European stone fruit yellows: a destructive disease in the Mediterranean basin

Carraro L., Osler R.

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SUMMARY - Stone fruit species are affected by severe diseases associated with phytoplasmas. European stone fruit yellows (ESFY) is present in several countries of Europe and the Mediterranean. ESFY - phytoplasma induces economically important disorders in apricot, Japanese plum and peach and can infect several other Prunus spp. Cacopsylla pruni is the vector of the disease transmitting it in a persistent manner. The observation of symptoms in sensitive stone fruit species (apricot and Japanese plum) can indicate the presence of ESFY in a given area. However, several other methods are reliable for the detection of the pathogen: (i) greenhouse indexing using peach GF 305; (ii) DAPI method; and (iii) molecular methods (PCR or nested-PCR). Being a phytoplasma disease, it is in practice not curable. Therefore, control is necessarily based on prevention using healthy planting material, which is of basic importance. In areas with low infection pressure, where the disease is absent and the presence of the vector is very low (or absent), the use of healthy plants can be sufficient. In areas with medium or high infection pressure, where ESFY is endemic (present on wild plants) and the populations of C. pruni are abundant, the control of the vector is necessary. In areas with high natural pressure of ESFY the cultivation of tolerant species (i.e. European plum) instead of sensitive ones (i.e. Japanese plum) is often advisable. In addition plants with induced-resistance (cross protection) can be used especially in already infected areas.

Key words: Mediterranean, stone fruits, phytoplasma, ESFY, diagnosis, disease control

INTRODUCTION

In Europe, and particularly in the Mediterranean basin, several stone fruit (Prunus) species are affected by severe diseases associated with phytoplasmas. These include apricot chlorotic leaf roll (Morvan, 1977), plum leptonecrosis (Giuunchedi et al., 1978), peach yellows (Poggi Pollini et al., 1993) and peach decline (Ionica, 1985). Lorenz et al. (1994) determined the common aetiology of these diseases and proposed the single name ‘European stone fruit yellows’ (ESFY). On the basis of sequence and restriction fragment length polymorphism (RFLP) analysis of PCR-amplified 16S rDNA, the agent of
ESFY is placed within the apple proliferation (AP) group of phytoplasmas (Lee et al., 1998; Seemüller et al., 1998). This cluster also includes phytoplasmas associated with other perennial fruit tree diseases present in Europe such as AP and pear decline (PD). These phytoplasmas are closely related but distinguishable from each other (Carraro et al., 2001b; Jarausch et al., 1998; Lorenz et al., 1995). ESFY-phytoplasma is also distinctly different from the agents of X-disease and peach yellow leaf roll, major phytoplasma diseases of stone fruit trees in North America, which have not been detected in Europe (Kison et al., 1997). ESFY-phytoplasma induces economically important disorders in apricot (Desvignes and Cornaggia, 1982), Japanese plum (Dosba et al., 1991) and peach (Marcone et al., 1996) and can infect several other Prunus spp.

GEOGRAPHIC DISTRIBUTION

European stone fruit yellows is present in several countries of Europe. Occurrence of the disease has been reported in Albania (Myrta et al., 2003), Austria (Laimer da Camada Machado et al., 2001), Bulgaria (Topchiiska et al., 2000), Czech Republic (Navratil et al., 2001), England (Davies and Adams, 2000), France (Desvignes and Cornaggia, 1982), Germany (Lederer and Seemüller, 1992), Greece (Rumbos and Bosalis, 1985), Hungary (Süle, 1999), Italy (Goidanich, 1933), Romania (Ionica, 1985), Slovenia (Brzin et al., 2001), Spain (Sanchez Capucino and Forner, 1973), Switzerland (Ramel et al., 2001). Recently the presence of ESFY was ascertained also in Turkey (G. Sertkaya, unpublished).

The incidence of the disease is different in each country, depending on various factors. In any case ESFY is a serious problem in the countries bordering on the Mediterranean sea (Spain, France, Italy, Balkans), where the cultivation of susceptible and sensitive Prunus species (apricot and Japanese plum) is widespread. Likewise, ESFY could become important in the future in other areas where stone fruit trees are cultivated, if control measures are not applied.

HOSTS AND SYMPTOMATOLOGY

ESFY-phytoplasma can infect several Prunus species. Among these, apricot and Japanese plum are the most susceptible and sensitive. Although symptom severity is fairly variable, infected P.armeniaca and P.salicina trees in general show typical yellows accompanied by leaf roll followed by leaf reddening, reduction or suppression of dormancy with the consequent risk of frost damage, severe and progressive necroses, decline and eventual death of the tree. Within the most sensitive cultivars, 100% of the infected plants can die. Production can be totally lost.

In peach the disease is not so devastating as in apricot and Japanese plum, although in north Italy Poggi Pollini et al. (2001) recently detected a disquieting diffusion.

European plum is susceptible but generally tolerant to ESFY (Carraro et al., 1998a). Some cvs. however, can show weak symptoms but low mortality (Jarausch et al., 2000).

Wild or cultivated Prunus species, such as P. cerasifera, P. mahaleb, P. padus, P. spinosa, P. tomentosa, are highly tolerant to the disease and the presence of specific symptoms is an exception (Ferrini et al., 2002); however P. cerasifera, P. spinosa and P. tomentosa were fairly susceptible (Carraro et al., 2002a). P. avium in contrast demonstrated a high level of resistance to ESFY (Jarausch et al., 1999). The presence of the agent was reported also in P. serrulata, P. amygdalus, P. insititia and P. cerasus.

The susceptibility and sensibility of the rootstocks to ESFY varies according to the different genotypes: some are highly sensitive, i.e. apricot seedlings and Rubira peach; others, such as Bromptom, are tolerant (Kison and Seemüller, 2001).

EPIDEMIOLOGY

European stone fruit yellows is an epidemic disease, characterised by rapid and widespread diffusion especially when the conditions are favourable for host-plants and vectors.

Cacopsylla pruni (Fig.6) is the vector of the disease (Carraro et al., 1998b); the insect completes one generation per year and overwinters as adult on shelter plants (conifers are reported). At the end of winter, C. pruni moves from shelter plants to stone fruit trees for oviposition. From May till the beginning of July,
the new generation feeds on the primary host; as soon as adult, C. pruni abandons the stone fruit trees (Conci et al., 1992). The insect is strictly oligophagous on Prunus spp and has a Centralasiatic-European distribution.

C. pruni transmits ESFY-phytoplasma in a persistent manner: the minimum acquisition period is 2-4 days; the minimum latent period 2-3 weeks; the minimum inoculation period 1-2 days. The retention of infectivity in C. pruni lasts through the winter and the following spring, when the overwintering insects reach the stone fruit trees, they are already infected and infective (Carraro et al., 2001a). Important similarities exist among pear decline, apple proliferation and ESFY: the agents of the three diseases are phytoplasmas all belonging to AP group and all transmitted by psyllids.

In areas with high infection pressure, the natural infectivity of C. pruni reaches levels greater than 10% (mean individual transmission potency) (Carraro et al., 2002b) and the annual rate of newly infected plants the 20% (Carraro et al., 1992). Carraro et al. (2002a) demonstrated the important role played by wild Prunus species - such as P. spinosa and P. cerasifera, both hosts for the vector and the agent of ESFY in the epidemiic cycle of the disease; the phytoplasma can survive and persist in nature independently of the presence of cultivated susceptible plants. It should also be noted that some cultivated Prunus spp are completely tolerant; therefore these plants can act as sources of inoculum for the spread of ESFY.

Recently in France, Jarausch et al. (2001) detected ESFY-phytoplasma in Celtis australis, Fraxinus excelsior and Rosa canina growing in the surroundings of infected apricot orchards. The exact role played by these non-Prunus species in the epidemiology of the disease is not yet clear; probably they are end-hosts of the phytoplasma.

DETECTION

The simple observation of symptoms is not sufficient for an exact diagnosis of the disease because several Prunus spp. are tolerant to ESFY; but the observation of sensitive stone fruit species (apricot and Japanese plum) can indicate the presence of ESFY in a given area. Several other methods are reliable for the detection of the pathogen.

Greenhouse indexing, using peach GF 305 as a test plant (Desvignes et al., 1999) is a useful method. For large scale diagnosis, the DAPI method (Seemüller, 1976) can be used, although the percentage of false negatives can reach high levels; this generally occurs when phytoplasma colonisation of plants is poor or uneven.

Molecular methods (PCR or nested-PCR) are currently applied for the detection of ESFY-phytoplasma both in plants and in insects: they provide an exact and precise diagnosis. Different primer pair sequences are known and available for the amplification of portions of ESFY-phytoplasma DNA. Some of them, such as ECA1/ECA2 (Jarausch et al., 1998), are highly specific and do not need RFLP analyses; others, such as P1/P7 (Schneider et al., 1995), are 'universal' for phytoplasmas and can be used for the first amplification in nested-PCR followed by the second amplification using AP-group specific primers, as R16(X)F1/R1 (Lee et al., 1995) or f01/r01 (Lorenz et al., 1995). After the nested-PCR, the RFLP analyses of the PCR products is necessary for the exact identification of the ESFY-phytoplasma. It should be mentioned that the possibilities and the primer 'combinations' are numerous and all efficacious; in our lab, as a routine, we apply the nested-PCR technique using the primers P1/P7 followed by f01/r01 and RFLP analyses (Carraro et al., 2002a).

CONTROL

European stone fruit yellows, being a phytoplasma disease, is in practice not curable; therefore control is by necessity based on prevention. The use of tested-healthy plant material is of basic importance. It is clear therefore that precise knowledge of the epidemiology of the disease is necessary for its control.

In areas with low infection pressure, where the disease is absent and the presence of the vector is very low (or absent), the use of healthy plants can be sufficient. In areas with medium or high infection pressure, where ESFY is endemic (present on wild plants) and the populations of C. pruni are abundant, the control of the vector is necessary. Vector control has been made easier, since we know the period when the overwintering adults reimmigrate to Prunus species and when the new generation abandons the primary hosts. Besides, the vector has only one generation per year, this further facilitates its control.
In areas with high natural pressure of ESFY the cultivation of tolerant species (ex. *P. domestica*) instead of sensitive ones (ex. *P. salicina*) is often advisable. In addition plants with induced-resistance (cross protection) can be used especially in already infected areas (Morvan et al., 1991).

REFERENCES


