cixiidae). Annales de la Société Entomologique de France (N. S.) **34**:63-70.

800. **Sforza, R., T. Bourgoin, S. W. Wilson, and E. Boudon-Padieu.** 1999. Field observations, laboratory rearing and description of immatures of the planthopper *Hyalesthes obsoletus* (Hemiptera: Cixiidae). European Journal of Entomology **96**:409-418.

801. **Sforza, R., D. Clair, X. Daire, J. Larrue, and E. Boudon-Padieu.** 1998. The role of *Hyalesthes obsoletus* (Hemiptera: Cixiidae) in the occurrence of bois noir of grapevines in France. Journal of Phytopathology **146**:549-556.

802. **Sforza, R. and C. Greif.** 2000. Les cochenilles et l'enroulement viral de la vigne. Données de phytopathologie et d'éthologie (Mealybugs and grapevine leafroll. Phytopathological and ethological data). Phytoma - La Défense des Végétaux (532):46-49.

803. **Sforza, R., V. Komar, and C. Greif.** 2000. New scale insect vectors of grapevine closteroviruses, p. 14. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

804. **Sharon, R., P. Weintraub, and T. Zahavi.** 2003. Effect of rootstock on grapevine yellows - facts and explanations, p. 73-74. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

805. **Shi, B.J., N. Habili, R. Gafny, and R. H. Symons.** 2004. Extensive variation of sequence within isolates of grapevine virus B. Virus Genes **29**:279-285.

806. **Shi, B.J., N. Habili, and R. H. Symons.** 2000. Grapevine fleck virus: large sequence variation in a small region of the genome, p. 78-79. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

807. **Shi, B.J., N. Habili, and R. H. Symons.** 2003. Nucleotide sequence variation in a small region of the *Grapevine fleck virus* replicase provides evidence for two sequence variants of the virus. Annals of applied Biology **142**:349-355.

808. **Shi, B.J., N. Habili, D. Webb, and R. H. Symons.** 2000. Extensive variation of sequence within grapevine virus B isolates, p. 48-49. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

809. **Sim, S.T., A. Rowhani, and D. A. Golino.** 2003. Experimental transmission of *grapevine leafroll-associated virus 5* and *9* by longtailed mealybugs, p. 211-212. *In* Extended abstracts 14th Meeeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

810. **Simon, A., L. Bodor, and G. Bujtas.** 2003. Effect of grape viruses (fanleaf, yellow mosaic, leafroll) on quantity and quality of yield and on the status of grapevine plantation, p. 250-251. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

811. **Skoric, D., A. Saric, M. Vibio, E. Murari, M. Krajacik, and A. Bertaccini.** 1998. Molecular identification and seasonal monitoring of phytoplasmas infecting Croatian grapevines. Vitis **37**:171-175.

812. **Soares, C., A. Mansinho, M. Teixeira Santos, O. A. Sequeira, and G. Nolasco.** 2000. Studying the genomic variability of rupestris stem pitting associated virus-1, p. 41-42. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

813. **Sopp, E., E. H. Rühl, and H. Holst.** 1998. Resistance of rootstocks to the virus transmitting nematode *Xiphnema index*. Viticultural and Enological Science **53**:3-6.

814. **Spada, S.** 2003. Selection and biodiversity in viticulture:the point of view of nurserymen, p. 151. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

815. **Spielmann, A., V. Douet-Orhant, P. Gugerli, and S. Krastanova.** 2000. Resistance to nepoviruses in grapevine and *Nicotiana benthamiana*: expression of several putative resistance genes in transgenic plants. Acta Horticulturae (528):373-378.

816. **Spielmann, A., S. Krastanova, V. Douet-Orhant, and P. Gugerli.** 2000. Analysis of transgenic grapevine *(Vitis rupestris)* and *Nicotiana benthamiana* plants expressing an Arabis mosaic virus coat protein gene. Plant Science **156**:235-244.

817. **Spinthiropoulou, H.C., N. A. Leventakis, M. N. Stavrakakis, A. F. Biniari, A. G. Goulioti, B. A. Marinos, C. I. Dovas, and N. I. Katis.** 2004. Clonal selection of the Greek grape wine cultivar "Xinomavro". Acta Horticulturae (652):45-49.

818. **Stefanelli, G., A. Villani, C. Coiutti, A. Gregoris, and C. Frausin.** 2000. Fenologia di *Scaphoideus titanus* Ball in diverse aree viticole del Friuli-Venezia Giulia (Phenology of *Scaphoideus titanus* in various viticultural areas of Friuli-Venezia Giuliana), p. 37-43. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma

pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine,Italy.

819. **Stefanelli, G., A. Villani, A. Gregoris, and C. Coiutti.** 2000. *Scaphoideus titanus* Ball in aree del Fruli-Venezia Giulia a viticoltura marginale (*Scaphoideus titanus* in regions of Friuli- Venezia Giulia with marginal viticulture), p. 29-35. *In* Flavescenza dorata e legno nero della vite in Friuli-Venezia Giulia. I risultati di un programma pluriennale di controllo. Atti del Convegno, Gorizia 5 Novembre 1999. (Flavescence dorée and blackwood of grapevine in Friuli-Venezia Giulia. Results of a long-term control programme. Proceedings of the meeting, Gorizia 5th November 1999). Dipartimento di Biologia Applicata alla Difesa delle Piante, University, Udine, Italy.

820. **Stewart, S. and A. Nassuth.** 2001. RT-PCR based detection of *Rupestris stem pitting associated virus* within field-grown grapevines throughout the year. Plant Disease **85**:617-620.

821. **Stimilli, G., S. Nardi, and R. Credi.** 2002. Incidenza delle virosi della vite nelle Marche (Incidence of grapevine virus diseases in the Marches). L'Informatore agrario **58**(38):63-64.

822. **Streten, C., D. Barbara, A. Padovan, and K. Gibb.** 2000. Identification of the major membrane protein of Australian grapevine yellows and related phytoplasmas, p. 94-95. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide.

823. **Symons, R.H.** 1998. Waite Diagnostics - a service for the viticultural industry. The Australian Grapegrower and Winemaker (417):44-46.

824. **Symons, R.H. and N. Habili.** 2000. Grapevine virus A is associated with restricted growth in the spring. The Australian Grapegrower and Winemaker (443):17-18.

825. **Symons, R.H., N. Habili, and R. Bonfiglioli.** 2000. Waite Diagnostics - Development of a diagnostic service for the Australian Viticultural Industry, p. 149. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

826. **Szychowski, J.A., R. Credi, K. Reanwarakorn, and J. S. Semancik.** 1998. Population diversity in grapevine yellow speckle viroid-1 and the relationship to disease expression. Virology **248**:432-444.

827. **Tanne, E.** 2000. Progress in grapevine virus research. Acta Horticulturae (526):481-484.

828. **Tanne, E., E. Boudon-Padieu, D. Clair, M. Davidovich, S. Melamed, and M. Klein.** 2001. Detection of phytoplasma by polymerase chain reaction of insect feeding medium and its use in determining vectoring ability. Phytopathology **91**:741-746.

829. **Tanne, E., D. Clair, and E. Boudon-Padieu.** 2000. PCR detection of phytoplasmas-DNA in artificial feeding medium of phytoplasma infected leafhopper: a method to screen for natural vectors of phytoplasma diseases, p. 105-106. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

830. **Tanne, E., S. Melamed, L. Koznetsova, M. Davidovich, P. Weintraub, and M. Klein.** 2000. Potential vectors of grapevine yellows in Israel, p. 91. *In* R.H. Symons (ed.) Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

831. **Tarnowski, G., P. A. Worlock, and S. Ulanovsky.** 2002. First report of Rupestris stem pitting associated virus in Argentina. Plant Disease **86**:921.

832. **Tassart-Subirats, V., D. Clair, S. Grenan, E. Boudon-Padieu, and J. Larrue.** 2003. Hot water treatment: curing efficiency for phytoplasma infection and effects on plant multiplication material, p. 69-70. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

833. **Terlizzi, F., L. Biolchini, and R. Credi.** 2004. Molecular characterization of Italian *Grapevine fanleaf virus* isolates. Journal of Plant Pathology **86** (Special issue):335.

834. **Terlizzi, F. and R. Credi.** 2002. RT-PCR and ISEM detection of *Grapevine rupestris stem pitting-associated virus*. Journal of Plant Pathology **84**:196.

835. **Terlizzi, F. and R. Credi.** 2003. Partial molecular characterization of Italian *Grapevine rupestris stem pitting-associated virus* isolates, p. 133-134. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

836. **Thompson, D.A.** 1998. The role of NAPPO in fruit crop virus-testing and certification. Acta Horticulturae (472):747-750.

837. **Tomazic, I., Z. Korosec-Koruza, and B. Koruza.** 2000. GLRaV-1 and stem pitting disease - two factors affecting the yield of grapevine cv. Refosk, p. 160-161. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

838. **Tomazic, I., N. Petrovic, D. Gonsalves, and Z. Korosec-Koruza.** 2003. Analyses of grapevine viruses in association with rugose wood disease, p. 135. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

839. **Tomazic, I., U. Vrhovsek, and Z. Korosec-Koruza.** 2003. The influence of virus diseases on grape polyphenols of cv. 'Refosk'. Zbornik Biotehniske Fakultete Univerze v Ljubljani **81**:287-295.

840. **Torregrosa, L., A. Bonnet, A. Torregrosa, and D. Boubals.** 2000. Une nouvelle forme symptomatologique du court-noué de la vigne: Qui a vu cela? (A new symptom expression of grapevine fanleaf: who has seen this?). Progrès Agricole et Viticole **117**:488-490.

841. **Torres, E., S. Botti, J. Rahola, V. Blanco, M. P. Martin, and A. Bertaccini.** 2003. Molecular characterization and geographical distribution of flavescence dorée-phytoplasmas in Spain, p. 87-88. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

842. **Torres-Viñals, M., S. Sabaté-Casaseca, N. Aktouche, S. Grenan, G. Lopez, M. Porta-Falguera, and L. Torregrosa.** 2004. Large-scale production of somatic embryos as a source of hypocotyl explants for *Vitis vinifera* micrografting. Vitis **43**:163-168.

843. **Trespaille-Barrau, J.M.** 2000. Flavescence dorée:situation du vecteur et de la maladie jusqu'en 1999 (Flavescence dorée: situation of the vector and of the disease until 1999). Progrès Agricole et Viticole **117**:270-271.

844. **Troncoso, A., M. Cantos, P. Paneque, G. Paneque, C. Weiland, and F. Perez-Camacho.** 2004. GFLV-infection and in vitro behaviour of infected plant material of three typical Andalusian grapevine cultivars. Acta Horticulturae (652):359-365.

845. **Tsvetkov, I., B. Choleva, M. Yankulova, N. Minchev, V. Colova, and A. Atanassov.** 2003. Evaluation of transgenic grapes tolerance toward *Grapevine fanleaf virus*, p. 231-232. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

846. **Tsvetkov, I., N. Ioannou, A. Hadjinicoli, A. Hadjinicolis, and A. Atanassov.** 2003. Development and evaluation of a Cyprus grapevine genebank, p. 157-158. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

847. **Tsvetkov, I., N. Ioannou, A. Hadjinicoli, A. Hadjinicolis, and A. Atanassov.** 2003. Flurprimidol and D-mannitol as tools for *in vitro* storage of grapevine germplasm, p. 248-249. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

848. **Turturo, C., M. Dell'Orco, P. Saldarelli, A. Minafra, and L. Stavolone.** 2003. RNA silencing is suppressed by *Grapevine virus A* infection, p. 121. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

849. **Turturo, C., M. E. Rott, A. Minafra, P. Saldarelli, W. Jelkmann, and G. P. Martelli.** 2000. Grapevine leafroll associated virus 1: partial cloning and RT- PCR detection, p. 15-16. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

850. **Turturo, C., M. E. Rott, A. Minafra, P. Saldarelli, W. Jelkmann, and G. P. Martelli.** 2000. Partial molecular characterization and RT-PCR detection of grapevine leafroll-associated virus 7, p. 17-18. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

851. **Turturo, C., P. Saldarelli, G. Bottalico, M. Dell'Orco, A. Minafra, I. Gribaudo, V. Savino, and G. P. Martelli.** 2003. Induction of gene silencing to *Grapevine virus A* and *Grapevine virus B* through marker free transformation of *Nicotiana* and *Vitis* spp, p. 233. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

852. **Turturo, C., P. Saldarelli, G. Bottalico, M. Dell'Orco, A. Minafra, I. Gribaudo, V. Savino, and G. P. Martelli.** 2003. Induction of gene silencing to *Grapevine virus A* and *Grapevine virus B* through marker free transformation of *Nicotiana* and *Vitis* spp. Journal of Plant Pathology **85** (special issue):276.

853. **Turturo, C., P. Saldarelli, D. Yafeng, M. Digiaro, V. Savino, and G. P. Martelli.** 2003. Preliminary investigations of genetic variability of *Grapevine leafroll-associated virus 3* isolates, p. 38. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

854. **Tzeng, H.L.C., M. J. Chen, and D. D. S. Tzeng.** 1999. Improvement of techniques for purification of leafroll associated closterovirus from affected grapevines and the preparation of antisera for disease indexing. Botanical Bulletin of Academia Sinica (Taipeh) **40**:295-304.

855. **Uyemoto, J.K. and A. Rowhani.** 2003. Discovery of different grapevine sources with graft-transmissible agents causing union-incompatibility on sensitive rootstocks, p. 139-140. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

856. **Uyemoto, J.K., A. Rowhani, and D. Luvisi.** 2000. An association of rootstock stem lesions in *Vitis* species and different graft-transmissible agents, p. 83-84. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

857. **Uyemoto, J.K., A. Rowhani, D. Luvisi, and C. R. Krag.** 2001. New closterovirus in "Redglobe" grape causes decline of grafted plants. California Agriculture **55**:28-31.

858. **Valat, L., M. Burrus, M. Fuchs, and M. C. Mauro.** 2003. Review of techniques to inoculate grapevines with grapevine fanleaf virus: lessons and perspectives. American Journal of Enology and Viticulture **54**:279-285.

859. **Valat, L., F. Mode, M. C. Mauro, and M. Burrus.** 2003. Preliminary attempts to biolistic inoculation of *grapevine fanleaf virus*. Journal of Virological Methods **108**:29-40.

860. **Valat, L., F. Mode, M. C. Mauro, M. Burrus, and L. Pinck.** 2000. Towards direct inoculation of GFLV into grapevine, p. 67. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

861. **Valat, L., S. Toutain, N. Courtois, F. Gaire, E. Decout, L. Pinck, M. C. Mauro, and M. Burrus.** 2000. GFLV replication in electroporated grapevine protoplasts. Plant Science **155**:203-212.

862. **Valero, M., A. Ibanez, and A. Morte.** 2003. Effects of high vineyard temperatures on the grapevine leafroll associated virus elimination from *Vitis vinfera* L. cv. Naploleon tissue cultures. Scientia Horticulturae **97**:289-296.

863. **Van der Merve, M.** 2000. Grapevine viruses: sensitive detection by PCR. Plant Protection News (58):7-10.

864. **Van der Merve, M., G. G. F. Kasdorf, and G. Pietersen.** 2000. The use of PCR for the detection of grapevine leafroll- associated virus 3, p.141-142. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

865. **Varga, K., M. Kölber, M. Martini, M. Pondrelli, I. Ember, G. Tökés, J. Lazar, J. Mikulas, E. Papp, G. Szendrey, A. Schweigert, and A. Bertaccini.** 2000. Phytoplasma identification in Hungarian grapevines by two nested-PCR systems, p. 113-115. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

866. **Vercesi, A. and G. Scattini.** 2000. Diffusione della flavescenza dorata della vite in Oltrepò pavese nel 1999 (Spread of flavescence dorée of grapevine in Oltrepo pavese in 1999). Vignevini **27**(9):52-55.

867. **Vicchi, V.** 2001. Flavescenza dorata: la situazione in Emilia-Romagna (Flavescence dorée: the situation in Emilia-Romagna), p. 69-72. *In* F. Pasini (ed.), Le Emergenze Fitosanitarie della Vite. Notiziario tecnico N.63. Centro Ricerche Produzioni Vegetali, CRPV, Faenza, Italy.

868. **Viggiani, G.** 2002. Il vettore della flavescenza dorata trovato in Basilicata (The vector of flavescence dorée found in Basilicata, Italy). L'Informatore agrario **58**(36):59.

869. **Viggiani, G.** 2004. Il vettore della flavescenza dorata anche in Campania (The vector of flavescence dorée in Campania too). L'Informatore agrario **60**(18):98.

870. **Vigne, E., M. Bergdoll, S. Guyader, and M. Fuchs.** 2004. Population structure and genetic variability within isolates of *Grapevine fanleaf virus* from a naturally infected vineyard in France: evidence for mixed infection and recombination. Journal of General Virology **85**:2435-2445.

871. **Vigne, E., V. Komar, and M. Fuchs.** 2004. Field safety assessment of recombination in transgenic grapevines expressing the coat protein gene of *Grapevine fanleaf virus*. Transgenic Research **13**:165-179.

872. **Vigne, E., V. Komar, M. C. Mauro, and M. Fuchs.** 2003. Structure of a population of *grapevine fanleaf virus* isolates from a Chardonnay vineyard in the Champagne region in France: evidence for mixed infection and recombination, p. 13. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy,13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

873. **Vindimian, M.E., A. M. Ciccotti, U. Malossini, and I. Roncador.** 1998. Biological indexing in greenhouse with the use of micropropagated material of genus *Vitis*. Acta Horticulturae (473):151-153.

874. **Vindimian, M.E., A. M. Cicotti, U. Malossini, and I. Roncador.** 1998. Risultati preliminari di un metodo di saggio biologico in serra con l'utilizzo di materiale micropropagato di vite. Vignevini **25**(4):73-75.

875. **Vingione, M., S. Meglioraldi, M. Cardoni, and A. R. Babini.** 2003. Indagine sulla diffusione dei virus nei vigneti della provincia di Reggio Emilia (Investigation of the spread of viruses in vineyards of the Reggio Emilia Province). Vignevini **30**(9):79-82.

876. **Waite, H., J. Crocker, G. Fletcher, P. Wright, and A. deLaine.** 2001. Hot water treatment in commercial nursery practice - an overview. The Australian Grapegrower and Winemaker (449a):39-43.

877. **Walker, M.A. and Y. Jin.** 2000. Breeding *Vitis rupestris x Muscadinia rotundifolia* to control *Xiphinema index* and fanleaf degeneration. Acta Horticulturae (528):511-515.

878. **Walker, M.A. and Y. M. Jin.** 1998. Development of resistant rootstocks to control *Xiphinema index* and fanleaf degeneration. Acta Horticulturae (473):113-120.

879. **Walter, B.** 1998. La virologie de la vigne progresse (Grapevine virology is progressing). Progrès Agricole et Viticole **115**:18-20.

880. **Walter, B.** 1999. Sanitary selection of grapevine: European network for the establishment of reference protocols for detection of infectious agents. Options Méditerranéennes, Série B (29A):103-105.

881. **Walter, B., E. Boudon-Padieu, and M. Ridé.** 2000. Maladies à virus, bactéries et phytoplasmes de la vigne (Virus, bacterial and phytoplasma diseases of grapevine). Editions Féret, F-33073 Mérignac (France).

882. **Walter, B. and G. P. Martelli.** 1998. Considerations on grapevine selection and certification. Vitis **37**:87-90.

883. **Walton, V.M. and K. L. Pringle.** 2004. A survey of mealybugs and associated natural ennemies in vineyards in the Western Cape Province, South Africa. South African Journal of Enology and Viticulture **25**:23-25.

884. **Walton, V.M. and K. L. Pringle.** 2004. Vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae), a key pest in South African vineyards. A review. South African Journal of Enology and Viticulture **25**:54-62.

885. **Wan Chow Wah, Y.F. and R. H. Symons.** 1999. Transmission of viroids via grape seeds. Journal of Phytopathology **147**:285-291.

886. **Wang, Q., R. Gafny, P. Li, M. Mawassi, I. Sela, and E. Tanne.** 2003. Elimination of *Grapevine virus A* by cryopreservation, p. 242. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

887. **Wang, Q., M. Mawassi, P. Li, R. Gafny, I. Sela, and E. Tanne.** 2003. Elimination of grapevine virus A (GVA) by cryopreservation of in vitro-grown shoot tips of *Vitis vinifera* L. Plant Science **165**:321-327.

888. **Wang, Q.C., E. Tanne, A. Arav, and R. Gafny.** 2000. Cryopreservation of in vitro-grown shoot tips of grapevine by encapsulation-dehydration. Plant Cell,Tissue and Organ Culture **63**:41-46.

889. **Wang, X.R., N. Bosselut, C. Castagnone, R. Voisin, P. Abad, and D. Esmenjaud.** 2003. Multiplex polymerase chain reaction identification of single individuals of the longidorid nematodes *Xiphinema index, X. diversicaudatum, X. vuittenezi,* and *X. italiae* using specific primers from ribosomal genes. Phytopathology **93**:160-166.

890. **Weber, A. and M. Maixner.** 1998. Survey of populations of the planthopper *Hyalesthes obsoletus* Sign. (Auchenorrhyncha, Cixiidae) for infection with the phytoplasma causing grapevine yellows in Germany. Journal of Applied Entomology **122**:375-381.

891. **Weber, A. and M. Maixner.** 1998. Habitat requirements of *Hyalesthes obsoletus* Signoret (Auchenorrhyncha:Cixiidae) and approaches to control this planthopper in vineyards. IOBC/wprs Bulletin **21**(2):77-78.

892. **Weiland, C.M., M. Cantos, A. Troncoso, and F. Perez-Camacho.** 2004. Regeneration of virus-free plants by in vitro chemotherapy of GFLV (Grapevine fanleaf virus) infected explants of *Vitis vinifera*L. cv "Zalema". Acta Horticulturae (652):463-466.

893. **Weiland, C.M. and F. Perez-Camacho.** 2004. Comparison of the logistic and Gompertz equations to describe plant disease progress of Grapevine fanleaf virus (GFLV) in 'Condado de Huelva' (Spain) zone. Acta Horticulturae (652):305-308.

894. **Wetzel, T., A. Beck, U. Wegener, and G. Krczal.** 2004. Complete nucleotide sequence of the RNA1 of a grapevine isolate of Arabis mosaic virus. Archives of Virology **149**:989-995.

895. **Wetzel, T., R. Jardak, L. Meunier, A. Ghorbel, G. Reustle, and G. Krczal.** 2002. Simultaneous RT/PCR detection and differentiation of arabis mosaic and grapevine fanleaf nepoviruses with a single pair of primers. Journal of Virological Methods **101**:63-69.

896. **Wetzel, T., L. Meunier, U. Jaeger, G. Krczal, and G. Reustle.** 2000. Analysis of the variability in the movement protein gene among grapevine fanleaf and arabis mosaic nepovirus isolates, p. 65. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

897. **Wetzel, T., L. Meunier, U. Jaeger, G. Reustle, and G. Krczal.** 2001. Complete nucleotide sequences of the RNAs 2 of German isolates of Grapevine fanleaf and Arabis mosaic nepoviruses. Virus Research **75**:139-145.

898. **Whattam, M.** 2001. Grapevine corky bark disease: a serious quarantine threat of grapevine for Australia. Australasian Plant Pathology **30**:379-380.

899. **White, D.T., L. L. Blackall, P. T. Scott, and K. B. Walsh.** 1998. Phylogenetic positions of phytoplasmas associated with dieback, yellow crinkle and mosaic diseases of papaya, and their proposed inclusion in 'Candidatus Phytoplasma australiense' and a new taxon,' Candidatus Phytoplasma australasia'. International Journal of Systematic Bacteriology **48**:941-951.

900. **Wilcox, W.F., Z. Y. Jiang, and D. Gonsalves.** 1998. Leafroll virus is common in cultivated American grapevines in Western New York. Plant Disease **82**:1062.

901. **Wilson, Y.M.** 1999. Grapevine yellows in Europe. The Australian Grapegrower and Winemaker (426a):55-58.

902. **Xue, B., K. S. Ling, C. L. Reid, S. Krastanova, M. Sekiya, E. A. Momol, S. Süle, J. Mozsar, D. Gonsalves, and T. J. Burr.** 1999. Transformation of five grape rootstocks with plant virus genes and a *vir-E2* gene from *Agrobacterium tumefaciens*. In Vitro Cellular and Developmental Biology. Plant **35**:226-231.

903. **Yoshikawa, N., S. Gotoh, M. Umezawa, N. Satoh, H. Satoh, T. Takahashi, T. Ito, and K. Yoshida.** 2000. Transgenic *Nicotiana occidentalis* plants expressing the 50 kDa protein of Apple chlorotic leaf spot virus display increased susceptibility to homologous virus, but strong resistance to Grapevine berry inner necrosis virus. Phytopathology **90**:311-316.

904. **Zahavi, T., S. Orenstein, and E. Tanne.** 2000. Factors affecting the occurrence of grapevine yellows in Israel, p. 103-104. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

905. **Zhang, Y.M., Y. Li, Y. T. Tian, P. La, and W. Q. Cai.** 2000. Cloning, sequencing and expressing of coat protein gene of grapevine leaf roll associated closterovirus. Acta Phytopathologica Sinica **30**:232-236.

906. **Zhang, Y.M., Y. T. Tian, and X. F. Luo.** 1998. Microapical culture of grapevine and detection of grapevine fanleaf virus by ELISA and probe. Journal of Beijing Forestry University **20**:54-58.

907. **Zhang, Y.P. and A. Rowhani.** 2000. A strategy for rapid cDNA cloning from double-stranded RNA templates isolated from plants infected with RNA viruses using Taq DNA polymerase. Journal of Virological Methods **84**:59-63.

908. **Zhang, Y.P., J. K. Uyemoto, D. A. Golino, and A. Rowhani.** 1998. Nucleotide sequence and RT-PCR detection of a virus associated with grapevine rupestris stem-pitting disease. Phytopathology **88**:1231-1237.

909. **Zhou, Z., N. Abou-Ghanem, D. Boscia, O. Potere, D. E. Goszczynski, and M. A. Castellano.** 2000. Monoclonal antibodies for detection and characterization of grapevine leafroll associated virus 2, p. 130. *In* R. H. Symons (ed.), Extended abstracts 13th Meeting ICVG, Adelaide, Australia, 12-17 March 2000. University of Adelaide, Adelaide, Australia.

910. **Zhou, Z., C. Turturo, O. Potere, P. Saldarelli, D. Boscia, and G. P. Martelli.** 2003. Production and characteriztion of monoclonal antibodies specific to *Grapevine leafroll associated virus 3* and epitope mapping of the coat protein gene. Journal of Plant Pathology **85** (Special issue):316.

911. **Zhou, Z., C. Turturo, O. Potere, P. Sancassani, D. Boscia, and G. P. Martelli.** 2003. Production and characterization of monoclonal antibodies specific for *Grapevine leafroll-associated virus 3* and epitope mapping of the coat protein, p. 203. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari.

912. **Zhu, H.Y., K. S. Ling, D. E. Goszczynski, J. R. Mcferson, and D. Gonsalves.** 1998. Nucleotide sequence and genome organization of grapevine leafroll-associated virus-2 are similar to beet yellows virus, the closterovirus type member. Journal of General Virology **79**:1289-1298.

913. **Zorloni, A., P. A. Bianco, R. Tonesi, and G. Belli.** 2004. Frequent occurrence of latent infections by different viruses in grapevine detected during clonal selection in Lombardia. Journal of Plant Pathology **86** (Special issue):340.

914. **Zorloni, A., P. A. Bianco, R. Vitali, and G. Belli.** 2003. Reduction of grapevine flavescence dorée infections by winter pruning. Journal of Plant Pathology **85** (Special issue):299-300.

915. **Zorloni, A., S. Cinquanta, S. Prati, and P. A. Bianco.** 2003. Transmission of an Italian isolate of *Grapevine leafroll- associated virus 3* by the mealybug *Heliococcus bohemicus*, p. 215. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

916. **Zorloni, A., S. Cinquanta, G. Scattini, and G. Belli.** 2003. Latent infections by different viruses recently detected in grapevine during sanitary selection in Lombardia (northern Italy), p. 165-166. *In* Extended abstracts 14th Meeting ICVG, Locorotondo, Italy, 13-17 September 2003. Department of Plant Protection and Applied Microbiology, University, Bari (Italy).

917. **Zorloni, A., S. Prati, P. A. Bianco, and G. Belli.** 2004. Further data on the experimental transmission of *Grapevine leafroll-associated virus 1* and *-3* and of *Grapevine virus A* by mealybugs. Journal of Plant Pathology **86** (Special issue):339-340.

918. **Zorloni, A., G. Scattini, P. A. Bianco, and G. Belli.** 2002. Verifica dell'efficacia della potatura invernale come metodo di contenimento della Flavescenza dorata della vite (Verification of the efficacy of winter pollarding as a control method for grapevine flavescence dorée). Petria **12**:407-408.

919. **Zuchetto, C.A.** 1999. Epidemiologia ed evoluzione dei sintomi della flavescenza dorata nell'area del Prosecco (Epidemiology and evolution of symptoms of flavescence dorée in the Prosecco area). PhD thesis, Università di Padova, Istituto di Entomologia, Padova, Italy.

920. **Zuppiroli, G., V. Vicchi, and A. Venturi.** 2001. Flavescenza dorata della vite. Comparsa e diffusione in Emilia- Romagna (Flavescence dorée of grapevine. Occurrence and diffusion in Emilia-Romagna). Agricoltura **29**(3):69-73.