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Data Sheets on Quarantine Pests

Xanthomonas fragariae

IDENTITY

Name: *Xanthomonas fragariae* Kennedy & King
Taxonomic position: Bacteria: Gracilicutes
Common names: Angular leaf spot (English)
Taches angulaires (French)
Blattfleckenkrankheit (German)
Maculatura angolare delle foglie (Italian)
Mancha angular da folha (Portuguese)
Bayer computer code: XANTFR
EPPO A2 list: No. 135
EU Annex designation: II/A2

HOSTS

Fragaria ananassa, the predominant cultivated strawberry, whose progenitors derive from hybridization between *F. chiloensis* and *F. virginiana*, is the main host, but its numerous cultivars vary a great deal in susceptibility. *F. virginiana, F. vesca, Potentilla fruticosa* and *P. glandulosa* have been infected following experimental inoculation. Among *Fragaria* spp. only *F. moschata* is immune (Kennedy & King, 1962a; Kennedy, 1965; Maas, 1984). Cultivated strawberries are the host of concern throughout the EPPO region.

GEOGRAPHICAL DISTRIBUTION

X. fragariae was first described in 1962 in North America. It probably spread from there, with planting material, to other continents but this is only a presumption.
EPPO region: Locally present in France (Rat, 1974), Greece (Panagopoulos *et al*., 1978), Israel (found but not established), Italy (including Sicily; Mazzucchi *et al*., 1973), Portugal (Fernandes & Pinto-Ganhao, 1981), Romania (Severin *et al.*, 1985), Spain (Lopez *et al.*, 1985) and Switzerland (Grimm *et al.*, 1993).
Asia: Israel (found but not established), Taiwan.
Africa: Ethiopia, Réunion (detected in 1986 and reported eradicated; Pruvost *et al*., 1988).
North America: USA (California, Florida, Kentucky, Minnesota, Wisconsin) (Kennedy & King, 1962b).
South America: Argentina (Alippi *et al.*, 1989), Brazil (Minas Gerais, Rio Grande do Sul, São Paulo), Chile (found in 1992 and eradicated), Ecuador (found but not established), Paraguay, Uruguay, Venezuela.
Oceania: Found in the past but eradicated in Australia (New South Wales, Victoria) and New Zealand.
EU: Present.
Distribution map: See IMI (1993, No. 520).

BIOLOGY

Residues of infected leaves and crown infections on runners used for planting are sources of inoculum for primary infections. In the residues of infected leaves, in or on soil, the bacterium survives from one crop to the next. In dried infected leaves, kept in the laboratory, the bacterium may survive for at least 2.5 years. Bacterial cells are transferred from residues to young leaves at the beginning of the growing season. From crown infection pockets, the bacterium causes lesions along the veins at the base of the youngest leaves, which develop in the apical crown region.

The bacterium exudes from primary lesions, and bacterial cells are spread by aerosols, caused by rain and sprinkler irrigation, and transported by wind to healthy leaves. Penetration occurs through the stomata. Infections of the crowns occur through local wounds or downwards from the affected leaves. During the growing season several cycles of secondary infections may occur. The bacterium may attack flowers, but not fruits.

During epidemics, when environmental conditions favour exudation and spread, the bacterium may cause systemic infections associated with crown pockets. Systemic infections may arise under damp nursery conditions. The conditions favouring infection are moderate to cool daytime temperatures (about 20°C), low night-time temperatures and high humidities (Maas, 1984). For more information, see Kennedy & King (1962b), Hildebrand *et al*. (1967), Maas (1984).

DETECTION AND IDENTIFICATION

Symptoms

On leaves, 1-4 mm, angular, shiny, water-soaked spots appear surrounded by the smallest veins. In the early stage the spots are only visible on the lower surface and appear translucent against the light. They enlarge, coalesce and after about 2 weeks are also visible on the upper surface as water-soaked, angular spots, which become reddish-brown in colour. They have a shiny appearance and are usually covered by bacterial exudate which when dry turns brown and appears as gum-like scales. Spots coalesce more frequently along the primary and secondary veins. The dead tissues tear and break off, and the diseased leaf may assume a ragged appearance.

In the most severe cases crown infection pockets may be seen inside after dissection. They appear as localized, water-soaked zones, frequently confined to one side of the crown.

For more information, see Kennedy & King (1962b), Hildebrand *et al*. (1967), Mazzucchi *et al*. (1973), Panagopoulos *et al*. (1978), Maas (1984).

Morphology

X. fragariae is an aerobic, Gram-negative, non-spore-forming, non-capsulate rod; size averaging 0.4 x 1.3 µm. Most cells are non-motile, but some have a single polar flagellum. On beef-extract-peptone agar, or similar medium without added carbohydrate, colonies are circular, entire, convex, glistening, translucent to pale-yellow (Bradbury, 1977).

Detection and inspection methods

The presence of the bacterium in affected plants may be confirmed by direct isolation or indirect immunofluorescence antibody staining (IFAS) of suspensions obtained by macerating in a mortar some water-soaked spots in a small volume of distilled water (Mazzucchi *et al*., 1973).

Direct isolation is difficult because the growth of the bacterium is very slow and its colonies are easily overgrown by those of secondary organisms. Isolation may be successful if the suspension is streaked on yeast dextrose chalk agar plates and incubated at 27°C at high humidities. Colonies develop more frequently where a mass of cells is transferred in close association. The first colonies are visible after 4-5 days. The colonies are circular, 0.5-1.0 mm in diameter, yellow-pigmented, dome-shaped, with entire edges. The pure culture is distinguishable from other phytopathogenic xanthomonads by at least seven characteristics (no growth at 33°C; no hydrolysis of aesculin; no acid from arabinose, galactose, trehalose, cellobiose; 0.5-1.0% maximum NaCl tolerance) (Kennedy & King, 1962b; Bradbury, 1984).

IFAS can be used successfully on the concentrated suspension or on its ten-fold dilution. In positive cases millions of small, rounded fluorescent bacteria can be seen. When using differential dilutions of antiserum, no interference has yet been reported due to the existence of cross-reactions with other bacteria. Detection is quite difficult on symptomless runners (Mazzucchi & Calzolari, 1987). Any crown infection pockets can only be detected by histological examination of single runners, which is difficult to apply to large lots. Moreover the runners may be so well cleaned that any small residues of old infected leaves are almost invisible. Recently a sampling detection method for symptomless runners was studied. Cleaned crowns of the sample are cut in quarters and homogenized. The bacteria are concentrated from the thick suspension by centrifuging. IFAS is applied to the final pellet. Although the method is not very sensitive, preliminary applications were quite encouraging. ELISA has also been tried out as a detection method (Lopez *et al.*, 1987).

MEANS OF MOVEMENT AND DISPERSAL

The bacterium is spread locally by splash dispersal. Commercial strawberry runners used for planting may spread the bacterium over short and long distances. They may still bear old, whole or torn, infected leaves or have crown infection pockets. Moreover, almost invisible fragments of infected leaves may be hidden in the apical crown region or between the roots (Kennedy & King, 1962a).

PEST SIGNIFICANCE

Economic impact

Like other strawberry leaf blights, *X. fragariae* causes a certain reduction in yield, but generally the disease is not destructive. However, heavy losses may occur with frequent overhead sprinkler irrigation.

Control

Use of healthy planting material and avoidance of conditions favouring disease are the main control methods. Treatments with copper-containing products have some effectiveness, but have to be applied very intensively, with a risk of phytotoxicity. Resistance to *X. fragariae* exists in breeding material, but not yet in commercial cultivars (Maas, 1984).

Phytosanitary risk

EPPO considers *X. fragariae* as an A2 quarantine organism (OEPP/EPPO, 1986), while IAPSC also considers it as of quarantine significance. The disease is absent from most strawberry-growing countries in Europe but probably has the potential to establish there.

Indeed, the general climatic conditions which are said to favour disease in North America tend to occur in Central and Northern Europe rather than in the Mediterranean countries where *X. fragariae* has been recorded until now. However, the specific influence of overhead sprinkler irrigation may be more characteristic of the Mediterranean countries. *X. fragariae* is certainly sufficiently damaging to deserve its quarantine status.

PHYTOSANITARY MEASURES

EPPO recommends, in its specific quarantine requirements (OEPP/EPPO, 1990), that strawberry planting material from infested countries should be derived from mother plants kept free from *X. fragariae* as part of a certification scheme (in preparation by EPPO), and in addition that the place of production should have been found free from the disease during the last five growing seasons. In addition, visual inspections during the dormant period can be useful. Inspectors should look for typical angular spots on old leaves or on their remains still attached to the runners. Samples from lots kept in cold storage must be inspected immediately after the runners are taken out and thawed. The spots can no longer be seen after only 1 day at room temperature.

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