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Data Sheets on Quarantine Pests

Viteus vitifoliae

IDENTITY

Name: *Viteus vitifoliae* (Fitch)
Synonyms: *Daktulosphaira vitifoliae* (Fitch)
Phylloxera vastatrix Planchon
Phylloxera vitifoliae (Fitch)
Taxonomic position: Insecta: Hemiptera: Homoptera: Phylloxeridae
Common names: Grapevine phylloxera, vine louse (English)
Phylloxéra de la vigne (French)
Reblaus (German)
Filoxera (Spanish)
Notes on taxonomy and nomenclature: The full life-cycle of *V. vitifoliae* on American *Vitis* spp. is a complex alternation between an aerial, leaf-feeding form, *gallicolae*, and the root-feeding form, *radicicolae*. On the European species *V. vinifera*, the *radicicolae* form predominates and the *gallicolae* form is virtually absent. The occurrence or non-occurrence of the *gallicolae* form also depends on several other factors, including vine cultivar and environment (Stevenson & Jubb, 1976).
Bayer computer code: VITEVI
EPPO A2 list: No. 106
EU Annex designation: II/A2 - as *Daktulosphaira vitifoliae*

HOSTS

The principal economic hosts are *Vitis* spp. There are large differences in tolerance or resistance between species: *V. vinifera* is extremely susceptible to attack by the *radicicolae* form but the leaves are resistant, whereas the American species *V. riparia* withstands extensive galling of the leaves but is resistant to root attack. *V. riparia* is therefore widely used in interspecific hybrid rootstock production. Other American species are resistant (*V. rupestris*, *V. berlandieri*) or susceptible (*V. labrusca*, *V. aestivalis*) to damage.

V. vinifera is now widely grown throughout the EPPO region, but is generally grafted to American rootstocks and is therefore resistant to *V. vitifoliae*.

GEOGRAPHICAL DISTRIBUTION

V. vitifoliae is native to North America and was introduced into Europe in the latter part of the 19th century. It has continued to spread throughout the 20th century.
EPPO region: Algeria, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Greece (but not Crete), Hungary, Israel, Italy, Lebanon, Luxembourg, Macedonia, Malta, Moldova, Morocco, Portugal, Romania, Russia (southern), Slovakia, Slovenia, Spain, Switzerland, Syria, Tunisia, Turkey, UK (recently introduced into England; distribution very restricted), Ukraine, Yugoslavia.

Asia: Armenia, Azerbaijan, China (north), Georgia, India, Israel, Japan, Jordan, Korea Democratic People's Republic, Korea Republic, Lebanon, Syria, Turkey.
Africa: Algeria, Morocco, South Africa, Tunisia, Zimbabwe.
North America: Bermuda, Canada (British Columbia, Manitoba, Ontario), Mexico, USA (Arkansas, Arizona, California, Connecticut, New Mexico, New York, Ohio, Pennsylvania, Texas, Washington).
Central America and Caribbean: Panama.
South America: Argentina, Bolivia, Brazil, Colombia, Peru, Uruguay, Venezuela.
Oceania: Australia (New South Wales, Queensland, South Australia, Victoria), New Zealand.
EU: Present.
Distribution map: See CIE (1975, No. 339).

BIOLOGY

On American grape species, *V. vitifoliae* lives on the roots and leaves, and has a full cycle of development with the presence of all forms of the aphid. This full cycle involves migration from the roots to the leaves and back to the roots, and also an alternation of parthenogenetic and sexual reproduction. On cultivars of the European grapevine, *V. vinifera*, the aphid normally infests only the underground parts of the plant and undergoes an incomplete cycle of seasonal development, with no change of feeding site.

The winter is passed as eggs attached to the grapevine stems (American grapevines) and in the form of 1st and 2nd instar nymphs on the nodules or galls on vine roots (European grapevines). The survival of eggs on stems is dependent on temperature: optimal temperatures for survival are between 21 and 36°C (Granett & Timper, 1987).

In the full life-cycle, eggs on the stems hatch in spring, after the foliage has come out, and the yellow aphids developing from these eggs, the *gallicolae* form, migrate to the leaves, where they begin feeding, so causing the formation of galls. As soon as the aphids mature, they lay 400-600 eggs inside each gall. Four to six generations of the *gallicolae* appear. Individuals of the final generation of these leaf-inhabiting aphids drop to the ground and burrow beneath the soil to the roots, as deep as 1.2 m, where they can live for a number of parthenogenetic generations. Towards autumn, winged, sexuparous forms are produced on the grapevine roots; they leave the ground and fly to grapevine leaves. After 24 h, two kinds of eggs are laid; larger ones give rise to females, and smaller ones to males. This sexed generation mates, producing the winter eggs, thus completing the life-cycle. Even very severe winter conditions do not kill the eggs.

On European cultivars of *V. vinifera*, *radicicolae* become active, feeding on the roots, as soon as growth starts in the spring. They continue to multiply parthenogenetically through the summer. Sexuparous forms appear but cannot develop further on the leaves, and the aerial life-cycle is therefore not completed.

V. vitifoliae can survive under virtually all climatic conditions tolerated by its host plant. It appears not to be influenced by temperature, rainfall or humidity within that range (de Klerk, 1974). In South Africa it has been shown to be influenced by soil type, with infestations decreasing as the percentage of fine and medium sand content of a soil increases. *V. vitifoliae* does not occur in soils with a medium to fine sand content of more than 65% (de Klerk, 1974). Development from egg to adult female takes about 22 days and the annual active reproducing period is 7.5 months.

For more information, see Dominguez Garcia-Tejero (1957), Maillet (1957), Rilling (1964), Daris (1970), Bovey (1972), Gorkavenko (1975), Gorkavenko & Gorkavenko (1977).

DETECTION AND IDENTIFICATION

Symptoms

- ***Gallicolae* form**

Small galls, about the size of half a pea, develop on the leaf surface, sometimes so numerous as to cover practically the entire leaf. The galls are open on the underside of the leaf. Although leaf galling by phylloxera does not normally cause significant losses in grape production, severe infestations do cause considerable distortion and dropping of affected leaves late in the season.

- ***Radicicolae* form**

Numerous knots or galls form on grapevine roots, with rotting of the roots, yellowing of the foliage and general decrease in vigour of the vines. Death of the vines may result within 3-10 years.

Morphology

- ***Gallicolae* form**

Adult

Globular aphid, 1.6-1.8 mm long and 1-1.2 mm wide; cephalothorax widened and its dorsal face rounded off; abdomen tapers off and is slightly frayed posteriorly; antennae composed of three segments, the 3rd one being the most developed and provided with a large primary latero-external sensorium; the processus terminalis is short and broad, little differentiated at its base, having a length which is one-third in excess of that of the 3rd segment (dimension taken from the base of the sensorium to the tip of the antenna, excluding the apiales); dorsal cuticle is rough, but entirely free from tubercles. The rostrum reaches the femora of the foremost legs.

- ***Racicicolae* form**

Eggs

The eggs are 300-330 x 160-170 µm.

Larva

The four larval stages have the same general external morphology as the adult. In the later stages, the width of the body increases more rapidly than the length, and the body thus becomes rounder in outline. Similarly the size of the legs and antennae does not increase at the same rate as that of the body; they therefore appear smaller in the later stages. From the second stage onwards, the tubercles on the dorsal surface become more obvious.

Adult

General appearance similar to *gallicolae* form, but smaller, being about 1 mm in length. It is distinguished by the presence of tubercles on the dorsal surface - 12 on the head, 28 on the thorax and 30 on the abdomen. On the antenna, the processus terminalis is well differentiated and much finer than that of the *gallicolae* form.

MEANS OF MOVEMENT AND DISPERSAL

V. vitifoliae has very limited capacity for natural spread if it remains more or less confined to the root system in the *radicicolae* form (as it does in Europe), and this is partly what ensured that the species did not very rapidly occupy all European vineyards. The *radicicolae* form is liable to be carried in international trade only on grapevine plants for planting, i.e. not on fruit.

PEST SIGNIFICANCE

Economic impact

V. vitifoliae is the most destructive pest of grapes known in Europe and the western USA, and has become an important pest of wine grapes in Pennsylvania. Within 25 years of its introduction into France from America (about 1860) it had destroyed nearly one-third of the vineyards in the country - more than 1000 000 ha - with incalculable economic and social consequences. This was because the European grapevine cultivars then grown were highly susceptible. The solution found was to replant with European cultivars grafted on American rootstocks, a practice which is now almost universal wherever *V. vitifoliae* occurs. The pest remains especially threatening for the few regions where susceptible grape cultivars are still cultivated on their own roots (rather than on resistant rootstocks). It is also more damaging in recently planted vineyards, and damage is less significant on vigorous vines over 10 years old. Leaf infestation is reported to have no economic effect on wine grapes, or on the quality and quantity of wine made from them (Strapazzon *et al.*, 1986; Strapazzon & Girolami, 1985b).

For more information, see Balachowsky & Mesnil (1935), Dominguez Garcia-Tejero (1957), Rilling (1964).

Control

Use of resistant rootstocks has been the main and most successful control measure for many decades. However, recent studies indicate that this practice might become less effective in future as new biotypes of *V. vitifoliae* develop (Williams & Shambaugh, 1988). In Italy, new biotypes have developed in several parts of the country, distinct from those which were originally introduced from the USA (Strapazzon & Girolami, 1985a). A combined German and New Zealand research project demonstrated differences in susceptibility of several rootstocks after inoculations with New Zealand and German populations of *V. vitifoliae* (King & Rilling, 1985), and in the USA research studies showed that certain populations of the pest could overcome the resistance of even highly resistant cultivars (Granett *et al*., 1985).

Phytosanitary risk

V. vitifoliae is an A2 quarantine pest for EPPO (OEPP/EPPO, 1981) and has quarantine significance for NAPPO. It has been one of the classic objects of phytosanitary regulations, leading to the first international measures and agreements for phytosanitary purposes in Europe. However, the number of important viticultural regions which remain free from phylloxera is now very limited. Within the EPPO region, examples include Cyprus, parts of Greece, small areas in the Czech Republic and Switzerland. A few vineyards in the UK (where many grapevines have been planted in the 1980s) are subject to statutory eradication procedures following pest infestations. Once established, the insect is extremely difficult and costly to eradicate. However, it is now so widespread in the EPPO region that one can question whether it is worth maintaining quarantine measures for the benefit of such a small group of growers. In any case, schemes for certification of grapevine planting material (OEPP/EPPO, in preparation) should provide a simple means of ensuring that all traded grapevine planting material is free from *V. vitifoliae*.

A different problem is the introduction or appearance of possible new biotypes of the pest, presenting a threat to grape-growing countries within EPPO. The establishment of new biotypes which have overcome the resistance of certain rootstock cultivars could lead to a dramatic change in the phytosanitary situation in European and Mediterranean vineyards. However, it is possible that even this problem can be solved by certification rather than by plant quarantine.

PHYTOSANITARY MEASURES

According to the EPPO specific quarantine requirement (OEPP/EPPO, 1990), grape-growing countries may require that the place of production of plants for planting, and cut branches, has been inspected and that *V. vitifoliae* has not been found during the last two growing seasons. Additionally, they may require that the consignment has been treated either by fumigation with methyl bromide or hydrogen cyanide or dipped in parathion (OEPP/EPPO, 1987). It may be required that fruits of *Vitis* be free of leaves.

In Russia, it is recommended to fumigate grapevine stocks with methyl bromide (Litvinov *et al*., 1985a) or hexachlorobutadene (Litvinov *et al*., 1985b). In Japan, a hot water treatment for rootstocks at 45°C for 20 min has been reported to be effective (Sakai *et al*., 1985).

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