

A Survey of Mealybugs and Associated Natural Enemies in Vineyards in the Western Cape Province, South Africa

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A survey of mealybugs and their associated natural enemies occurring in vineyards was conducted in the Western Cape Province during the 1999/2000 and 2000/2001 seasons. *Planococcus ficus* (Signoret) was the dominant mealybug and was found for the first time on roots of grapevines. This has far-reaching implications for the control of this important vine leafroll virus vector as control measures have been focused on above-ground control. Other mealybugs recorded on vines were *Pseudococcus longispinus* (Targioni-Tozzetti) and *Ferrisia malvastra* (McDaniel). *Pseudococcus viburni* (Maskell) and *Ps. solani* Ferris were found on weeds in vineyards. The more frequently recorded natural enemies of *P. ficus* were species of *Nephus* predatory beetles and the parasitoids, *Coccidoxenoides perminutus* Girault, *Anagyrus* sp. and *Leptomastix dactylopii* (Howard).

The vine mealybug, *Planococcus ficus* (Signoret), causes direct crop loss and progressive weakening of vines through early leaf drop. It is also a vector of the vine leafroll virus (Engelbrecht & Kasdorf, 1990; Cabaleiro *et al.*, 1999; Sforza *et al.*, 2000). Nineteen other species of Pseudococcidae cause similar damage worldwide (Krishnamoorthy & Mani, 1989; Longo *et al.*, 1994; Ben-Dov 1994; Mazzeo & Russo, 1994; Williams, 1998). It is possible that mealybug species other than *P. ficus* could have colonised vineyards in South Africa subsequent to a survey by Kriegler (1954). Therefore updated information on the species complex of pseudococcids in South African vineyards was considered necessary.

MATERIALS AND METHODS

Mealybugs

A survey of mealybug species in vineyards was conducted in vineyards in the following districts: Stellenbosch (L'Avenir, 33°54'E, 18°52'S; alt. 146m), Malmesbury (Swartland wine cellar, 33°27'E, 18°44'S; alt. 210 m), Porterville (Lankgewag, 33°10'E, 19°01'S; alt. 866 m), Paarl (St. Pieters Roche, 33°45'E, 18°56'S; alt. 115 m), Hex River Valley (Werda, 33°26'E, 19°33'S; alt. 370 m), Robertson (Goree, 33°49'E, 19°47'S; alt. 180 m), Vredendal (Houmoed, 31°66'E, 18°49'S; alt. 56 m), Montagu (Witklei, 33°79'E, 20°25'S; alt. 465 m), McGregor (Steenbokslaagte, 33°54'E, 20°42'S; alt. 354 m), Barrydale (Lentelus, 33°57'E, 19°49'S; alt. 165 m), Ladismith (33°30'E, 21°16'S; alt. 531 m), Calitzdorp (33°32'E, 21°41'S; alt. 280 m) and De Rust (Doornkraal, 33°24'E, 22°33'S; alt. 593 m) during March of 2000.

In all sampled vineyards at least five vines were randomly selected and sampled by collecting mealybugs from bunches, leaves and the main stems. In addition, mealybugs were collected in the listed areas (Table 1) on vine roots by digging to a depth of

60 cm in the region of the main stem and on weeds growing in close proximity to vines. All mealybug samples were preserved in 70% alcohol and sent to I. Millar of the Plant Protection Research Institute (PPRI) in Pretoria for identification.

Natural enemies

Natural enemies were sampled monthly for a period of two years (March 1999 to March 2001) because natural enemy species composition and density varied during the season (Urban, 1985). Due to the intensity of this sampling method, sampling of natural enemies was limited to one block of one hectare, which was regularly inspected in each of three grape-growing areas, namely Stellenbosch (33°54'E, 18°52'S, alt. 146 m) (Merlot noir, planted in 1989), Hex River Valley (33°30'E, 19°33'S, alt. 370 m) (Dauphine, planted in 1985) and Robertson (33°49'E, 19°47'S, alt. 180 m) (Cabernet Sauvignon, planted in 1990).

In each surveyed vineyard two butternuts (Urban, 1985) and two sticky traps (Samways, 1988; Viggiani, 1995) were used: one on the edge and one in the middle of each of the blocks. These were placed between 1.2 and 1.5 m above ground level in the cordon area of the vines. Yellow rectangular Agribiol® (200 mm x 100 mm) sticky traps were used to sample adult parasitoids and predators. This method was complemented by using butternuts infested with *P. ficus* which each contained at least one hundred mealybugs at various stages of development to sample all stages of *P. ficus* natural enemies. These traps were placed in polystyrene containers with entry holes smeared with petroleum jelly, which effectively excluded ants.

The butternuts and sticky traps were left in the field for one month, after which they were replaced. Butternuts were placed in emergence cages for between one and two months, after which natural enemies were identified and counted. Yellow sticky traps were taken to the laboratory, where identification and counting of

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adult predatory beetles and parasitoids was conducted using a stereoscopic microscope. Initial verification and comparison with reference material of the predatory beetle and parasitoid species was done in conjunction with V. B. Whitehead at the S.A. Museum in Cape Town, and G. L. Prinsloo at the ARC – Plant Protection Research Institute in Pretoria, respectively.

RESULTS AND DISCUSSION

Most vines were infested with *P. ficus* (Table 1), with the largest populations above ground throughout the season. This suggested that *P. ficus* was the dominant mealybug infesting vines. However, *P. ficus* was also present on vine roots to a depth of 30 cm. In one case *P. ficus* was found surviving on the roots of a vineyard that had been uprooted 24 months earlier in the McGregor area. Mealybug species previously not recorded on vines included *Pseudococcus longispinus* (Targioni-Tozzetti) and *Ferrisia malvastra* (McDaniel), which were found in the Stellenbosch area.

Mealybugs on weeds were found mainly on the roots. Of the mealybugs found on weeds in vineyards, only *Pseudococcus viburni* (Maskell) was previously reported on grapevines in Chile (Gonzalez, *et al.*, 1996), Australia (Williams, 1985), New

Zealand (Cox, 1987), United States (Phillips & Sherk, 1991) and Israel (Ben-Dov, 1994). However, during the present survey it was not recorded on grapevines.

Predatory beetles found feeding on *P. ficus* were recorded in Stellenbosch, Hex River Valley and Robertson, and included *Cryptolaemus montrouzieri* Mulsant, *Nephus angustus* (Casey), *N. quadrivittatus* (Mulsant), *N. binaevatus* (Mulsant), *Nephus* sp., *Hyperaspis felixi* (Mulsant), *Scymnus nubilus* Mulsant, *Cydonia lunata* F., a *Rhizobiellus* sp. and a *Hippodamia* sp., confirming work by Whitehead (1957). The only predatory beetle not previously recorded in South Africa prior to the survey was *S. nubilus*. This species was recorded from all areas. Beetles in the genus *Nephus* were the most abundant predatory beetles. Other species of predatory beetles were found only occasionally. The only predators found other than Coleoptera were *Chrysopa* spp.

In all three vineyard regions surveyed for natural enemies, encyrtid parasitoids were recovered. These included three primary parasitoids: *Anagyrus* sp., which could not be identified to species level (G. L. Prinsloo, personal communication), *Leptomastix dactylopii* (Howard) and *Coccidoxenoides perminutus* Girault. A fourth encyrtid, *Chrysoplatecyrus splendens*

TABLE 1

Mealybug species recorded during a survey from 1999 to 2001 on different host plants in vineyards in the areas of Barrydale (B), Calitzdorp (C), De Rust (DR), Hex River Valley (HRV), Ladismith (L), Malmesbury (Mal), McGregor (McG), Montagu (Mon), Paarl (P), Porterville (Por), Robertson (R), Stellenbosch (S) and Vredendal (V) in the Western Cape Province, South Africa.

Host plant	Areas in which mealybugs were surveyed	Areas in which mealybug species occurred	Mealybug species
<i>Vitis vinifera</i> L. (above ground)	B, C, DR, HRV, L, Mal, McG, Mon, P, Por, R, S & V	B, C, DR, HRV, L, Mal, McG, Mon, P, Por, R, S & V	<i>Planococcus ficus</i> (Signoret)
	B, C, DR, HRV, L, Mal, McG, Mon, P, Por, R, S & V	S	<i>Pseudococcus longispinus</i> (Targioni-Tozzetti) and <i>Ferrisia malvastra</i> (McDaniel)
<i>Vitis vinifera</i> L. (below ground)	HRV, Mal, McG, R, S & V	HRV, Mal, McG, R, S & V	<i>Planococcus ficus</i> (Signoret)
<i>Conyza bonariensis</i> (L.) Cronq (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	S	<i>Vryburgia transvaalensis</i> (Brain) & <i>Phenacoccus solani</i> Ferris
<i>Conyza bonariensis</i> (L.) Cronq (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	HRV, Mal, McG, Mon, P, Por, R, S & V	<i>Pseudococcus viburni</i> (Maskell)
<i>Bidens pilosa</i> L. (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	S	<i>Phenacoccus solani</i> Ferris
<i>Bidens pilosa</i> L. (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	HRV, Mal, McG, Mon, P, Por, R, S & V	<i>Pseudococcus viburni</i> (Maskell)
<i>Datura stramonium</i> L. (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	HRV, Mal, McG, Mon, P, Por, R, S & V	<i>Pseudococcus viburni</i> (Maskell)
<i>Erodium moschantum</i> (L.) L'Herit ex Ait.(roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	HRV, Mal, McG, Mon, P, Por, R, S & V	<i>Pseudococcus viburni</i> (Maskell)
<i>Sonchus oleraceus</i> (L.) Hill. (roots)	HRV, Mal, McG, Mon, P, Por, R, S & V	HRV, Mal, McG, Mon, P, Por, R, S & V	<i>Pseudococcus viburni</i> (Maskell)

Howard, was found once in Robertson and Stellenbosch.

Possible hyperparasitoids reared from *P. ficus* were *Chartocerus* spp. (Hymenoptera: Signiphoridae), *Cheiloneurus* spp. (Hymenoptera: Encyrtidae) and *Pachyneuron* spp. (Hymenoptera: Pteromalidae). They were recorded in Stellenbosch, Hex River Valley and Robertson.

CONCLUSIONS

The dominant mealybug species in South African vineyards was *P. ficus*, which confirmed work by Whitehead (1957), with *Ps. longispinus* recorded occasionally. *Ps. longispinus* was an addition to the list of pseudococcid vine leafroll virus vectors in South Africa and should be included in future epidemiological work on the vine leafroll virus.

The fact that *P. ficus* could colonise roots to a depth of 30 cm has far-reaching implications for the control of this virus vector. At present chemical control of vine mealybug targets the pest on above-ground parts of the vine. No below-ground control measures are available. This suggests that current vector control practices in supposedly vine leafroll virus-free propagation blocks need revision to include below-ground *P. ficus* control.

The range of natural enemies found during the study period was similar to that found in South Africa by Whitehead (1957) and Urban (1985). This indicated that no significant change regarding dominance of specific species has occurred since the 1950s. Care should, however, be taken to preserve these insects by limiting chemical sprays as outlined by Walton & Pringle (1999, 2001). Future work on natural enemies should be focused on the importation of new species, possibly similar to those reported by Trjapitzyn & Trjapitzyn (1999) from Argentina.

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