EPPO Datasheet: *Margarodes prieskaensis*

Last updated: 2022-05-19

IDENTITY

Preferred name: *Margarodes prieskaensis*
Authority: (Jakubski)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Hemiptera: Sternorrhyncha: Margarodidae
Other scientific names: *Sphaeraspis prieskaensis* Jakubski
Common names: ground pearls, margarodes
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EPPO Categorization: A1 list
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EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: MARGPR

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

Margarodes prieskaensis was originally described as *Sphaeraspis prieskaensis* by Jakubski (1965). Morrison & Morrison (1966) synonymized the genus *Sphaeraspis* with *Margarodes*, making the new combination *Margarodes prieskaensis* (Jakubski).

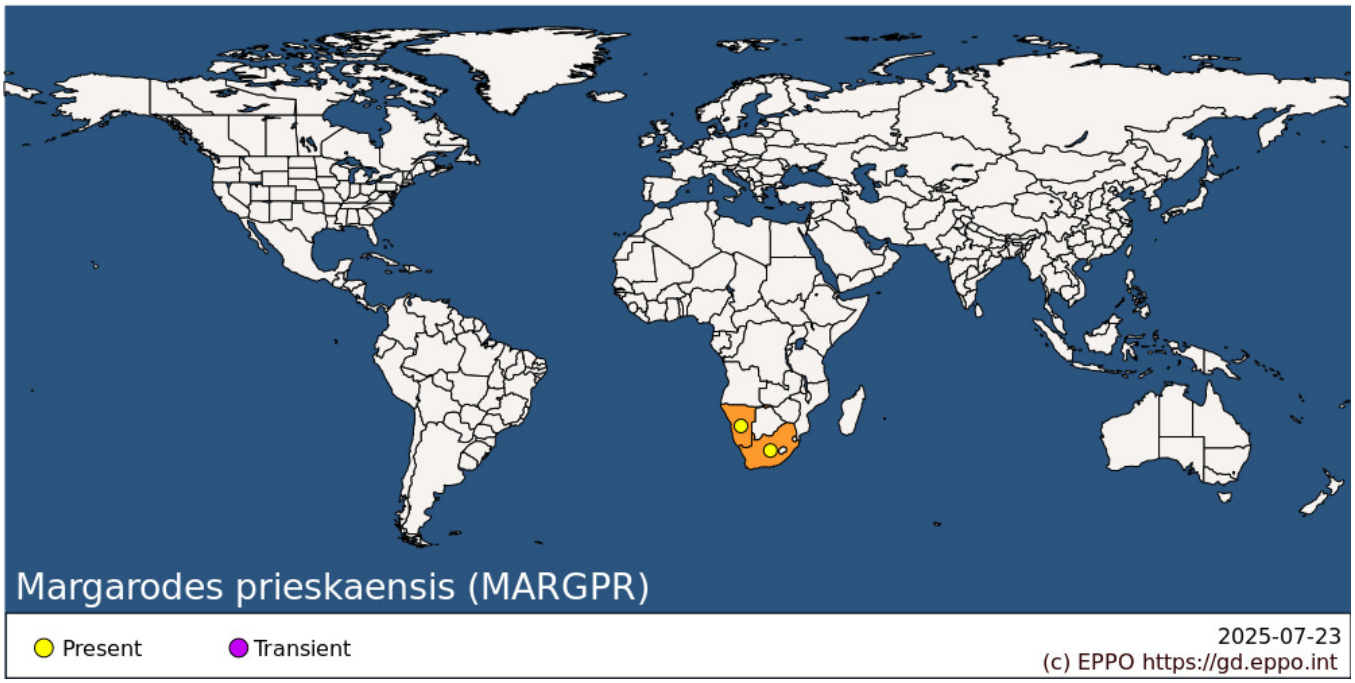
HOSTS

Margarodes prieskaensis has only been recorded feeding on the roots of its hosts. Its only known crop host is grapevine (*Vitis vinifera*) (Vitaceae); this would be the host at risk in the EPPO region. The only wild host known is the camel thorn tree, *Vachellia erioloba* (synonym *Acacia erioloba*) (Fabaceae), which is common along the entire Orange River valley in Namibia and North-West South Africa (Giliomee *et al*., 2022 in press); soil in areas where this tree grows may already contain the pest. The tree does not occur in the EPPO region.

Host list: *Vachellia erioloba*, *Vitis vinifera*

GEOGRAPHICAL DISTRIBUTION

Margarodes prieskaensis has been recorded only from Southern Africa, along the Orange River in Namibia (Karas region) and in Northern South Africa (in the provinces of Northern Cape (Orange River irrigation area), Limpopo, parts of Mpumalanga and North West) (De Klerk, 1978, 2017; Giliomee *et al*., 2022 in press).



Africa: Namibia, South Africa

BIOLOGY

The biology and behaviour of *M. prieskaensis* in Southern Africa was described in detail by Du Toit (1975). There is one generation per year (Giliomee *et al*., 2022 in press). Eggs are laid in the spring (October and November) in the soil close to grapevine roots, at a depth of about 50 cm. Newly hatched nymphs disperse through the soil and attach to the rootlets by their mouthparts, to feed on roots 0.5-1.2 m below the soil surface, and 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, non-feeding cyst resistant to unfavourable conditions. Cysts remain attached to the roots by their long, sucking mouthparts (de Klerk, 2017) and can remain dormant but 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. In autumn (from early May in the Northern Cape to August or even September in other regions), when the soil temperature at 50 cm depth is 16-24°C, male prepupae emerge from some of the cysts and migrate upwards to just below the soil surface (about 2.0 cm) to pupate; they undergo complete metamorphosis. In winter (June to August), just after the lowest subterranean temperatures (6-7°C) have been reached, sexually mature wingless females (from some cysts 50 cm deep in the soil) and small, inconspicuous winged males (from pupae about 2.0 cm below the soil surface) make their way up to the soil surface to mate (Du Toit, 1975; de Klerk, 2017; Giliomee *et al*., 2022 in press). Mating is usually complete by late winter (early September); then, over a period of about four days, the fertilized females burrow about 50 cm into the soil to lay eggs in a pocket lined with secreted wax filaments, near a root. The peak period of oviposition is in early spring (from the end of October to the beginning of November). On average, each fertilized adult female lives about 24 days and may produce about 900 eggs (De Klerk, 2017; Giliomee *et al*., 2022 in press).

DETECTION AND IDENTIFICATION

Symptoms

Infestations of vineyards by *M. prieskaensis* 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. prieskaensis* 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. prieskaensis*, no root or leaf galls are formed.

Morphology

Eggs

Newly laid eggs are each 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. The second-instar cysts (ground pearls) are up to 6.0 mm in diameter, approximately spherical, dull yellow, thick-walled and very hard, with a surface texture resembling a tortoise shell (de Klerk, 2017). When the hard outer layers are removed, the insect within is bright yellow.

Adults

The ovoid yellow adult females 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. A fertilized adult female lives about 24 days, dying soon after oviposition (De Klerk, 2017); unfertilized females may survive for about 80 days (inferred from Du Toit, 1975). Slide-mounted adult females have bulbous spines on the posterior end of the abdomen and seven pairs of abdominal spiracles (de Klerk *et al.*, 1982; 1983). For detailed morphological descriptions of the immature and adult female stages, see Jakubski (1965), de Klerk *et al.* (1982), and also the EPPO diagnostic protocol (EPPO, 2007). The adult male of *M. prieskaensis* is 3.8-4.4 mm long (Hodgson & Foldi, 2006) and resembles a midge, having long antennae, legs, a single pair of wings and a tail tuft of white wax filaments; it was described and illustrated by Hodgson and Foldi (2006). Males do not feed, and live for only about three days (Du Toit, 1975).

Authoritative identification requires detailed microscopic study of the cysts and/or adult female 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 that infest grapevine roots (*M. capensis*, *M. greeni*, *M. prieskaensis*, *M. trimeni* and *M. vredendalensis*). Two references each cover some of the species from both South Africa and South America: Jakubski (1965) covers *M. capensis*, *M. greeni*, *M. prieskensis*, *M. trimeni* and *M. vitis* but gives no key, and is very difficult to use for identification purposes; and Giliomee *et al*. (2022 in press) gives very brief diagnoses of *M. capensis*, *M. prieskaensis* and *M. vitis* only, but no key. The slide-mounted adult female of *M. prieskaensis* has the body covered with long and short, almost straight setae and has short bulbous spines on the posterior end of the abdomen; whereas that of *M. vitis* has numerous spines on the metathorax and abdomen, each spine being enlarged apically, and the spines become progressively denser towards the apex of the abdomen (Giliomee *et al*., 2022 in press).

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. In mid-winter, if *M. prieskaensis* is present the yellow posteriors of adult females (waiting to mate) are clearly visible protruding through the soil surface (Du Toit, 1975; de Klerk 2017). 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 yellow spherical cysts up to 6.0 mm in diameter with a surface texture like a tortoise shell. Cysts on roots or lying 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. prieskaensis* 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 prieskaensis is an increasingly serious pest of vineyards in Northern South Africa, where grapevines are grown to produce table grapes, wine, and dried fruits. Infestation results in vines dying in patches and several vineyards being completely destroyed (de Klerk, 1980; Swart & de Klerk, 1986). The ground pearl devitalizes the host directly by sap and nutrient depletion and probably by injecting toxins, and vines in conditions of stress sometimes die within four to 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

It is known that the grapevine root stock cultivars 99 Richter, 101-14 Mgt and Rupestris du Lot are killed by *M. prieskaensis* (de Klerk, 2017). Although many European and American varieties have been tested, no cultivars resistant to *M. prieskaensis* have been found. No natural enemies of *M. prieskaensis* have been documented. Consequently, the only possible control has been with insecticides, which presents technical problems because the target insects mostly 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 (de Klerk, 1987; 2017). As cysts can survive in the soil for years without feeding and only a certain percentage of them annually develop into females (de Klerk, 1980), follow-up treatments in successive years are essential. In addition, fumigation against nematodes can reduce numbers of ground pearl male pre-pupae and pupae near the soil surface if present (de Klerk, 1987; 2017); care is necessary as some soil fumigants are phytotoxic (de Klerk, 2017).

Where an infestation of *M. prieskaensis* 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).

If an infestation is suspected, in early spring yellow or white sticky traps can be used to detect winged males, to determine the emergence timing and the location and size of infestations for further insecticide treatment. The chemical structure of the sex pheromone of *M. prieskaensis* was recently identified (Giliomee *et al*., 2022 in press) but is too complex to synthesise economically for use in pheromone traps to catch males.

The extreme difficulty of controlling or eradicating ground pearls means that it is important that infestations are detected early and eliminated by fumigation of affected areas and replacing the vines. Annual follow-up evaluations are then necessary to decide on the need for any follow-up treatments (de Klerk, 2017).

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 prieskaensis occurs in countries with a range of climate types including temperate oceanic climate (type Cfb 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. prieskaensis* would be able to establish in the EPPO region (EFSA, 2019). *Margarodes prieskaensis* 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 2019/2072 (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 a pest-free area for the whole country) or in a pest-free place/site of production for *M. prieskaensis*, 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.

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