EPPO Datasheet: *Margarodes capensis*

Last updated: 2022-06-20

IDENTITY

Preferred name: *Margarodes capensis*
Authority: Giard
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Hemiptera: Sternorrhyncha: Margarodidae
Common names: ground pearls, vine margarodes
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EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: MARGCA

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Notes on taxonomy and nomenclature

Six non-European species of *Margarodes* have been recorded on the roots of grapevine, five of them from Southern Africa: *M. capensis* Giard, *M. greeni* Brain, *M. prieskaensis* (Jakubski), *M. trimeni* (Giard) and *M. vredendalensis* de Klerk (de Klerk *et al*., 1983; de Klerk, 1985). The sixth species, *M. vitis* (Philippi), occurs in South America.

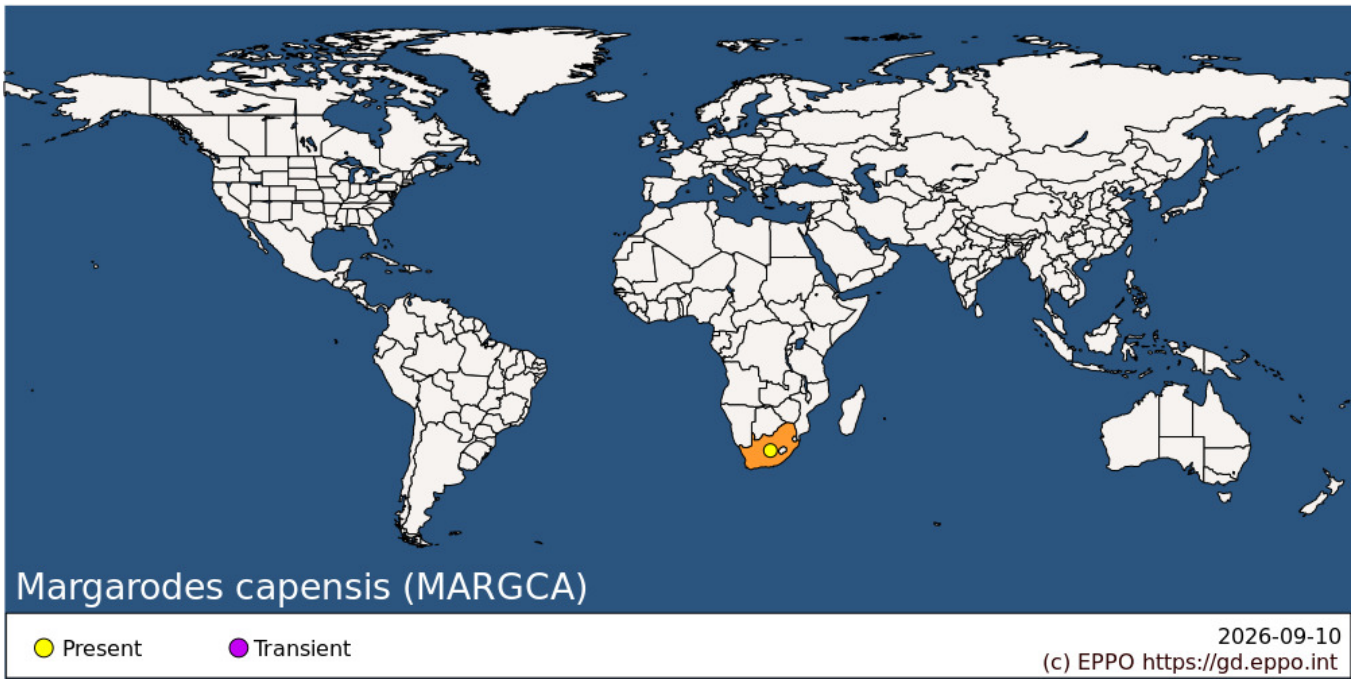
HOSTS

Margarodes capensis has only been recorded on the roots of grapevine (*Vitis vinifera*) and on roots of *Rumex acetosella* subsp. *pyrenaicus* (synonym: *Rumex angiocarpus*, Polygonaceae), an introduced weed growing in vineyards (Brain, 1915; de Klerk, 1978). Grapevines would be the host at risk in the EPPO region. It is by no means certain that grapevine is the only cultivated crop that this ground pearl could infest. The indigenous host plants of this ground pearl have not been identified yet.

Host list: *Rumex acetosella subsp. pyrenaicus*, *Vitis vinifera*

GEOGRAPHICAL DISTRIBUTION

Margarodes capensis has been recorded only from South Africa, where it occurs in Western Cape province in the areas around Malmesbury (Jakubski, 1965; de Klerk *et al*., 1982), Worcester and Stellenbosch (Jakubski, 1965).



Africa: South Africa

BIOLOGY

Margarodes capensis is parthenogenetic, with one generation per year (Jakubski, 1965; de Klerk, 1978; de Klerk *et al* ., 1980). The biology of *M. capensis* was studied under laboratory and field conditions by De Klerk (1978). The females are most abundant in soil at a depth of 16-75 cm, while cysts occur mostly at a depth of 46-60 cm, the zone of greatest root abundance, but they can occur as deep as 120 cm. Only 3-10% of cysts collected in the field developed into adult females annually, emerging between the end of November and the beginning of March with the peak in late January to mid-February. In a single sample of cysts collected from the field, adult females emerged in four successive years and, after the fourth year, 19% of the remaining cysts were still alive. Under laboratory conditions, emergence of adult females from cysts mostly occurred at 20-30?C, whereas at 40?C there was 100% mortality. The adult female lives 24 days on average, 11 days of which are spent in oviposition; after about 9 days in vitro an average of 251 eggs per female were deposited in a string with wax filaments, but in the field clusters of eggs are laid in the soil close to grapevine roots, in pockets lined with secreted wax filaments; the eggs hatch 34-43 days later. Newly hatched nymphs disperse through the soil and attach by their mouthparts to rootlets 0.5-1.2 m below the soil surface, to feed; they then become sessile. After about two months they moult to the legless second-instar nymphal cyst stage, which lasts for more than a year and has two phases: an initial feeding and growing phase, followed by secretion of a protective waxy covering and multiple moults to form a pearl-like, dormant non-feeding cyst resistant to unfavourable conditions. Cysts remain attached to the roots by the long mouthparts (de Klerk, 2017) and can remain viable in the soil for several years; their maximum longevity is not known. Nor is it known precisely what triggers, or can prevent, cyst formation. De Klerk (1978) found that the vertical distribution of *M. capensis* cysts was directly related to the vertical distribution of grapevine roots; very dry and very wet soil conditions inhibited the occurrence of cysts, but cyst distribution was not affected by the percentage of clay in the soil.

DETECTION AND IDENTIFICATION

Symptoms

Infestations of vineyards by species of *Margarodes*, including *M. capensis*, 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. Infested vines 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 infestation symptoms resemble those caused by grapevine phylloxera (*Daktulosphaira vitifoliae* (Fitch), Hemiptera: Aphidomorpha: Phylloxeridae), but in the case of *M. capensis* no root or leaf galls are formed.

Morphology

Eggs

Newly laid eggs are each 0.43-0.60 mm long, smooth, glossy-white, elongated, with one end more rounded than the other (de Klerk, 1978; de Klerk *et al*., 1982).

Nymphs

First-instar nymphs are creamy white, elongate, 0.84-0.91 mm long, with antennae and legs clearly visible under the dissection microscope (Jakubski, 1965; de Klerk, 1978, de Klerk *et al*., 1982). The second-instar cysts (ground pearls) are approximately spherical, 3.5-6.3 mm diameter, dull, light to dark brown, thick-walled and very hard, with a bark-like surface texture (Jakubski 1965; de Klerk, 1978; de Klerk *et al.*, 1982). When the hard outer layers are removed, the insect within is yellow. The slide-mounted cyst has 7 pairs of abdominal spiracles, and fewer than 10 cicatrices (sometimes arranged in pairs) between the anus and the last pair of abdominal spiracles (Jakubski, 1965; de Klerk *et al*., 1982).

Adults

According to de Klerk (1978) and de Klerk *et al*. (1982), the ovoid, dirty white to yellowish adult females of *M. capensis* vary considerably in size (from 3.8–7.5 mm long and 3.1-6.0 mm wide), with bodies sparsely covered with short hair-like setae and segmentation clearly visible; they have characteristic enlarged fossorial (digging) forelegs with heavily sclerotised dark-brown claws. According to Jakubski (1965), the slide-mounted adult female has 7 pairs of abdominal spiracles, the posterior end of abdomen without bulbous spines, ventral setae short (less than 200 ?m long), multilocular pores restricted to the metathorax and head, and short blunt subcylindrical spines present on margins and mid-venter of the thorax and abdomen; medial areas of the dorsum are entirely without spines. The prothoracic pleurites are covered with delicate, flexible hairs but lack spines. For detailed morphological descriptions of the immature and adult female stages, see Jakubski (1965) and de Klerk *et al.* (1982). Being parthenogenetic, this species does not produce any males.

Authoritative identification requires detailed microscopic study of the cysts and/or adult females by a scale insect specialist. Prior to identification, specimens may be preserved in 70% ethanol. De Klerk *et al.* (1983) and Watson (2022) provide morphological keys to live cysts, slide-mounted cysts and adult females, of ten South African *Margarodes* spp. including the five species that infest grapevine roots (*M. capensis*, *M. greeni*, *M. prieskaensis*, *M. trimeni* and *M. vredendalensis*). The adult female of the South American species, *M. vitis*, is described by Jakubski (1965) but there is no key provided to identify the species so it is very difficult to use for identification purposes. Foldi & Soria (1989) provide descriptions and illustrations of the adult female and cyst stage of *M. vitis* but no identification key.

Detection and inspection methods

In vineyards, patches of possible infestation can be detected visually. Symptoms Infestations of vineyards by species of *Margarodes*, including *M. capensis*, 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. Infested vines 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 infestation symptoms resemble those caused by grapevine phylloxera (*Daktulosphaira vitifoliae* (Fitch), Hemiptera: Aphidomorpha: Phylloxeridae), but in the case of *M. capensis* no root or leaf galls are formed.

PATHWAYS FOR MOVEMENT

Natural dispersal of *M. capensis* is extremely limited due to the subterranean habit of the insect; the first-instar crawlers and 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 plants for planting (when moved with roots and soil attached) and / or in soil.

PEST SIGNIFICANCE

Economic impact

There is no data available on the actual economic impact of *M. capensis.* Ground pearls devitalize the host directly by sap and nutrient depletion, and vines sometimes die within five or six years (de Klerk, 2017). Infestation of vines stressed by drought or nematode infestation can result in them dying in patches. The pest is difficult to control due to its subterranean habit and even after an interval of several years, vineyards replanted in infested soils are readily reinfested. Once infested, land may become unsuitable for commercial vineyard cultivation indefinitely (de Klerk, 1978, 2017).

Control

Although many European and American varieties of *Vitis vinifera* have been tested, no resistant cultivars have been found; nor have any natural enemies of *M. capensis* have been documented. Consequently, the only possible control has been with insecticides, which presents technical problems because the target insects live 0.5-1.2 m underground. Soil drenches of systemic insecticides applied to control *Planococcus ficus* mealybugs shortly after harvest (in autumn), when the annual population of new cysts starts feeding and translocation in vines is still active, can reduce ground pearl infestations. As cysts can survive in the soil for years without feeding and only a certain percentage of cysts annually develop into adult females (de Klerk, 1978), follow-up treatments in successive years are essential. Fumigation for nematodes before planting could reduce numbers of females if done at the time when the females are active (but this method is not officially registered). After first treatments, annual re-evaluation of pest presence is necessary to decide on the need for any follow-up treatments (de Klerk, 2017).

Where an infestation of *M. capensis* has resulted in removal of the vines, the pest might be eliminated eventually by growing a series of annual crops over four or more years, because the cyst stage lasts longer than one year (de Klerk, 2017). However, since the native hosts of *M. capensis* are not known, there is uncertainty as to what type of annual crops would not serve as hosts for the ground pearls.

As *M. capensis* is a parthenogenetic species, there is no sex pheromone to exploit to monitor population levels by trapping males.

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; and *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.

Margarodes capensis occurs in South Africa in the Western Cape province, in winter rainfall areas around Malmesbury, Stellenbosch and Worcester where the climate varies with altitude between warm, dry temperate (Köppen-Geiger climate types Csa and Csb) and cold, arid steppe (Bsk). Across the EPPO region a variety of soil types and climates occur, and grapevines are widely cultivated, so it is assumed that *M. capensis* would be able to establish in the EPPO region (EFSA, 2019), particularly in drier Mediterranean areas. *M. capensis* can remain dormant as cysts in the soil for many years, 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, point 10 of Regulation/2072 (EU, 2019)) and prohibit the import of soil. Other appropriate phytosanitary measures to regulate import of *Vitis* (other than seeds) with roots into the EPPO region could require that these plants are produced in a pest-free area (including for the whole country) or in a pest-free place/site of production for *M. capensis*, established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'*

(EPPO, 2016). Rooted grapevine plant material destined for export from South Africa are reported to be treated with both hot water and insecticide before shipment, to reduce the risk of infestation, and additional treatments are sometimes required on arrival in the country of destination. 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

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