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Virus and virus-like diseases of citrus in Greece and certification

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SUMMARY - Most of the citrus virus diseases are present in Greece: impietratura, concave gum, psorosis complex, blind pocket, cristacortis, crinkly leaf, infectious variegation, exocortis, cachexia, gummy bark and woody galls. Quarantine measures are applied against the introduction of tristeza and stubborn.
Legislative measures and institutions involved in the production of healthy propagating material are described. Certified material is indexed in glasshouse and in the field for tristeza, tristeza seedling yellows, vein enation-woody gall, exocortis, cachexia, stubborn, infectious variegation psorosis complex, concave gum, impietratura, cristacortis.

Key words: citrus, viruses, virus-like, certification, quarantine, Greece

RESUME *- La plupart des viroses des agrumes connues sont répandues en Grèce: impietratura, concavité gommeuse, complexe de la psorose, blind pocket, cristacortis, frisolée, panachure infectieuse, exocortis, cachexie, écorce gommeuse et galles du bois. Des mesures de quarantaine sont appliquées pour prévenir l'introduction de la tristeza et du stubborn.*
Les mesures législatives et les institutions impliquées dans la production du matériel de multiplication sain sont décrites. Le matériel certifié est soumis à des tests en serre et en plein champ pour l'indexage de la tristeza, des énations nervales, de l'exocortis, de la cachexie, du stubborn, de la panachure infectieuse, du complexe de la psorose, de la concavité gommeuse, de l'impietratura, du cristacortis et du stubborn.

Mots-clés: *agrumes, virus, virus similaires, certification, quarantaine, Grèce*

Introduction

The citrus industry is very important for the Greek agriculture and economy in general. Commercial citriculture is located in 29 out of the 54 prefectures of the country. Table I shows the main species grown with the respective numbers of trees, fruit production, and volume of exportation (Pontikis, 1995 personal communication), whereas Table II shows the main citrus varieties grown in the country (Pontikis, 1995 personal communication.; Psarros, 1995 personal communication).

Table I *- Quantitative data on the citrus industry and production in Greece*

Main species cultivated	Total number of trees	Annual production in tons	Exportation in tons
Orange	17,105,000	850,000 -1,000,000	320,000 -360,000
Lemon	5,00,000	140,000 -170,000	40,000 -60,000
Mandarin	3,200,000	70,000 -78,000	15,000
Grapefruit	20,000	7,000 -8,000	1,000

Table II *- Citrus varieties grown in Greece*

SWEET ORANGE	LEMON	MANDARIN	GRAPEFRUIT
Principal			
Washington Navel	Adamopoulou	Clementines	Marsh Seedless
Navelina	Eureka	- SRA 63	Redblush
Navelate	Interdonato	- Irael	Star Ruby
Newhall	Santa Teresa	- Porou	
Moro	Maglini	- Denules	
Tarocco	Zagara Bianca	- Marisol	
Sanguine Gouritsis	Lisbon	Ortanique	
Valencia	Vakalou	Satsuma	
Salustiana		Fortune	
Other		Encor	
Common	Karystino	Common (willow leaved)	Pink Marsh
Myrodato Tymbakiou	Local Polyforo		Duncan
Shamouti	Common Seeded		Foster
			Common

Occurrence of virus and virus-like diseases

The virus and virus-like diseases of citrus known to exist in Greece are the following (Alivizatos, 1995; Anonymous, 1971; Annual Reports, 1971; Ceramidas, 1976; Ceramidas *et al., 1981*; Holevas *et al,*. 1990;. Zois, 1976):

- Impietratura, widespread in sweet orange (Navelina, Valencia, other varieties), occurring also in bergamot, pummelo and sometimes in lemon)
- Concave gum, widespread in sweet orange, in lemon and mandarin
- Psorosis A
- Psorosis B
- Blind pocket
- Cristacortis, orange varieties, clementine, local lemon varieties
- Crinkly leaf, infectious variegation, in lemon
- Infectious variegation
- Exocortis, considerable spread
- Gummy bark, limited
- Xyloporosis (citrus cachexia), isolated cases in local mandarin and Satsuma
- Sour orange woody galls (newly described, see attached sheet on description)

No diseases induced by intracellular prokaryotes (stubborn, greening) and no citrus canker bacteria have been detected. There was one case with stubborn-like symptoms, but the *Spiroplasma citri* detection tests were negative (Alivizatos, 1995).

The psorosis complex, mainly concave gum and impietratura, are the most important infectious diseases of citrus in Greece; they are also the most widespread and cause serious symptoms. Psorosis A and B, even though causing severe symptoms, are not very widespread.

A characteristic phenomenon is worth considering with concave gum:

- it is widespread in the thousands of shading sour oranges of the streets of Athens and Attica in general;
- both wood symptoms and leaf symptoms (oak leaf patterns) are obvious.

These trees come directly from seedlings and were not grafted. So, the obvious question arises where the massive infection comes from or how the disease is transmitted. We can think of two hypotheses to answer these questions. There is either insect transmission, possibly by aphids (for instance, trees are

highly colonized by *Aphis spiraecola* and other aphid species), or transmission by cutting tools during pruning of trees by the municipal workers.

It is not known if the agent of citrus concave gum is a virus, or a viroid or a fastidious prokaryote. Finding its way of transmission may help revealing its nature as well. For instance, transmission by pruning would indicate a possible viroid nature.

Control

A) Legislative measures.

The Greek Government (Ministry of Agriculture, Direction of Plant Protection), alarmed by the disasters caused by citrus tristeza in Latin America and other places, and the degeneration of citrus crops by the other citrus virus diseases, issued the Royal Decree/19.2.1959 (amended in 1971 by the RD 756/1971 and in 1985 by the Presidential Decree 282/1985) by which the introduction in Greece of any citrus planting material was forbidden, except for Research Institutions which were allowed to import very limited quantities of certified material from recognised Institutions after governmental permit issued for each particular case. It is considered that it was this legislature which protected Greece from the introduction of tristeza and stubborn.

B) Production of healthy material

The following institutions are in charge or may be involved in the production of healthy citrus propagation material:

- **Poros Arboriculture Station (PAS)**, in the island of Poros. In charge: Agr. Eng. Ms Theodora Agorastou, two other Agr. Engs.: Mr Gerassimos Magripis and Mr Nikolaos Drettas.
- It is the main Citrus Institution, established in 1948. It is in charge of variety collection, variety and rootstock evaluation, and production of healthy propagation material for the whole country. An area of 200 stremmata (50 acres), out of 700, is devoted to this purpose, whereas the rest is covered with olive trees. The citrus mother blocks were established in 1970-1978 and the indexing facilities in 1972. The propagation material produced (seedlings and budwood) is certified for tristeza, exocortis, psorosis A, concave gum, cristacortis, impietratura, xyloporosis, stubborn and ringspot. The facilities available are two greenhouses, one for plant propagation 1.000 sq. m. and one for indexing 600 sq. m.(divided into warm and cold compartments), one screenhouse of 250 sq. m., and one shed of 1.000 sq. m. Table I shows the indexing as executed in the Station. ELISA testing, for the time being, is done in Aspropyrgos Quarantine Station in Athens, but it is expected that the Station will soon obtain its own ELISA facilities. The main difficulty is the very limited number of scientific and other personnel.

Table III *- Detection of virus and virus-like diseases in Poros Arboriculture Station, Greece*

Disease	**Indicators**	**Conditions**
Tristeza	Mexican lime	Glasshouse 18-25°C
Seedling yellows-tristeza	Sour orange, grapefruit, Eureka lemon	Glasshouse 18-25°C
Vein enation woody gall	Mexican lime	Glasshouse 18-25°C
Exocortis	Etrog citron Arizona 60-13	Glasshouse 18-25°C
Stubborn	Mme Vinous, Hamlin	Glasshouse 27-32°C
Cachexia-Xyloporosis	Orlando tangelo(Parson's special mandarin)	Field (Glasshouse 27-32°C)
Infectious variegation-crinkly leaf	Eureka lemon	Glasshouse 18-25°C
Concave gum, psorosis A, Impietratura, cristacortis	Pineapple, Hamlin, Mme Vinous	Glasshouse 18-25°C
Concave gum	Orlando tangelo	Field
Cristacortis	Orlando tangelo	Field
Impietratura	Grapefruit, *C. volkameriana*	Field
Ringspot	Grapefruit	Glasshouse 18-25°C

The Station is selling to the growers the following certified material: rootstock seeds (citrumelo, volkameriana lemon , sour orange, trifoliate orange, Troyer) (40-50 kg. annually), budsticks (about 10.000, 5 buds each) and a small number of seedling rootstocks of 50 citrus varieties (sweet orange, lemon, grapefruit, mandarins, pummelo, trifoliate orange, Troyer, ect.).

- **Mother block of Evinohorion (Aetoloacarnania).** Citrus mother block established with material from Poros (PAS), to cover the nursery needs of Aetoloacarnania.
- **Xylocastron Arboriculture Station (XAS),** in Xylocastron, Corinthia. In charge: Agr. Eng. FotiosTsaniklidis.

  Established in 1928 (Act No. 6/5.2.1928 of the village of Xylocastron, following the Royal Decree of 13.12.1915) in 25 stremmata donated by the village, increased later to 50 (12,5 acres) by additional donations. Originally it served as national nursery but later it included variety collections. In 1985 the lemon mother block was established by its former Director Mr. Ch. Papastellatos in a greenhouse of 1800 sq. m. After thinning the number of trees due to the tree growth, the mother block today contains 813 lemon mother trees (varieties Lisbon, Eureka, Santa Teresa, Zagara Bianca, Maglini, Interdonato, Vacalou) grafted onto sour orange. The productivity is 100.000 buds per year. The budwood for the establishment of mother trees came from visually selected trees. Up to now the mother trees look healthy and no virus problem has been noticed in

their progeny trees, nevertheless the intention is that the mother trees undergo individual indexing and ELISA testing. The Station has a small greenhouse which could be used for cold or warm indexing, and needs another for the complementary indexing (warm or cold, respectively). In addition, the Institution below (PEGEAL Xylocastrou), located within the premises of the Station and in close collaboration with it, intends to obtain ELISA facilities for testing mother trees for tristeza and other pathogens.

- **District Laboratory of Agricultural Advisory Service and Fertiliser Analysis Xylocastrou** (PEGEAL Xylocastrou), of the National Agricultural Research Organization. In charge: Agr. Eng. Mr. Charalambos Papastellatos. Other Agr. Engs.: Mr. D. Vyzas, Mrs. Anna Assimakopoulou, Mrs. Alexandra Mavragani and Mr V. Georghiou.

  It was established in 1987 close to XAS. Its purpose is to advise growers on matters of plant protection and fertilisation (disease diagnosis, leaf and soil testing for nutrients). Interested in contributing to the lemon mother block above by ELISA and other laboratory testing. Its main shortage is in scientific and other personnel.

- **Chania Institute of Subtropical Plants and Olive**, Crete. It has established a citrus variety collection since 1970s, used mainly for horticultural studies (Dr È. Protopapadakis).

  Summarising the Greek situation as to the citrus virus and virus-like diseases and certification of propagation material, it can be pointed out that even though no major problems seem to occur and the mother blocks are of acceptable health quality, this situation needs to be improved. The improvement refers to both the facilities and the number of trained scientific personnel, as well as to supporting technical personnel.

Survey for tristeza

As mentioned, strict legislative measures have long been taken and mother trees are tristeza-tested, so that tristeza does not occur in Greece. Nevertheless, considering the seriousness of the disease, a survey is to start in commercial groves in September 1995, through ELISA tests by Aspropygros Quarantine Station in Athens.

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