EPPO Datasheet: *Margarodes vredendalensis*

Last updated: 2022-05-19

IDENTITY

Preferred name: *Margarodes vredendalensis*
Authority: de Klerk
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Hemiptera: Sternorrhyncha: Margarodidae
Common names: ground pearls, margarodes
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: MARGVR

more photos...

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, 1983; 1985). The sixth species, *M. vitis* (Philippi), occurs in South America.

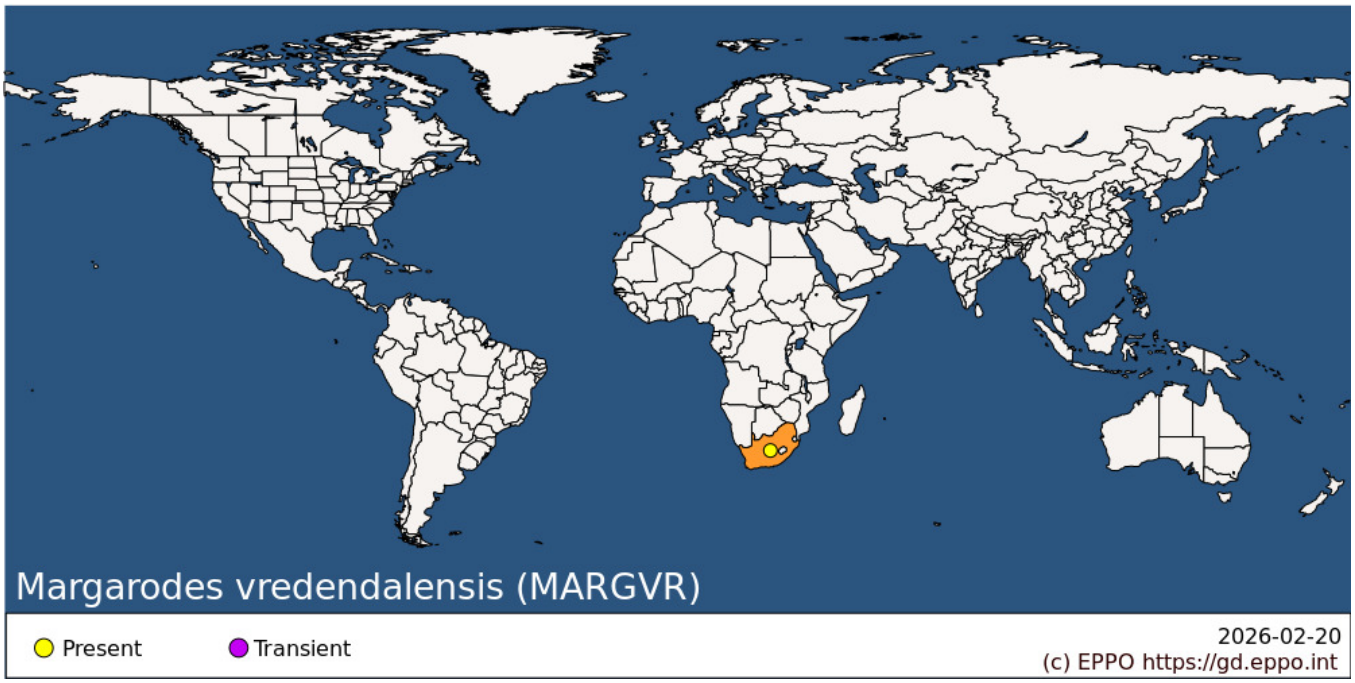
HOSTS

Margarodes vredendalensis has only been recorded on the roots of grapevine (*Vitis vinifera*) so far (De Klerk, 1983). This 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 the ground pearl have not been identified yet.

Host list: *Vitis vinifera*

GEOGRAPHICAL DISTRIBUTION

Margarodes vredendalensis has been recorded only from South Africa where it occurs in the Western Cape province and Northern Olifants River Valley (de Klerk, 1978).



Africa: South Africa

BIOLOGY

Margarodes vredendalensis is parthenogenetic, with one generation per year (de Klerk, 1980; Giliomee *et al*., 2022 in press). The females live in soil in the zones of greatest root abundance, usually at a depth of 46-60 cm but sometimes as deep as 120 cm. Under laboratory conditions, only 10-16% of the cysts developed into adult females annually, emerging in late summer (January and February) even when cysts were detached from the host plant; in a single population, adult females emerged in four successive years. The average adult female lifespan was 40 days, with oviposition commencing about 15 days after emergence from the cyst and occurring over a period of 18 days. An average of 507 eggs per female were deposited in the soil close to grapevine roots, in a pocket lined with secreted wax filaments. The eggs hatched 34-48 days later, in the autumn (de Klerk, 1980). Newly hatched nymphs disperse through the soil and attach to the rootlets, 0.5-1.2 m below the soil surface, by their mouthparts, to feed; they then become sessile. The legless second-instar nymphal stage lasts for more than a year (de Klerk, 2017) 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 their long, sucking 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. The vertical distribution of cysts was directly related to the vertical distribution of roots and had a significant negative correlation with soil moisture and percentage of clay in the soil (de Klerk, 1980).

DETECTION AND IDENTIFICATION

Symptoms

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

Morphology

Eggs

Newly laid eggs are approximately 0.6 mm long, smooth, glossy-white, elongate-ovoid and slightly curved, with one end more bluntly pointed than the other (EPPO, 2007).

Nymphs

First-instar nymphs are creamy white, elongate, approximately 1 mm long, with antennae and legs clearly visible under the dissection microscope. The second-instar cysts (ground pearls) are up to 8.6 mm in diameter, approximately spherical, light to dark brown, thick-walled and very hard, with a warty surface texture (de Klerk *et al.* 1982; de Klerk 2017). When the hard outer layers are removed, the insect within is yellow.

Adults

The ovoid yellow adult females of *M. vredendalensis* vary considerably in size (up to 10 mm long and 5 mm wide), with soft deeply segmented bodies densely covered with long hair-like setae; they have characteristic enlarged fossorial (digging) forelegs with dark-brown claws. An adult female lives up to 49 days, dying soon after oviposition (de Klerk, 1980). In slide-mounted adult females the body spines are not bulbous, and are all of similar size; there are seven pairs of abdominal spiracles (de Klerk *et al.*, 1982, 1983; Watson, 2022). For detailed morphological descriptions of the immature and adult female stages, see Jakubski (1965) and de Klerk *et al.* (1982, 1983). 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, and slide-mounted cysts and adult females, of ten South African *Margarodes* spp. including the five species from this country 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 to 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 by looking for groups of vines exhibiting poor growth, small leaves curling downwards and dieback. Adult female *M. vredendalensis* never appear at the soil surface because they do not need to mate (de Klerk, 2017). 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 light to dark brown spherical cysts up to 8.6 mm in diameter with a warty surface texture (de Klerk *et al*., 1982; de Klerk, 2017). Cysts on roots or free in the soil are present throughout the year and easily detected.

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

PATHWAYS FOR MOVEMENT

Natural dispersal 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

Margarodes ground pearls are increasingly serious pests of vineyards in Northern South Africa, where grapevines are grown to produce table grapes, wine and dried fruits. Infestation of vines stressed by drought or nematode infestation can result in them dying in patches. In the case of the related species *M. prieskaensis*, some vineyards have been completely destroyed (de Klerk, 1980; Swart & de Klerk, 1986). Ground pearls devitalize the host directly by sap and nutrient depletion and probably by injecting toxins, and vines sometimes die within five or six years (de Klerk, 2017). 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. Infested land may become permanently unsuitable for commercial vineyard cultivation (de Klerk, 1980).

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. vredendalensis* 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, 1980), 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. vredendalensis* 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).

As *M. vredendalensis* 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 vredendalensis occurs in South Africa around the towns of Vredendal, Lutzville and Van Rhynsdorp, in hot arid (Köppen-Geiger climate type Bwh) and cold arid (Bwk) desert regions, where horticulture depends on irrigation from the Olifants River (E. Allsopp, pers. comm., ARC Infruitec-Nietvoorbij, 2022). Across the EPPO region a variety of soil types and climates occur, and grapevines are widely cultivated, so it is assumed that *M. vredendalensis* would be able to establish in the EPPO region (EFSA, 2019), particularly in drier Mediterranean areas (E. Allsopp, pers. comm., ARC Infruitec-Nietvoorbij, 2022). *Margarodes vredendalensis* 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. vredendalensis*, 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).

REFERENCES

Annecke DP & Moran VC (1982) *Insects and mites of cultivated plants in South Africa*, 382 pp. Butterworths, Durban (SA).

EFSA (2019) Pest categorisation of non-EU Margarodidae. *EFSA Journal* **17** (4), 5672, 1–42. Available from: https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2019.5672 (accessed 12 February 2022).

EPPO (2007) PM 7/82 (1) *Margarodes prieskaensis*, *Margarodes vitis*, *Margarodes vredendalensis. EPPO Bulletin* **37**, 560–570. Available from: https://gd.eppo.int/download/standard/206/pm7-082-1-en.pdf (accessed 12 February 2022).

EPPO (2016) EPPO Standard PM 5/8 (1) *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'. EPPO Bulletin* **46**, 421–442. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1111/epp.12340 (accessed 12 February 2022).

EPPO (2018) PM 3/85 (1) Inspection of places of production – *Vitis* plants for planting. *EPPO Bulletin* **48** (3), 330–349. Available from: https://gd.eppo.int/download/standard/738/pm3-085-1-en.pdf (accessed 12 February 2022).

EU (2019) Commission Implementing Regulation 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019. Annex VI, points 10. Available from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R2072

Foldi I & Soria SJ (1989) Les cochenilles nuisibles à la vigne en Amérique du Sud (Homoptera: Coccoidea). *Annales de la Société entomologique de France (N.S.)* **25**(4), 411-430.

Giliomee J, de Klerk C & Watson GW (2022 in press) 3.3.4 Margarodes spp. In: Encyclopedia of Scale Insect Pests (Eds Kondo T & Watson GW), pp. 69-73. CAB International, Wallingford (UK).Jakubski AW (1965) *A critical revision of the families Margarodidae and Termitococcidae (Hemiptera, Coccoidea)*, 187 pp. British Museum (Natural History), London (UK).

de Klerk CA (1978) Morphology and taxonomy of the South African species of the genus *Margarodes* (Hemiptera: Margarodidea), with detailed studies on the biology of two vine infesting species. PhD thesis, Stellenbosch University, South Africa.

de Klerk CA (1980) Biology of *Margarodes vredendalensis* de Klerk (Coccoidea: Margarodidae) in South Africa. *South African Journal of Enology and Viticulture* **1**, 47-58. Available at https://doi.org/10.21548/1-1-2413 (accessed 4 March 2022).

de Klerk CA (1983) Two new species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) from South Africa. *Phytophylactica* **15**, 85-93.

de Klerk CA (1985) Occurrence of South African species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) with special reference to vine infesting species. *Phytophylactica* **17**, 215-216.

de Klerk CA (2017) Identification, control and management of grapevine *Margarodes*. Viticulture research,

Winetech Technical, available at https://www.wineland.co.za/identification-control-management-grapevine-margarodes/ (accessed 3 March 2022).

de Klerk CA, Ben-Dov Y & Giliomee JH (1982) Redescriptions of four vine infesting species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) from South Africa. *Phytophylactica* **14**, 61-76.

de Klerk CA, Ben-Dov Y & Giliomee JH (1983) General morphology of South African species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) with keys to nymphs and adult females. *Phytophylactica* **15**, 133-144.

Swart PL & de Klerk CA (1986) Scale insects. In: *Crop pests of Southern Africa. Bulletin 407, Vol. 1. Deciduous fruit, grapes and berries* (Ed. by Myburgh, A.C.), 92 pp. Department of Agriculture and Water Supply, Pretoria (SA).

Watson GW (2022) Towards identification of the scale insects (Hemiptera: Coccomorpha) of continental Africa: 2. Checklists and keys to six archaeococcid families. *Zootaxa* **5105**(3), 301-356.

ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2022 by Gillian W. Watson, Natural History Museum, London, UK. Her valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2026) *Margarodes vredendalensis*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

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).

Co-funded by the European Union