PEST FACT SHEET

Grapevine phylloxera

Daktulosphaira vitifoliae

Common names: grape leaf louse, filloksera
Higher taxon: Hemiptera: Phylloxeridae
Synonyms: *Viteus vitifoliae* (Fitch)
EPPO code: VITEVI

Grapevine phylloxera is an aphid-like insect which originated in North America but now occurs throughout almost all grapevine growing regions of the world. It is considered to be the worst economic pest of grapevine in the world.

The pest has a very complex life cycle and is capable of sexual and asexual reproduction, and of infesting and forming galls on grapevine leaves and roots. In South Africa, the root-gall form is present almost exclusively, except in limited areas. There are no males when reproduction is asexual. Grapevine phylloxera damages vine roots by inserting its sucking mouthparts, which causes galls to form and the root systems of vines to weaken over time.

There are no effective biological or chemical controls for grapevine phylloxera. The best prevention is achieved through cultural control measures, by keeping soil in susceptible regions adequately watered and fertilized, and by grafting vines onto American rootstocks which are resistant to phylloxera infestation. Phylloxera biotypes are specific to grapevine species and regions. However, new research shows that hybridization is possible and there is a risk of emergence of new and resistant phylloxera biotypes worldwide.

Grapevine phylloxera nymphs.

CORINNA S. BAZELET, PhD ~ IPM INITIATIVE ~ STELLENBOSCH UNIVERSITY
+27 21 808 9600 ~ CBAZELET@SUN.AC.ZA
Edited by Dr. Pia Addison

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BIOLOGY

Number of generations per year in South Africa: ≤10
Length of generation from hatching to death: 16 days at 24^{0}C
Threshold for development: 9.3^{0}C

Grapevine phylloxera is an aphid-like pest with a very complicated life cycle which consists of four different forms: a sexual form, a leaf form (*gallicolae*), a root form (*radicicolae*) and a winged form. It can reproduce both sexually and asexually (parthenogenetically), by laying unfertilized eggs from which female clones of the mother emerge. In South Africa, the root form (*radicicolae*) is predominant, with parthenogenetic reproduction which produces females only. The occurrence of the leaf form (*gallicolae*) depends on vine species, cultivar and environment, the combination of which is rarely suitable in South Africa, except occasionally within nurseries. On American grapevines, all four forms exist. Crawlers move back and forth from the roots to the leaves, and parthenogenetic and sexual reproduction are alternated.

Sexual form

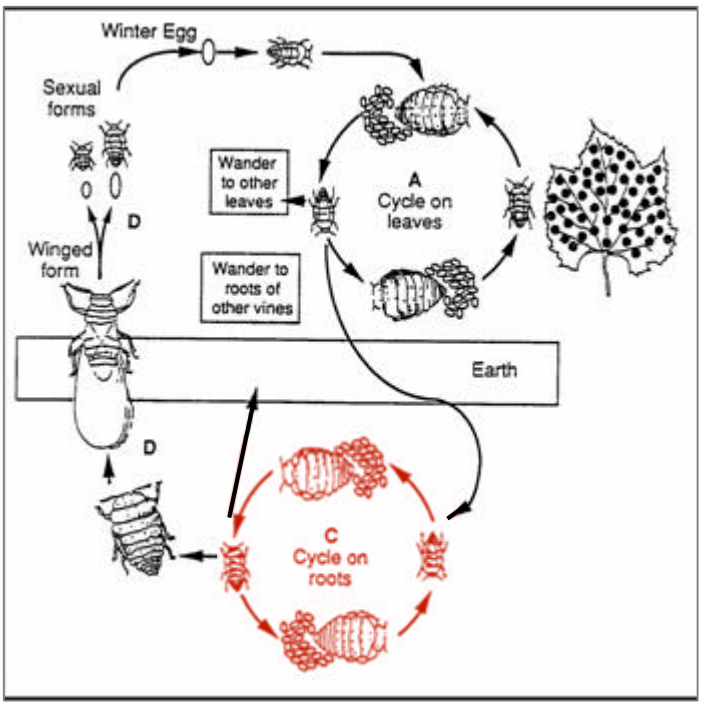
Adult male and female phylloxera of the sexual form normally emerge in the wintertime and have no digestive system. They emerge from nymphs hatched from eggs laid on the underside of leaves. The adults mate soon after emerging. The female lays one egg on the bark of a grapevine trunk before dying. This egg develops into the leaf form *(gallicolae).*

Gallicolae form

Phylloxera crawlers from eggs laid on the bark migrate to leaves where they begin feeding by inserting their needle-like mouthparts into plant tissue and sucking phloem. Saliva injected into the leaf causes the formation of characteristic leaf galls. Once the phylloxera have undergone four nymphal stages, the female adult emerges and lays 400-600 unfertilized eggs within the gall. Nymphs which emerge from these eggs are all females and can either move to nearby leaves or drop to the ground. The *gallicolae* form undergoes 4-6 generations throughout the season. The final generation drops to the ground to produce the root form.

Radicicolae form

Several generations can occur within the soil. These generations are all wingless and reproduce parthenogenetically, producing only females. Feeding by the root form is the primary cause of damage to grapevines by phylloxera.



Grapevine phylloxera life cycle. From: http://www.growables.org/information/LowChillFruit/images/GrapevinePhylloxeraLifeCycle.jpg. Typical life cycle in South Africa indicated in red.

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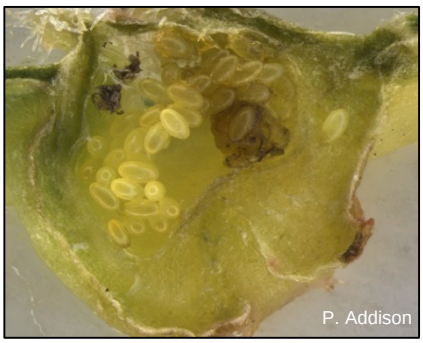
Damage associated with radicicolae form

Phylloxera insert their needle-like mouthparts into the roots of grapevines. This causes localized enlargements or swelling of phloem cells on the roots and forms characteristic galls which are yellow and fleshy on young, fibrous feeder roots (often called tuberosities) and appear as fleshy outgrowths that cause the root to bend at the point of feeding or brown warts on storage roots (called nodosities). Secondary fungal infections lead to necrotic spots on the feeding sites. Successive generations cause weakening of grapevine root systems. Vines are stunted and produce less grapes. Grapevines may eventually die.



Grapevine phylloxera eggs.

Winged form

Winged females emerge from the grapevine roots in the autumn and leave the ground to fly to leaves. After 24 hours, these winged females lay two types of eggs on the underside of leaves: larger eggs produce females and smaller eggs produce males. These eggs hatch to produce the sexual form in the wintertime.

Variations of this complex life cycle have been observed in different regions and on different grapevine species. It appears that the life cycle depends on a complex interaction of resistance of leaves and roots of different vine species to the various forms of the phylloxera. Different biotypes of phylloxera may also vary in terms of length of their life cycle and propensity to undergo each of the four life forms.

Grapevine phylloxera nymphs.

IDENTIFICATION

Egg

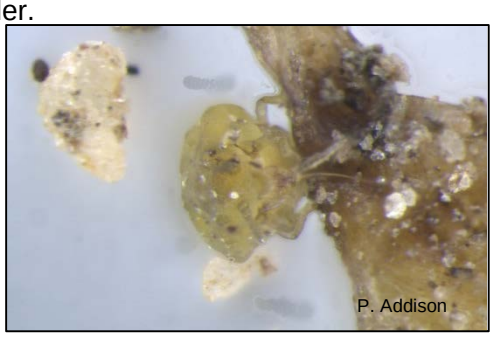
Size: 0.3 mm long, 0.15 mm wide
Oval and yellow at first, darkening as they mature.

Nymphs

Number of instars: 4;
Final instar size: >0.15 mm head capsule width;
First instar nymphs are the dispersal stage, called “crawlers”. Each instar becomes progressively larger. All stages look similar to adult females, but smaller.

Adult

Size: wingless females: 1 mm long, 0.5 mm wide
Number of eggs laid by single female (*radicicolae*): 50-70 eggs
No males are present in southern Africa. Adult females come in two forms – winged or wingless but only the wingless form occurs in South Africa. Colour varies from yellow, greenish to orange.



Grapevine phylloxera feeding.

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ECONOMIC IMPORTANCE

In South Africa, grapevine phylloxera galls occur mostly on rootstock varieties. Since the practice of grafting vines onto resistant rootstocks was widely adopted, grapevine phylloxera has not caused severe economic damage. However, the adaptation of new resistant phylloxeran biotypes poses a risk and should be monitored.

When grapevine phylloxera first invaded France in the late 1800s, it decimated one-third of the vineyards in the country. Any rootstock with *Vitis vinifera* parentage (European vines) is susceptible to phylloxera.

In areas where more than one vine species occur, phylloxera can hybridize through sexual reproduction and create new genotypes. Over time this can lead to biotypes of phylloxera which overcome the resistance of even the most resistant rootstock strains.

Grapevine phylloxera root gall (tuberosity)

Grapevine phylloxera root galls.

HOST PLANTS

Grapevine phylloxera infects all known species of grapevines. It does not occur on other plants.

Common name	Scientific name	Family
Grapevines	*Vitis* spp.	Vitaceae

Grapevine phylloxera leaf gall.

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MANAGEMENT

Monitoring

Vines which fail to grow healthy roots, become unproductive and show stunting of lateral shoot growth should be inspected for typical swellings and presence of nymphs and adult phylloxera. Emerging nymphs can be monitored by sticky traps placed on the ground around vine trunks. In regions of South Africa which are susceptible to phylloxera, soil and root samples should be taken between December and February to determine phylloxera infestation.

Prevention

The best prevention for grapevine phylloxera infestation is planting of resistant vines. North American grapevines are resistant to phylloxera. Worldwide, European grapevines are grafted onto American rootstocks (e.g. *Vitis riparia* and *V. aestivalis*) to prevent grapevine phylloxera establishment. Vines can also be planted in healthy, light and sandy soils as phylloxera thrive under plant stress conditions. Farm machinery should be disinfected to prevent phylloxera movement from place to place.

Control measures

No insecticides are registered against phylloxera in South Africa. Under experimental conditions, imidacloprids, spirotetramat and phosphines had some efficacy against phylloxera. However due to the presence of the pest within galls of grapevines, these are unlikely to be effective under field conditions. Dormant vine cuttings can be placed in hot water baths (43-52ºC) to kill latent phylloxera.

Grapevine phylloxera feeding damage to vine roots.

Grapevine phylloxera feeding damage to vine leaves. Source: http://bygl.osu.edu/index.php/node/400

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MANAGEMENT

Natural enemies (biological control)

No natural enemies have been identified in South Africa. Trials have been conducted in Europe to test the efficacy of entomopathogenic nematodes and entomopathogenic fungus, *Metarhizium anisopliae*, against grapevine phylloxera. *M. anispoliae* reduced population sizes for two years post-application, but this effect did not last in the long-term.

Attractants and trapping (pheromonal control)

No attractants or pheromonal control has been identified for grapevine phylloxera.

QUARANTINE REGULATIONS

Grapevine phylloxera is listed as an A2 quarantine pest by the European and Mediterranean plant protection organization (EPPO). However, most grape-producing regions of the world already have established populations of grapevine phylloxera. The only regions which still remain free of phylloxera in the EPPO region are Cyprus, and small parts of Greece, Czech Republic, Switzerland and the UK.

Grapevine phylloxera was one of the first pests ever subjected to international agreements for phytosanitary regulations. However, given its current distribution, it is under debate whether funds should continue to be allocated to preventing the spread of the current biotypes. Instead, many argue that funds should go to ensuring that resistant biotypes do not evolve and spread. Also, the spread of grapevine phylloxera has been most effectively curbed by certification procedures for planting of new grapevines rather than by phytosanitary regulations, and certification is the recommended way forward to continue to curb the status of this pest.

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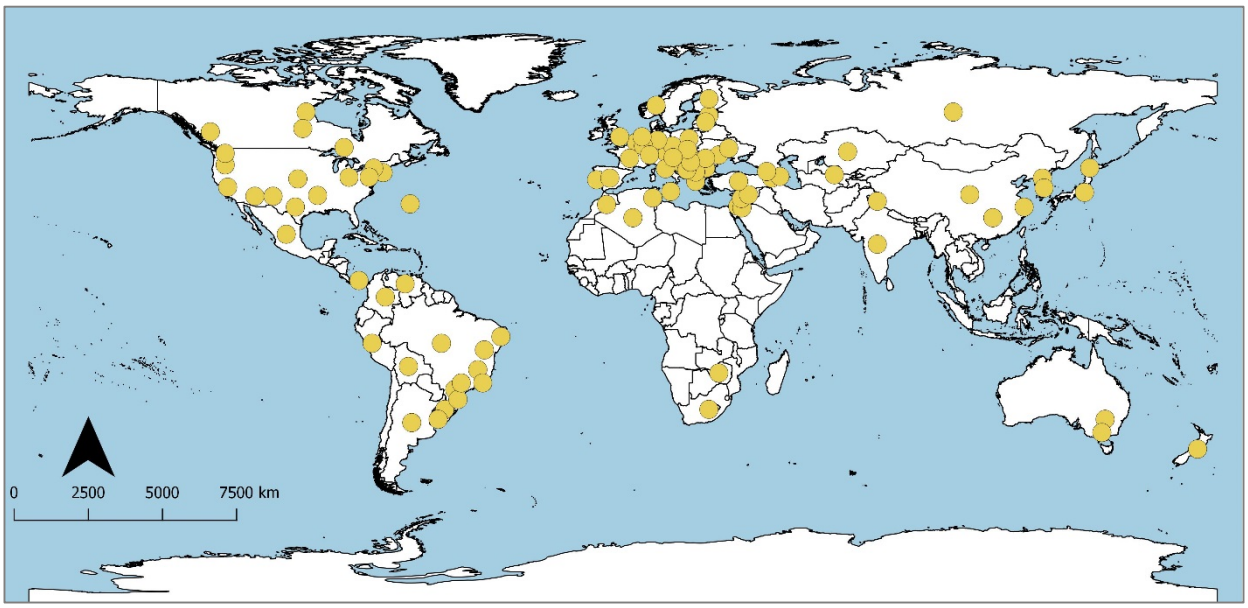
DISTRIBUTION

Grapevine phylloxera originated in North America, particularly in the eastern and central USA. In its native range it feeds on indigenous grapevines. It was introduced into Europe in the 1850s and from there spread to the rest of the grape-growing regions of the world. It was first reported in South Africa in 1886. In South Africa, it occurs in the Western Cape, and Orange River Valley, Northern Cape.



Grapevine phylloxera, *Daktulosphaira vitifoliae*, distribution. Data from CABI (2017). Map drawn by C.S. Bazelet.

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