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VIRUS DISEASES AFFECTING THE MEDITERRANEAN STONE FRUIT INDUSTRY: A DECADE OF SURVEYS

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SUMMARY - The sanitary status of the Mediterranean stone fruit industry is discussed, based on extended surveys carried out during the 1990s, i.e.in Albania, Italy (Apulia), Jordan, Lebanon, Malta, Palestine, Syria, Tunisia and Turkey (East-Anatolia). Sweet cherry was the most virus-infected crop (54% of the trees were infected by at least one virus) whereas apricot was the least infected (10%). Peach, plum and almond had infectin of 33%, 28% and 27% respectively. *Plum pox virus* (PPV), *Prunus necrotic ringspot virus* (PNRSV), *Prune dwarf virus* (PDV), *Apple mosaic virus* (ApMV*)* and *Apple chlorotic leaf spot virus* (ACLSV) were the important stone fruit viruses detected.

Key words: Mediterranean, stone fruits, PPV, PNRSV, PDV, ACLSV, ApMV

RESUME *- L'état sanitaire des espèces fruitières à noyau méditerranéennes est passé en revue, en s'appuyant essentiellement sur les résultats des prospections effectuées tout au long des années 90. Les prospections ont été réalisées en Albanie, Italie (Pouilles), Jordanie, au Liban, à Malte, en Palestine, Syrie, Tunisie et Turquie (Anatolie orientale). Le merisier était la culture la plus infectée par les virus (54% des arbres étaient infectés par au moins un virus), alors que l'abricotier était le moins infecté (10%). Quant au pêcher, au prunier et à l'amandier, le taux d'infection était de 33%, 28% et 27%, respectivement. Le Plum pox virus (PPV), le Prunus necrotic ringspot virus (PNRSV), le Prune dwarf virus (PDV), l'Apple mosaic virus (ApMV)et l'Apple chlorotic leaf spot virus (ACLSV) se sont avérés être les virus les plus importants chez les espèces fruitières à noyau dans la région.*

Mots-clés**:** *Méditerranée, espèces fruitières à noyau, PPV, PNRSV, PDV, ACLSV, ApMV*

INTRODUCTION

The Mediterranean region produces about 40% of the world supply of stone fruits. Almond and apricot are the most important crops contributing 50% and 45% of the total production, respectively. The cultivation of stone fruits in the Mediterranean is still broadly based on a high number of local varieties as every country possesses its own germplasm, important especially for domestic market (Bassi and Pirazzoli, 1998).

In this paper, the sanitary situation of the Mediterranean stone fruit industry is discussed, based on results of extended surveys in several countries during the 1990s by personnel at the Mediterranean Agronomic Institute, the University of Bari and local institutions.

REPORTED VIRUSES

Prunus spp. are affected by many viruses, the most frequent occur in the genera *Ilarvirus, Potyvirus* and *Trichovirus*. The following are the most important: *Plum pox virus* (PPV), *Prunus necrotic ringspot virus* (PNRSV), *Prune dwarf virus* (PDV), *Apple mosaic virus* (ApMV*)* and *Apple chlorotic leaf spot virus* (ACLSV). Nepoviruses are generally less frequent in the region and are reported mainly from the Northern shore (France, Italy, etc), i.e. Strawberry latent ringspot virus (SLRSV), *Myrobalan latent ringspot virus* (MLRSV) and *Raspberry ringspot virus* (RpRV).

Sharka, caused by PPV, is by far the main virus disease of stone fruits in the region, being widespread (Albania, Greece, ex-Yugoslavia) or well established (France, Italy, Spain) in the Northern rim, but

occurring in the South in restricted areas (Jordan, Syria) or not at all (Israel, Lebanon, Morocco, Palestine, Tunisia). The severity of the symptoms varies according to the *Prunus* species and cultivar, the virus strain, season and location. The disease causes blotches and/or deformations in the fruits of apricot, plum and peach, and severe fruit dropping in susceptible plum and apricot varieties. Four strains of the virus, with differences in biological, serological, molecular and epidemiological behaviour have been identified: Marcus (PPV-M), Dideron (PPV-D), El Amar (PPV-EA) and Cherry (PPV-C). The virus strains recorded most frequently in the region are PPV-D and PPV-M, whereas PPV-EA has been recorded only from Egypt (Myrta *et al*., 1998). Strain PPV-M, which has been present for long time only in Eastern-European countries, became established during the 1990s in Southern France and Northern Italy causing severe damages to the peach industry. PPV-M was reported recently from Southern countries such as Jordan and Syria (Al Rwahnih *et al*., 2000; Ismaeil, 2001).

Other viruses, belonging to the genera *Foveavirus, Closterovirus*, *Ilarvirus*, *Nepovirus,* etc. have been recorded occasionally, but there is no information on their incidence and economic importance. Stem-pitting disease was reported by several authors in different stone fruit species (Ragozzino and Caia, 1968; Agrios, 1971; Quacquarelli and Savino, 1980; Di Terlizzi and Savino, 1995). The disease has still an unclear aetiology, even if a *Closterovirus* was found associated with apricot stem-pitting in Italy (Abou Ghanem-Sabanadzovic *et al*., 2001). *American plum line pattern virus* (APLPV) was reported recently in Japanese plum trees from Albania, Italy and Tunisia (Myrta *et al*., 2002), whereas Apricot latent virus (ApLV) was found in France, Italy (Gentit *et al*., 2001b) and Palestine (Abbadi *et al*., 2003). In addition, two different nepoviruses were reported in France: *Stocky prune virus* (StPV) in plum by Candresse *et al.* (1998) and *Apricot latent ring spot virus* (ALRSV) in apricot by Gentit *et al.* (2001a).

SANITARY STATUS OF DIFFERENT STONE FRUIT CROPS

Surveys were done during the 1990s in stone fruit-growing areas of Albania, Italy (Apulia), Jordan, Lebanon, Malta, Palestine, Syria, Tunisia and Turkey (East-Anatolia). In the course of the studies, the sanitary status of the crops (Table 1) was evaluated by ELISA (Savino *et al*., 1991; Di Terlizzi *et al*., 1992; Choueiri *et al*., 1993; Jawhar *et al*., 1996; Edhib, 1996; Myrta *et al*., 1996; Zeramdini *et al*., 1996; Gatt *et al*.,1998; Sipahioglu *et al.*, 1999; Al Rwahnih *et al*., 2001; Amenduni *et al*., 2001; Ismaeil, 2001; Jarrar *et al.,* 2001). During our comparative analysis we included data reported from the above papers.

Table 1. Incidence of virus infection in different stone fruit species in some Mediterranean countries (%)

Country	Stone fruit crops				
	almond	Apricot	cherry	peach	plum
Albania	16	12	56	43	47
Italy (Apulia)	86	35	58	35	25
Jordan	14	11	10	18	10
Lebanon	21	5	45	24	18
Malta	4	74	n.t.	62	63
Palestine	15	3	14	16	20
Syria	14	6	16	24	5
Tunisia	34	5	10	15	12
Turkey (East Anatolia)	33*	0.3	21	15*	n.t.

*low number of tested trees; n.t. not tested

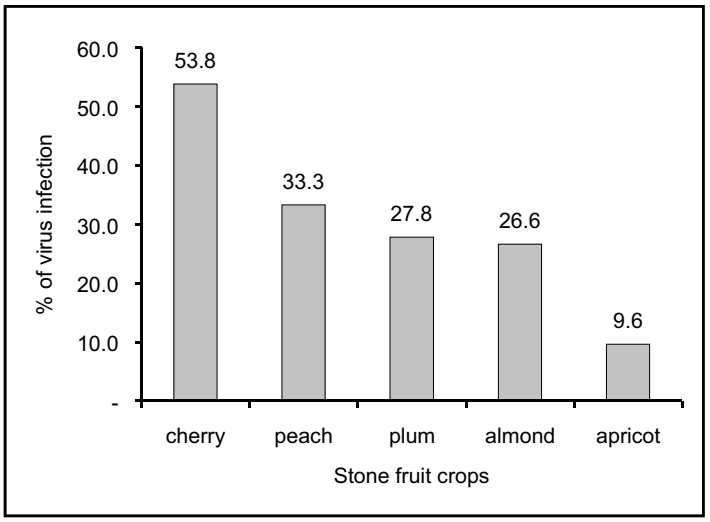

Fig. 1. Sanitary status of stone fruit trees in the Mediterranean

Almond

The major and most widespread virus-induced disorder of almond in the Mediterranean is a complex called mosaic, and characterised by a variety of symptoms ranging from bright chrome-yellow (calico) to chlorotic discolorations, localised necrosis of the leaf blade, leaf curling, bud failure, fasciations, rosetting, stunting and bushy growth. Three ilarviruses, ApMV, PDV and PNRSV, associated with almond mosaic throughout the Mediterranean, are involved to different extents in its aetiology (Martelli and Savino, 1997).

Virus-infected almond trees ranged from 4% in Malta up to 86% in Southern Italy, but the mean infection was 26.6% (Fig. 1), the most frequent infection rate ranging between 15 and 33%. The most common viruses were PNRSV and PDV. ACLSV and ApMV were found more rarely, the latter occurring with a high incidence only in Italy. PPV was never detected in almond (Fig. 2).

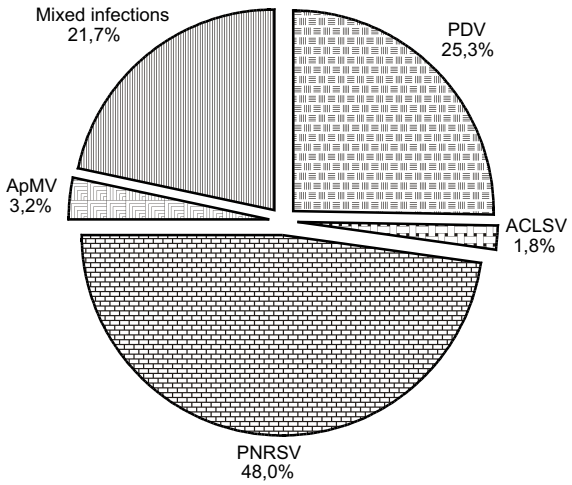

Fig. 2. Relative incidence of viruses in the almond industry

Apricot

Sharka is the main disease of apricot, notwithstanding the low rates of infection encountered generally in apricot, as compared with plum and peach. PPV-D strain was identified in apricot (especially in Spain, France, Italy) as well as PPV-M (prevailing in Greece, Cyprus, Turkey), whereas PPV-EA was reported from Egypt. Other frequent Mediterranean apricot viruses are PNRSV, ACLSV and PDV, which are found in symptomatic and symptomless trees. Among different apricot diseases caused by these viruses there

is “butteratura” from Italy (Ragozzino and Pugliano, 1974) and “viruela” from Spain (Peña-Iglesias and Ayuso, 1975; Cañizares *et al*., 2001), both caused by strains of ACLSV. The economic impact on the crop is similar to PPV, but the disease is not epidemic. Strains of PNRSV may also affect the quality of the fruits eliciting discoloured rings or spots, and occassionally necrotic line pattern.

Virus infection in apricot was less than 1% in East-Anatolia (Turkey) where the industry is based on a few local cultivars, and very high (74%) in Malta. The mean level of infection was 9.6%, the lowest among stone fruit crops (Fig.1). In the majority of the countries infections ranged from 5 to 12% (Table 1). The main viruses were ACLSV, PNRSV and PDV. PPV-M was found in limited areas and in a few trees in Albania, Jordan and Syria. ApMV was not detected in our surveys, but reported elsewhere (Fig 3).

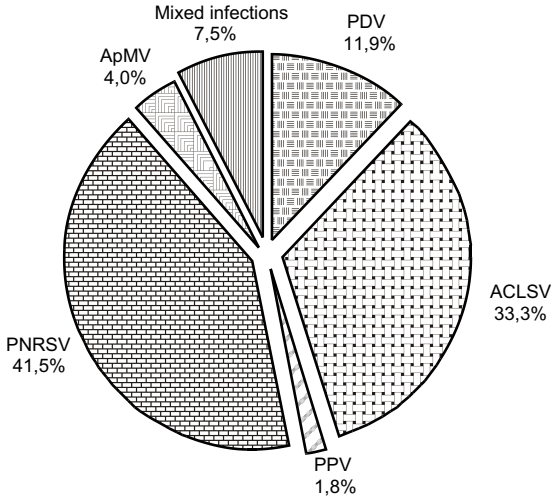

Fig 3. Relative incidence of viruses in the apricot industry

Cherry

The cherry industry is affected by many virus diseases, some are economically important. Diseased trees frequently developed chlorotic rings, chlorotic-necrotic ringspots, shot holes and yellow mosaic in the leaves, caused by PDV, PNRSV and ACLSV in single or mixed infections. Strains of these viruses were reported to cause discolorations, dark spots, pits and necrosis in the fruits (Savino, 1997; Desvignes, 1999). A few cherry trees naturally infected by PPV were reported from Southern Italy (Crescenzi *et al*., 1994), but this finding was not confirmed

The overall infection rate was the highest (53.3%) in cherry, compared with other stone fruits (Fig.1). PDV had an incidence of 70% to 90%. ACLSV wa high (over 60%) in Albania and Palestine and ApMV (3.3%) occurred only in Southern Italy. Incidence of PNRSV was 5.9% and no PPV was detected (Fig. 4).

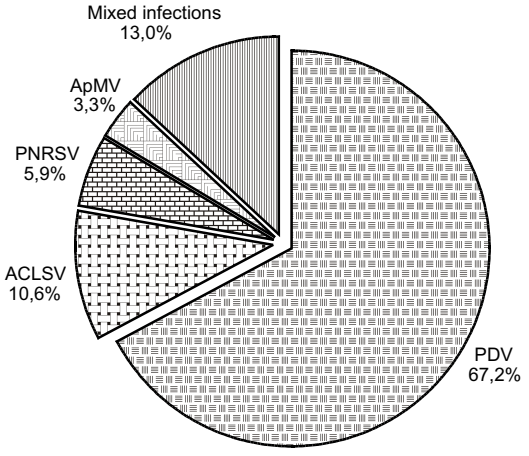

Fig. 4. Relative incidence of viruses in the cherry industry

Peach

Sharka (presence of PPV-M strain) where found, was the most destructive disease of peach affecting seriously orchards in the Northern countries (Greece, France, Italy). The peach industry of Northern Italy and Southern France (main peach producers in the region), were object of eradication programs, but PPV-M eradication efforts were largely unsuccessful, with the exception of Apulia region (Southern Italy) (Savino *et al.*, 1995). Peach stunt induces a relevant reduction in tree growth, is another frequently reported disease. This disease is associated with PDV, or mixed infections of PDV and PNRSV. Although rare, when present, nepoviruses severily affects productivity also.

Virus incidence was 15% in Tunisia and up to 62% in Malta (Table 1). Overall mean incidence in the Mediterranean was 33.3% (Fig. 1). Prevailing viruses were PNRSV and ACLSV. Mixed virus infections were more frequently in peach than in other crops. PPV-M was detected in Albania (1%) and Jordan, (2%)(Fig. 5).

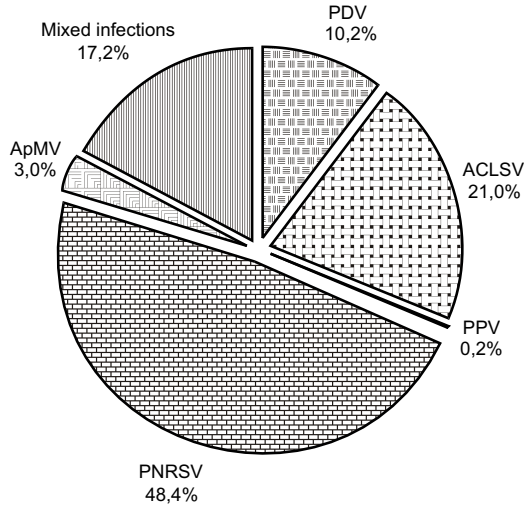

Fig. 5. Relative incidence of viruses in the peach industry

Plum

Since the first report of sharka from Bulgaria, the disease spread to Yugoslavia and Albania, where PPV infections in plum are endemic. PPV affect virtually the totality of the trees in many areas. PPV was later reported in many European-Mediterranean countries. PPV-infected trees produce poor quality fruits (deformations, flesh necrosis, low sugar and high acidity), or in many varieties suffer premature fruit drop. Leaf symptoms were chlorotic spots and rings. Another disease of plum is pseudopox (Németh, 1986), which resembles sharka, but caused by ACLSV. Savino *et al*. (1996) reported pseudopox from plum in Central Italy, and later in Southern Italy. Dwarfing (stunting) is associated with PDV alone, but more often in mixed infection with PNRSV.

Among Mediterranean countries surveyed, Syria had the lowest infection rate (5%) and Malta the highest (63%) (Table 1).The mean infection level was 27.8% (Fig.1). PNRSV, PDV and ACLSV were the most frequent viruses detected. PPV was by far the prevailing virus in Albania (59%), but detected only in two plum trees in Jordan. ApMV was not detected (Fig. 6).

A summary of viruses in the Mediterranean countries is given in Table 2.

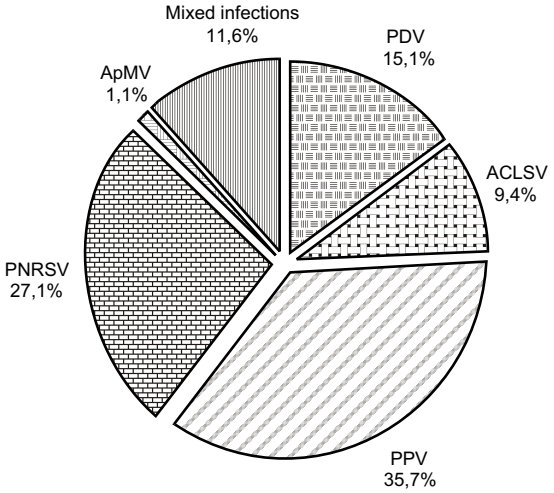

Fig. 6. Relative incidence of viruses in the plum industry

CONCLUSIONS

The general picture of the sanitary situation of the Mediterranean stone fruit industry did not change appreciably since the report by Dunez (1988) for the implementation of UNDP/FAO project RAB/86/018/A/01/12. During the '90s, sharka leapt across the ocean into Chile, USA and Canada. Also severe PPV strains spread in Southern France and Northern Italy. This presumably occurred due to the exchange and use of infected propagating material. In the Southern and Middle-Eastern countries, the general situation of PPV seems still comfortable but the incumbent risk is related to importing infected varieties from abroad. Two of three PPV foci in Jordan were in peach and plum orchards established with propagating material coming from Europe. Other viruses and relative diseases are present, but their incidence in the South and Middle East is still lower than in European countries.

Updating phytosanitary legislation and diagnostic technology, implementing effective quarantine controls and prompt eradication of trees infected by quarantine agents, and establishing national certification programs, are essential issues for avoiding the introduction and spread of quarantine graft-transmissible diseases and favour the development of quality nursery and fruit tree industry.

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Table 2. Viruses in stone fruit trees among Mediterranean countries*

Country	Viruses frequently detected					Viruses less frequently detected	
	PPV	ACLSV	PDV	PNRSV	ApMV	Nepoviruses	Others
Albania	+	+	+	+			APLPV
Algeria		+	+	+	+		
Croatia	+	+	+	+		ArMV, SLRSV	
Cyprus	+	+	+	+			
Egypt	+	+	+	+		PRMV, ToRSV	
France	+	+	+	+	+	ALRSV, CLRV, MLRSV, RpRV, SLRSV, StPV	ApLV, APLPV, CGRMV
Greece	+	+	+	+	+		
Israel			+	+			
Italy	+	+	+	+	+	CLRV, SLRSV	ApLV, APLPV, CGRMV, CMLV, PBNSPaV
Jordan	+	+	+	+	+		
Lebanon		+	+	+			CGRMV
Malta		+	+	+			
Morocco			+	+			
Palestine		+	+	+			ApLV, APLPV
Portugal	+			+			
Slovenia	+		+	+			
Spain	+	+	+	+	+	RpRV, SLRSV,	CGRMV
Syria	+	+	+	+	+	SLRSV	
Tunisia		+	+	+	+		APLPV
Turkey	+	+	+	+		CLRV, PRMV, RpRV, SLRSV, ToRSV	
Fr.Yugoslavia	+	+	+	+			

* This information was in part due to efforts of MNFTV participants and from previous publications (Németh, 1986; Diekmann and Putter, 1996; Desvignes, 1999); + : virus presence. Full virus name not cited in the text: CGRMV-Cherry green ring mottle virus; CLRV-*Cherry leaf roll virus*; CMLV-Cherry mottle leaf virus; PRMV-*Peach rosette mosaic virus*; PBNSPaV-Plum bark necrosis stem pitting-associated virus; StPV-Stocky prune virus; ToRSV-*Tomato ringspot virus*.

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