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Data Sheets on Quarantine Pests

Apple proliferation phytoplasma

IDENTITY

Name: Apple proliferation phytoplasma
Taxonomic position: Bacteria: Tenericutes: Mollicutes: Phytoplasmas
Common names: Apple proliferation, witches' broom (English)
Maladie des proliférations du pommier (French)
Triebsucht des Apfels (German)
Proliferaciones del manzano (Spanish)
EPPO computer code: APPXXX
EPPO A2 list: No. 87
EU Annex designation: I/A2

HOSTS

Apples are the main host. Cultivars vary in reaction but most, including seedlings, appear to be susceptible. The most sensitive cultivars include Belle de Boskoop, Gravenstein, Starking, Golden Delicious and Winter Banana. Roja de Benejama seems able to tolerate infection.

Pear trees with symptoms of proliferation have been found, but no proof of the presence of apple proliferation phytoplasma has been given.

GEOGRAPHICAL DISTRIBUTION

Proliferation has only been reported from the EPPO region. However, there are unconfirmed reports from India and South Africa (Seemüller, 1990).
EPPO region: Austria, Bulgaria, Czech Republic, France, Germany, Greece, Hungary, Italy, Moldova, Poland, Romania, Slovakia, Slovenia, Spain, Switzerland, UK (eradicated), Ukraine, Yugoslavia. Found but not established in Denmark and Netherlands. Found in Essex in 1985 and destroyed (Davies *et al.*, 1986).
Asia: India (unconfirmed).
Africa: South Africa (unconfirmed).
EU: Present.

BIOLOGY

The natural means of transmission is partly unknown, although transmission by root fusion may occur. Leafhoppers have been reported as vectors of the disease (Seemüller, 1990) but other extensive experiments failed to support this (Refatti *et al.*, 1986). There is no seed or pollen transmission. Proliferation has been transmitted by grafting from apple to apple. There is one report of graft transmission from apple to pear, but this has not been confirmed by subsequent experiments. There are also reports of its transmission to *Catharanthus roseus* using *Cuscuta* sp. (Marwitz *et al.*, 1974; Heintz, 1986). Proliferation is often disseminated in scion wood; although the causal agent does not appear to be systemic, trees may yield a high proportion of apparently healthy but infected buds.

Distribution of phytoplasmas in the tree is not constant over the year. In winter the content of phytoplasmas declines in the tree due to sieve tube degeneration. They also concentrate more in the roots but, during April to May, reinvade the stem from the roots and reach a peak in late summer or early autumn (Seemüller *et al.*, 1984). The distribution pattern of the phytoplasmas in the tree is also dependent on temperature. In France, phytoplasmas could be found throughout the trees at temperatures of 21-25°C, causing symptoms; at 29-32°C symptoms were inhibited and phytoplasmas were found only in the roots, but reinvaded the stems when plantlets were stored at the lower temperature (Ducrocquet *et al.*, 1986).

When a tree is inoculated with an infected bud the first symptoms appear the following year, mostly on the inoculated branches. When carried in the rootstock, the causal agent produces symptoms on the first growth of the scion. It appears to be localized mainly in suckers and terminal shoots, where it has been observed in the phloem of leaf petioles, midribs and stipules.

Infected trees are particularly sensitive to powdery mildew (*Podosphaera leucotricha*). There appears to be an interaction between apple rubbery wood disease and apple proliferation, the former promoting transmission of the latter. For more information, see Bovey (1963; 1972), Seidl & Komarkova (1974).

DETECTION AND IDENTIFICATION

Symptoms

On trees

Affected trees lack vigour, shoots are thin and the bark, which is sometimes fluted lengthwise, has a reddish-brown colour. Necrotic areas appear on the bark and some branches may wither. Diseased trees may die but, in mild infections, they may recover after the shock symptoms of the first 2-3 years and, subsequently, produce normal fruits again, especially if adequately fertilized.

On buds

Late growth of terminal buds in the autumn is usually the first noticeable symptom. A rosette of terminal leaves, which often becomes infected with powdery mildew, sometimes develops late in the season in place of the normal dormant bud. However, a more reliable symptom is the premature development of axillary buds, during the first 2 or 3 years following infection, which gives rise to secondary shoots forming witches' brooms near the apex of the main shoot. In healthy trees, on the other hand, laterals arise near the base of the shoots. The angle between the secondary shoots and the main shoot is markedly narrow on infected trees. Witches' brooms generally appear successively on various parts of the tree, or all at once over the whole tree, rather than repeatedly on the same branch.

On leaves

Appear earlier than normal and are finely and irregularly serrated and smaller. In many cases, especially with trees on calcareous soils, there is a chlorosis and reddening of the leaves. Early defoliation often occurs. It should be noted that chlorosis and reddening of leaves may be caused by agents other than proliferation; diagnosis should not, therefore, be based on this symptom alone.

On stipules

Abnormally long, and there may be up to four per leaf. Petioles are rather short.

On flowers

Delayed, sometimes until late summer or autumn, but most of the blossoms of infected trees are normal. A few phylloid flowers have been observed on cv. Cox's Orange; the stamens were converted to petals, some of the petals to leaves and the calyx lobes were enlarged and dentated.

On fruit

Depending on soil quality, fruit are markedly reduced in size, sometimes being only 25% of the weight of healthy fruit. In addition, flavour is poor, both sugar and acidity being reduced. The peduncles are longer and thinner and both the calyx end and peduncular cavities are shallower and broader, thus giving the fruit a flattened appearance. Seeds and seed cavities are smaller.

For more information, see Blumer & Bovey (1957), Schuch (1962), Bovey (1963; 1972).

Detection and inspection methods

With interstock grafting (i.e. grafting the material to be tested between seedling rootstock and indicator scion) latent infection can be determined within 2 years. If the very sensitive indicator *Malus* x *dawsoniana* is grafted directly in June on the scion, it develops a leaf reddening during the following autumn and a bark splitting and scaling during the next spring (Morvan & Castelain, 1975). Using the double-budding technique, the reaction is obvious shortly after budbreak. Use of this indicator significantly reduces the time needed for testing. An EPPO quarantine procedure on the detection of fruit tree phytoplasmas is in preparation.

MEANS OF MOVEMENT AND DISPERSAL

The possibility of introduction with infected plant material is relatively high because of symptomless infections. phytoplasmas can be present in infected trees, scion and rootstock material of apple. Natural spread cannot be estimated objectively because of the uncertainty of the importance of vectors.

PEST SIGNIFICANCE

Economic impact

This is one of the most important phytoplasma diseases of apple, affecting almost all cultivars, reducing size (by about 50%), weight (by 63-74%) and quality of fruit, as well as reducing tree vigour and increasing susceptibility to powdery mildew (*Podosphaera leucotricha*).

Control

Research activities have mostly concentrated on the breeding of resistant cultivars. At present, resistant rootstocks are the most efficient way to control the disease (Seemüller, 1990). Since the vector is unknown, it is not possible to control the natural spread of the disease and roguing may not always be successful.

Phytosanitary risk

Apple proliferation phytoplasma is an EPPO A2 quarantine organism (OEPP/EPPO, 1978) and has quarantine significance for COSAVE and NAPPO. Further spread of the disease could lead to considerable yield losses throughout the European and Mediterranean apple cultivation areas. For more information, see Bovey (1963; 1972).

PHYTOSANITARY MEASURES

Plants of apple for planting should come from a source found free from apple proliferation phytoplasma during the previous growing season. From countries where the disease occurs, the plants must additionally be no further than the second generation from the mother plant and must be tested by an EPPO-approved method (OEPP/EPPO, 1990). The EPPO

certification scheme for fruit trees (OEPP/EPPO, 1991/1992) covers apple proliferation phytoplasma and should give a high security for phytoplasma-free planting material.

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