EPPO Datasheet: *Margarodes vitis*

Last updated: 2022-05-19

IDENTITY

Preferred name: *Margarodes vitis*
Authority: (Philippi)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Hemiptera: Sternorrhyncha: Margarodidae
Other scientific names: *Coccionella vitis* (Philippi), *Margarodes vitium* Giard, *Sphaeraspis vitis* (Philippi)
Common names: ground pearls, margarodes
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EPPO Categorization: A1 list
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EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: MARGVI

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Notes on taxonomy and nomenclature

Six non-European species of *Margarodes* have been recorded on the roots of grapevine. *Margarodes vitis* (Philippi) occurs in South America. The other five species are found in Southern Africa: *M. capensis* Giard, *M. greeni* Brain, *M. prieskaensis* (Jakubski), *M. trimeni* (Giard) and *M. vredendalensis* de Klerk. The North American ground pearl species that used to be called *Margarodes meridionalis* Morrison is now known as *Dimargarodes meridionalis* (Morrison).

The cyst stage of *M. vitis* was first described as a nematode, *Heterodera vitis* Philippi, and only later as an insect, *Margarodes vitium* Giard. It is often referred to by the latter name in publications from South America.

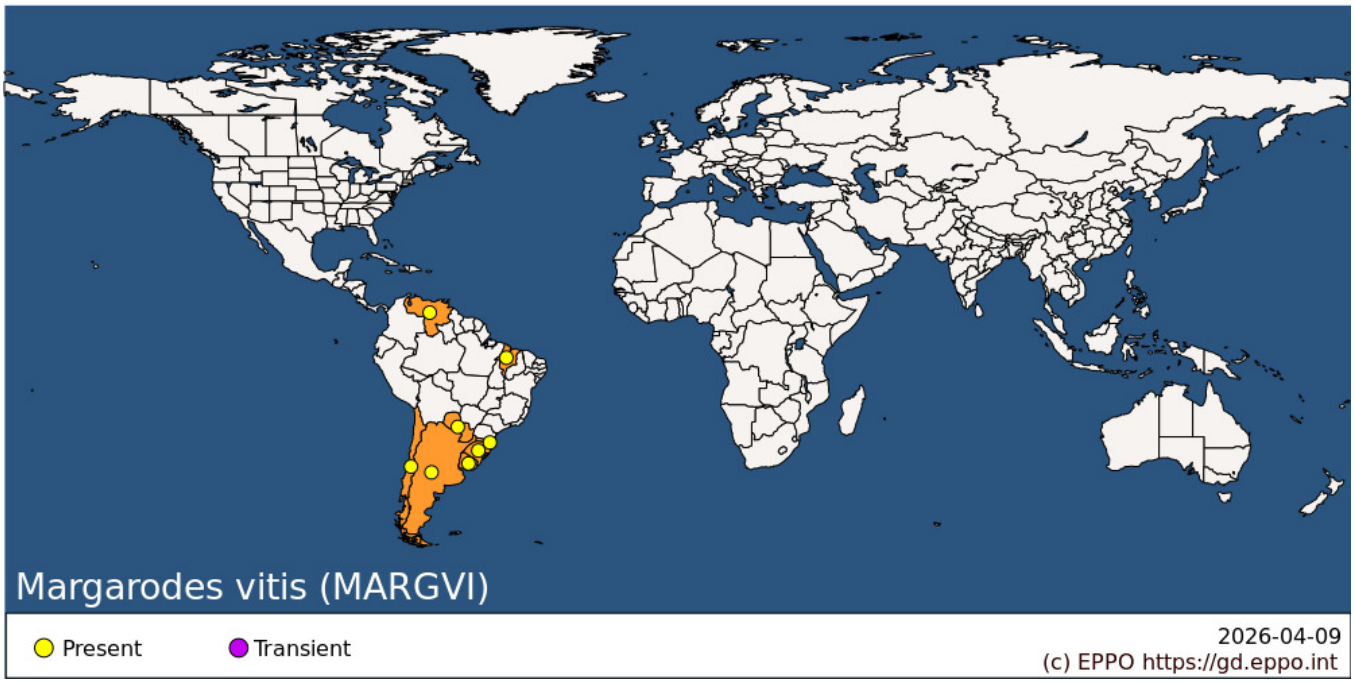
HOSTS

Margarodes vitis is polyphagous, feeding only on the roots of wild plants and weeds belonging to the families Apiaceae, Asteraceae, Casuarinaceae, Convolvulaceae, Euphorbiaceae, Fabaceae, Linaceae, Malvaceae, Nyctaginaceae, Poaceae, Polygonaceae, Rosaceae, Verbenaceae and Vitaceae. Grapevine (*Vitis vinifera*) is the principal, economically significant host, and this would be the host at risk in the EPPO region. Other cultivated hosts have been recorded in Cactaceae (*Opuntia* sp.) and Rhamnaceae (*Colletia spinosissima*) (González, 1989). *Margarodes vitis* is also recorded as a pest of tung (*Aleurites* sp., Euphorbiaceae) in Brazil (Mariconi & Zamith, 1973). Among the other genera on which it has been recorded, the following are of significance to the EPPO region: *Arachis*, *Cydonia*, *Dahlia*, *Linum*, *Petroselinum* and *Prunus* (Jakubski, 1965).

Host list: *Aleurites sp.*, *Apiaceae*, *Aralia sp.*, *Asteraceae*, *Cactaceae*, *Casuarinaceae*, *Colletia spinosa*, *Convolvulaceae*, *Cydonia oblonga*, *Dahlia sp.*, *Euphorbiaceae*, *Fabaceae*, *Linaceae*, *Malus domestica*, *Nyctaginaceae*, *Opuntia sp.*, *Petroselinum sp.*, *Poaceae*, *Polygalaceae*, *Prunus sp.*, *Rhamnaceae*, *Rosaceae*, *Rumex acetosella subsp. pyrenaicus*, *Tilioideae*, *Verbenaceae*, *Vitaceae*, *Vitis sp.*, *Vitis vinifera*

GEOGRAPHICAL DISTRIBUTION

Margarodes vitis is only known from South America. It was originally described from Chile and has since been recorded from Argentina, Brazil, Paraguay, Uruguay and Venezuela.



South America: Argentina, Brazil (Maranhao, Rio Grande do Sul, Santa Catarina), Chile, Paraguay, Uruguay, Venezuela

BIOLOGY

Margarodes vitis is a subterranean species that feeds on roots usually at a depth of 20-60 cm, but it can occur at depths of up to 120 cm. According to Foldi & Soria (1989), *M. vitis* is parthenogenetic (However, see note on rare exception described below) and remains in the soil all year. Adult females occur in the soil around the host's roots in late spring and early summer (between October and December). Adult females lack mouthparts and cannot feed; each female lays between 150 and 900 eggs (depending on body size) in long strings into an ovisac of white wax filaments near the roots in summer (these ovisacs can be found in the soil between November and February). Newly hatched first-instar nymphs have legs; they find and attach to the roots by their mouthparts to feed, then become sessile. The subsequent cyst stage remains attached by its mouthparts and undergoes two moults within the ground pearl (Giliomee *et al*., 2022 in press), feeding and growing after each moult before becoming dormant again (González, 1983). Dormant cysts can survive in the soil for many years (González, 1983; Giliomee *et al*., 2022 in press). Each year, adult females emerge from some of the cysts lying dormant in the soil and go on to reproduce. The life cycle from egg to adult takes at least 3 years (Foldi & Soria, 1989).

Jakubski (1965) described adult males, which are very rare, live for up to 14 days and appear for a short time above ground to mate. It is not known whether the rare production of males might indicate the presence of a sexual biotype or an unidentified cryptic species, or not. Mating would be expected to occur on the soil surface in early summer (between mid-November and the end of December).

DETECTION AND IDENTIFICATION

Symptoms

Infestations of vineyards by *M. vitis* are usually patchy. Over several years the patches increase in size, presumably because of the gradual subterranean dispersal of the first-instar nymphs and adult females. Vines infested with *M. vitis* exhibit gradual loss of vigour, shoots become thinner and shorter, and the leaves become smaller (Annecke & Moran, 1982) and tend to point downwards (de Klerk, 2017). One or more of the branches may die, followed in severe infestations by the eventual death of the whole plant within five or six years; the duration of this process varies but happens much faster if the vines are stressed by either too much or too little water (de Klerk, 2017). Ground pearl damage symptoms resemble those caused by grapevine phylloxera (*Daktulosphaira vitifoliae* (Fitch),

Hemiptera: Aphidomorpha: Pylloxeridae) but in the case of *M. vitis*, no root or leaf galls are formed.

Morphology

Eggs

Based on photographic evidence (from Dr Arnaldo Rodriguez, ConoSur vineyards & winery, Administrador Fundo Santa Elisa, Chimbarongo, Chile), the eggs of *M. vitis* are produced in long strings, with the eggs stuck together by their narrow ends. Newly laid eggs are elongate-ovoid, each approximately 0.6 mm long, smooth, creamy white and lightly coated with fine white wax filaments.

Nymphs

Based on photographic evidence (see above), first-instar nymphs of *M. vitis* are long and narrow, creamy white, each approximately 1 mm long, with antennae and legs clearly visible. The subsequent cyst stage is broadly ovoid to spherical, lacks legs, has very small antennae and is enclosed in an ovoid, hard, pale to mid-brown test, up to 7 mm long and 4-5 mm in diameter (EPPO, 2007). The light yellow to red-brown cyst (Foldi, 2005; EPPO, 2007) has a rough, scaly outer wall (EPPO, 2007; Giliomee *et al*., 2022 in press). When the hard outer layer is removed, the insect within is pale creamy yellow (EPPO, 2007).

Adults

The adult females are ovoid and very variable in size, up to 10 mm long and 5 mm wide, pale creamy yellow, with soft, deeply segmented bodies densely covered with long brown hair-like setae. They have characteristic enlarged fossorial (digging) forelegs with dark-brown claws (Giliomee *et al*., 2022 in press). The males described by Jakubski (1965), if conspecific with *M. vitis*, are extremely rare and probably about 3.8-4.4 mm long, with long antennae, legs, a single pair of wings and probably a tail tuft of white wax filaments.

Authoritative identification involves detailed microscopic study of the adult females and/or cysts by a scale insect specialist. Prior to identification, specimens may be preserved in 75% ethanol. A slide-mounted adult female has numerous spines on metathorax and abdomen, progressively denser towards apex of abdomen, with each spine enlarged apically (EPPO, 2007; Giliomee *et al*., 2022 in press).

For detailed morphological descriptions and illustrations, see Jakubski (1965) and Foldi & Soria (1989), as well as the EPPO diagnostic protocol (EPPO, 2007); Giliomee *et al*. (2022 in press) provide photographs.

Detection and inspection methods

In vineyards, patches of possible infestation can be detected visually by looking for groups of vines exhibiting poor growth, small leaves curling downwards and dieback. The parthenogenetic females remain underground all year. Further investigation involves digging down to the main concentration of vine roots (between 0.5-1.2 m depth), where the roots and the soil closely surrounding them should be examined. If root galls are found then vine phylloxera (*Daktulosphaira vitifoliae*) may be responsible for the damage. If root galls are not found, the inspection should look for dull, pale yellow to red-brown ovoid cysts up to 7.0 mm long with a dull, scaly surface. The cysts are present throughout the year on roots or lying free in the soil and are easily detected.

Crop inspection procedures for grapevine plants for planting have been developed (EPPO, 2018). The EPPO diagnostic protocol for *M. vitis* also provides detection and identification methods based on Morphology (EPPO, 2007; see also Morphology).

PATHWAYS FOR MOVEMENT

Natural dispersal is limited due to the subterranean habit of the insect; the first-instar crawlers and burrowing adult females within the soil are the only natural dispersal stages. However, infestation can be spread within and between vineyards or blocks of vines within a vineyard on soil cultivation implements (de Klerk, 2017). All the developmental stages may be transported over long distances from infested areas via human-assisted spread on grapevine or other plants for planting (when moved with roots and soil attached) and/or in soil.

PEST SIGNIFICANCE

Economic impact

An infestation of *M. vitis* devitalizes the host plant directly by sap depletion and probably by injecting toxins, damaging the roots which results in gradual decline, chlorosis, dieback and ultimately death in conditions of stress (Anonymous, 2016; Giliomee *et al*., 2022 in press). This ground pearl is of great economic importance in South America, causing severe damage to grapevines, especially in Chile where it is the most important pest in the central grapevine-growing region. Approximately 600 ha of vineyards are infested in Chile (Olalquiaga Fauré & Contesse Pinto, 1959), with up to 31 cysts per litre of soil causing quite extensive damage (Barnes *et al*., 1969). Significant damage is also done to grapevines in Argentina, Uruguay and Venezuela (González, 1983). *Margarodes vitis* is also a pest of tung (*Aleurites* sp.) in Brazil (Mariconi & Zamith, 1973).

Ground pearls are difficult to control and vineyards that are replanted in infested soils are readily reinfested, even after an interval of several years. In South Africa, other ground pearl species similar to *M. vitis* are increasingly serious pests of vineyards, resulting in vines dying in patches and some vineyards being completely destroyed (de Klerk, 1980; Swart & de Klerk, 1986). The soil may become permanently unsuitable for commercial grapevine cultivation (de Klerk, 1980).

Control

Natural enemies of *M. vitis* have not been documented. This ground pearl used to be controlled by flooding vineyards at the times of adult emergence (November to December) and hatching of young larvae (February), with repeated treatments over several years until no viable cysts remained (Galet, 1982). However, this method has practical limitations, tends to favour weeds and is of variable effectiveness.

There is no data available regarding grapevine varietal resistance to *M. vitis.* In South Africa, no vine rootstock resistance to the South African species of *Margarodes* has been found, although many European and American varieties have been tested (de Klerk, 2017), and at present, pesticide application is the only method of control. This presents technical problems because the target insects are underground.

In South Africa, effective control of *M. prieskaensis* has been obtained using neonicotinoid pesticides (thiamethozam or imidacloprid) as a soil application shortly after harvest, when the annual population of new cysts starts feeding and translocation in vines is still active (de Klerk, 2010). These are systemic insecticides, and the time of application has to be managed very strictly to avoid residues in the grapes. Follow-up treatments are essential, as only a certain proportion of cysts develop into females in a season and dormant cysts survive the treatment.

Previously in South Africa, adult females, male prepupae and pupae of *M. prieskaensis* had been controlled on a commercial scale in two vineyards by an application of hexachlorobutadiene (de Klerk, 1987). The best results were obtained after harvest during March. Although the cyst stages were not affected, applications in two consecutive years did effectively control the pest. However, in Argentina (Mendoza and San Jan provinces), soil treatments with hexachlorobutadiene did not give satisfactory control of *M. vitis* (Vega, 1978).

Phytosanitary risk

There are no *Margarodes* species occurring in the EPPO region on grapevine, nor any grapevine pest with similar biology. Accordingly, ground pearl species recorded on grapevine in South Africa and South America present a serious phytosanitary risk to vineyards in the EPPO region. Non-European ground pearl species recorded feeding on

grapevine roots are: *M. capensis, M. greeni, M. prieskaensis, M. trimeni* and *M. vredendalensis* from South Africa; *Dimargarodes meridionalis* Morrison from California, and the closely related *Eurhizococcus brasiliensis* (Hempel in Wille) from Brazil; however, the ground pearl species most damaging to grapevines is *M. vitis* in South America. It should be noted that grapevine rootstocks in South America (in countries where grapevine phylloxera is not present) may differ from those used in Europe and therefore there is a greater degree of uncertainty regarding the impact of the South American margarodids in European vineyards (EFSA, 2019). The relative polyphagy of *M. vitis* may mean that it presents a phytosanitary risk to other plant species grown in the EPPO region also.

Margarodes vitis occurs in countries with a range of climate types including temperate and humid subtropical (type Cfa according to the Köppen Geiger classification) which also occurs in the EPPO region where hosts are grown. Across the EPPO region a variety of soil types and climates occur and grapevines are widely cultivated, so it is assumed that *M. vitis* would be able to establish in the EPPO region (EFSA, 2019). *Margarodes vitis* can remain dormant as cysts in the soil for many years and can create colonies from single parthenogenetic females, making it extremely difficult to eradicate, so it is important to exclude it from the EPPO region.

PHYTOSANITARY MEASURES

A number of EPPO countries already ban the import of *Vitis* plants for planting (other than seeds) (e.g. EU countries: Annex VI, points 10 of Regulation 2019/2072 (EU, 2019)) and prohibit the import of soil. However, *M. vitis* is polyphagous and plants other than *Vitis vinifera* could provide a potential pathway. Other appropriate phytosanitary measures to import *Vitis* or other host plants for planting (other than seeds) with roots into the EPPO region could require that these plants are produced in a pest free area or in a pest free place/site of production for *M. vitis*, established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* (EPPO, 2016). Host plants for planting could also be imported using post-entry quarantine (in the framework of a bilateral agreement).

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Datasheet history

This datasheet was first published in 1997 in the second edition of 'Quarantine Pests for Europe', and revised in 2022. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', ‘Hosts’, and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1997) *Quarantine Pests for Europe (2nd edition).* CABI, Wallingford (GB).

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