

Data Sheets on Quarantine Pests

***Margarodes prieskaensis, Margarodes vitis and
Margarodes vredendalensis***

Seven non-European species of *Margarodes* have been recorded on the roots of grapevine, but only three have attracted recent attention as pests. They have a similar biology and can be covered by similar phytosanitary measures. They are accordingly considered together in this data sheet.

IDENTITY• ***Margarodes prieskaensis*****Name:** *Margarodes prieskaensis* (Jakubski)**Synonyms:** *Sphaeraspis prieskaensis* Jakubski**Taxonomic position:** Insecta: Hemiptera: Homoptera: Margarodidae**Common names:** Ground pearls, margarodes (English)

Perles de terre (French)

Gouepêrels, grondpêrels (Afrikaans)

Bayer computer code: MARGPR**EPPQ A1 list:** No. 214**EU Annex designation:** II/A1• ***Margarodes vitis*****Name:** *Margarodes vitis* (Philippi)**Synonyms:** *Coccionella vitis* (Philippi)*Margarodes vitium* Giard*Sphaeraspis vitis* (Philippi)**Taxonomic position:** Insecta: Hemiptera: Homoptera: Margarodidae**Common names:** Ground pearls, margarodes (English)

Cochenille du Chili, perles de terre (French)

Perla-de-terra, perlita, margarodes de la vid (Spanish)

Pérola-da-terra (Portuguese)

Notes on taxonomy and nomenclature: The cyst stage of this species 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.

Bayer computer code: MARGVI**EPPQ A1 list:** No. 215**EU Annex designation:** II/A1• ***Margarodes vredendalensis*****Name:** *Margarodes vredendalensis* De Klerk**Taxonomic position:** Insecta: Hemiptera: Homoptera: Margarodidae**Common names:** Ground pearls, margarodes (English)

Perles de terre (French)

Gouepêrels, grondpêrels (Afrikaans)

Bayer computer code: MARGVR**EPPQ A1 list:** No. 216**EU Annex designation:** II/A1

HOSTS

- ***Margarodes prieskaensis***
Only recorded on the roots of grapevine (*Vitis vinifera*). This would be the host at risk in the EPPO region.
- ***Margarodes vitis***
Polyphagous on the roots of wild plants or weeds belonging to Apiaceae, Asteraceae, Casuarinaceae, Convolvulaceae, Euphorbiaceae, Fabaceae, Linaceae, Nyctaginaceae, Poaceae, Polygonaceae, Rosaceae, Tiliaceae, Verbenaceae and Vitidaceae. Grapevine (*Vitis vinifera*) is the principal, economically significant host. *M. vitis* is also recorded as a pest of tung (*Aleurites* sp.) in Brazil (Mariconi & Zamith, 1973). Among the other genera on which it has been recorded, the following are of some significance to the EPPO region: *Arachis*, *Cydonia*, *Dahlia*, *Linum*, *Petroselinum*, *Prunus* (Jakubski, 1965).
- ***Margarodes vredendalensis***
Only recorded on the roots of grapevine (*Vitis vinifera*). This would be the host at risk in the EPPO region.

GEOGRAPHICAL DISTRIBUTION

- ***Margarodes prieskaensis***
EPPO region: Absent.
Africa: South Africa (northern Cape).
EU: Absent.
Distribution map: See De Klerk (1985).
- ***Margarodes vitis***
EPPO region: Absent.
South America: Argentina, Brazil (Rio Grande do Sul), Chile, Paraguay, Uruguay, Venezuela (Foldi & Soria, 1989; Mariconi & Zamith, 1973).
EU: Absent.
- ***Margarodes vredendalensis***
EPPO region: Absent.
Africa: South Africa (north-western Cape).
EU: Absent.
Distribution map: See De Klerk (1985).

BIOLOGY

- ***Margarodes prieskaensis***
The biology and behaviour of this species has been described in detail by Du Toit (1975). Eggs are laid in the spring in the soil close to grapevine roots at a depth of about 50 cm. Newly hatched nymphs attach themselves to the roots by their mouth parts and become sessile. The second nymphal stage has two phases: a feeding and growing phase followed by a non-feeding phase. Once feeding is complete, the nymphs are capable of secreting a protective waxy covering to form pearl-like cysts enabling them to resist unfavourable conditions. The cysts can remain inactive and viable in the soil for a very long period (a number of years). It is not known precisely what triggers, or can prevent, cyst formation (or what is their maximum longevity). Sexually mature females and male prepupae emerge from the cysts. The females make their way upwards through the soil in mid-July just after the lowest subterranean winter temperatures (6-7°C) have been reached. Males undergo complete metamorphosis, pupating just below the soil surface in early May when temperatures are about 16°C. Mating is usually complete by early September and females

then burrow into the soil. The peak period of oviposition is from the end of October to the beginning of November.

- ***Margarodes vitis***

M. vitis is subterranean (except for the adult males), living on roots usually at a depth of 20-60 cm, but occurring at depths of up to 120 cm. Adult females oviposit eggs into an ovisac from November to February. The number of eggs laid varies widely (150 to 900), depending on the size of the adult female. The second and third instars are capable of producing cysts which can survive for many years. Adult females occur in October to December. According to Foldi & Soria (1989) *M. vitis* is parthenogenetic. However, Jakubski (1965) gives a description for adult males which are apparently very rare, live for up to 14 days and appear for a short time above ground. Mating occurs between mid-November and the end of December. The life cycle from egg to adult takes 3 years (Foldi & Soria, 1989).

- ***Margarodes vredendalensis***

The biology of *M. vredendalensis* has been described in detail by De Klerk (1980). This species is parthenogenetic and subterranean, living in zones of greatest root abundance, usually at a depth of 46-60 cm. It can occur at depths of up to 120 cm. Under laboratory conditions adult females emerged during January and February, but only 10-16% of the cysts developed into females annually. Although cysts were detached from the host plant, females emerged during four successive years from the same population. The average adult female lifespan was 40 days with an oviposition period of 18 days resulting in 507 eggs per female. The vertical distribution of cysts was directly related to the vertical distribution of roots and has significant negative correlation with soil moisture and percentage of clay in the soil.

DETECTION AND IDENTIFICATION

Symptoms

Grapevines infested with *Margarodes* exhibit a gradual decline in vigour, shoots become thinner and shorter and leaves smaller (Annecke & Moran, 1982). One or more of the branches of the vine may die, followed in severe infestations by the eventual death of the whole plant. The duration of this process varies greatly. Infestations of vineyards are usually patchy. The patches increase in size, presumably because of the gradual subterranean movement of the larvae and adult females. The symptoms resemble those caused by grapevine phylloxera (*Viteus vitifoliae*) but in the case of *Margarodes* no root galls are formed.

Morphology

Eggs

Newly laid eggs are smooth, glossy-white, elongate, approximately 0.6 mm in length and slightly curved with one end more bluntly pointed.

Nymph

First instars are creamy-white, elongate, approximately 1 mm in length with antennae and legs clearly visible. The cysts are spherical with a rough surface, thick-walled and very hard, whitish or light to dark-brown in colour and 1-8 mm in diameter. The cysts are bright-yellow when the outer layers are removed.

Adult

The males are small and winged. The adult females are oval and yellow, with soft deeply segmented bodies, densely covered with long hair-like setae. They have characteristic enlarged fossorial (digging) forelegs with dark-brown claws. They attain a length of 10 mm and width of 5 mm. Both the cysts and adult females of each species vary considerably in size.

Authoritative identification involves 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) provide morphological keys to adult females and immature stages of the 10 South African *Margarodes* spp. including five species that infest grapevine roots (*M. vredendalensis*, *M. prieskaensis*, *M. capensis* Giard, *M. greeni* Brain and *M. trimeni* Giard).

- ***Margarodes prieskaensis***

For detailed morphological descriptions of the immature stages and adult female, see Jakubski (1965) and De Klerk *et al.* (1982). According to the latter authors, the adult male of this species was described by Theron (1958) under the name *M. vitium*.

- ***Margarodes vitis***

For detailed morphological descriptions and illustrations, see Jakubski (1965) and Foldi & Soria (1989).

- ***Margarodes vredendalensis***

For a detailed morphological description see De Klerk (1983). This species closely resembles *M. prieskaensis*, from which it differs mainly in the absence of bulbous spines.

MEANS OF MOVEMENT AND DISPERSAL

Natural dispersal is limited due to the small size of the insect, lack of wings in the adult female, general immobility, subterranean nature and sessile stages. Therefore *Margarodes* spp. have a low natural dispersal potential. The first instar crawlers and adult females within the soil are the main dispersal phases. All stages may be introduced on grapevine roots or in soil from infested areas. Fruits and seeds are very unlikely to carry the pest.

PEST SIGNIFICANCE

Economic impact

An infestation of *Margarodes* may devitalize the host directly by sap depletion and by injecting toxins. *Margarodes* spp. are difficult to control and vineyards that are replanted in infested soils are readily reinfested, even if planted after an interval of several years. The soil may become permanently unsuitable for economic vineyard cultivation (De Klerk, 1980).

M. vitis is of great economic importance causing severe damage to grapevines in South America, especially in Chile where it is the most important pest of grapevine in the central grapevine-growing region. Approximately 600 ha of vineyards are infested in Chile (Fauré & Pinto, 1959). It is also a pest of tung in Brazil (Mariconi & Zamith, 1973).

Margarodes spp. are an increasingly serious pest of vineyards in South Africa, resulting in vines dying in patches and several vineyards being completely destroyed (De Klerk, 1980; Swart & De Klerk, 1986).

Control

In South America, *M. vitis* used to be controlled by flooding vineyards at the time of adult emergence (November-December) and hatching of young larvae (February), with repeated treatments over several years until no viable cysts remained (Galet, 1982). However, this method obviously has practical limitations, tends to favour weeds and is of variable effectiveness. Although many European and American varieties have been tested, no resistance to *Margarodes* spp. has been found. This includes American rootstocks, so it does not seem that the solution found for phylloxera (*Viteus vitifoliae*) can be used in this case. Natural enemies of these *Margarodes* spp. are unknown. As a result, the only possible control has been with insecticides, and this has presented technical problems because the target insects are underground. However, in South Africa, adult females as well as male

prepupae and pupae of *M. prieskaensis* have been controlled on a commercial scale in two established vineyards by an application of hexachlorobutadiene with hand-held soil-injector guns at a rate of 12 ml/m² (De Klerk, 1987). The best results were obtained after harvest during March. Although the cyst stages were not affected, applications during two consecutive years did effectively control the pest. 1,3-dichloropropene, aldicarb, fenamiphos, carbofuran and oxamyl were ineffective. In Argentina, hexachlorobutadiene did not give satisfactory control of *M. vitis* (Vega, 1978). Aldrin and lindane were used in the past in Chile (Fauré & Pinto, 1959).

Phytosanitary risk

M. prieskaensis, *M. vitis* and *M. vredendalensis* were all three recently added to the EPPO A1 list, but are not regarded as quarantine pests by any other regional plant protection organization. There are no *Margarodes* spp. occurring in the EPPO region on grapevine, nor any pest with similar biology. Accordingly, the *Margarodes* spp. recorded on grapevine in South Africa and South America present a serious phytosanitary risk to vineyards in the EPPO region.

Although there are some other non-European *Margarodes* spp. recorded on grapevine (*M. capensis*, *M. greeni* and *M. trimeni* from South Africa; *M. meridionalis* Morrison from California and the closely related *Eurhizococcus brasiliensis* (Hempel in Wille) from Brazil), the most important pest species is clearly *M. vitis*, with the other two species described in this data sheet also sufficiently important to require control in South Africa.

PHYTOSANITARY MEASURES

Importation of grapevine plants for planting, with roots or associated soil, or of soil as such, should be prohibited from countries where these species of *Margarodes* occur. They have the capacity to remain dormant as cysts in the soil for many years and for some species to create colonies from single parthenogenetic females.

BIBLIOGRAPHY

- Annecke, D.P.; Moran, V.C. (1982) *Insects and mites of cultivated plants in South Africa*, 382 pp. Butterworths, Durban, South Africa.
- De Klerk, C.A. (1980) Biology of *Margarodes vredendalensis* De Klerk (Coccoidea: Margarodidae) in South Africa. *South African Journal of Enology and Viticulture* **1**, 47-58.
- De Klerk, C.A. (1983) Two new species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) from South Africa. *Phytophylactica* **15**, 85-93.
- De Klerk, C.A. (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, C.A. (1987) Chemical control of *Margarodes prieskaensis* (Jakubski) (Coccoidea: Margarodidae) on grapevines. *South African Journal for Enology and Viticulture* **8**, 11-14.
- De Klerk, C.A.; Ben-Dov, Y.; Giliomee, J.H. (1982) Redescriptions of four vine infesting species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) from South Africa. *Phytophylactica* **14**, 61-76.
- De Klerk, C.A.; Ben-Dov, Y.; Giliomee, J.H. (1983) General morphology of South African species of *Margarodes* Guilding (Homoptera: Coccoidea: Margarodidae) with keys to nymphs and adult females. *Phytophylactica* **15**, 133-144.

- Du Toit, G.D.G. (1975) Notes on the biology and behaviour of *Sphaeraspis prieskaensis* Jakubski (Hemiptera: Coccoidea) a pest on grapevine roots. In: *Proceedings of the First Congress of the Entomological Society of Southern Africa, 1974 Stellenbosch* (Ed. by Durr, H.J.R.; Giliomee, J.H.; Naser, S.), pp. 255-257. Entomological Society of Southern Africa, Pretoria, South Africa.
- Fauré, G.O.; Pinto, J.C. (1959) Pests of grapevine in Chile. *FAO Plant Protection Bulletin* **7**, 73-77.
- Foldi, I.; Soria, S.J. (1989) Les cochenilles nuisibles à la vigne en Amérique du Sud (Homoptera: Coccoidea). *Annales de la Société Entomologique de France* **25**, 411-430.
- Galet, P. (1982) *Les maladies et parasites de la vigne*. Vol. II, pp. 1332-1336. Paysan du Midi, Montpellier, France.
- Jakubski, A.W. (1965) *A critical revision of the families Margarodidae and Termitococcidae (Hemiptera, Coccoidea)*, 187 pp. British Museum (Natural History), London, UK.
- Mariconi, F.A.M.; Zamith, A.P.L. (1973) [Contribution to the knowledge of Margarodinae (Homoptera, Margarodidae) that occur in Brazil]. *Anals da Sociedade Entomologica do Brasil* **2**, 86-101.
- Swart, P.L.; De Klerk, C.A. (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, South Africa.
- Theron, J.G. (1958) Comparative studies on the morphology of male scale insects (Hemiptera: Coccoidea). *Annals, University of Stellenbosch (Section A)* **34**, 1-71.
- Vega, E. (1978) Vineyard replanting and soil disinfection in Argentina. *Bulletin de l'OIV* **56**, 250-262.