SEASONAL POPULATION STUDIES OF VINE MEALYBUG, *PLANOCOCCUS FICUS* (SIGNORET), AND ITS NATURAL ENEMIES IN VINEYARDS IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA

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**ABSTRACT**

Trial sites were regularly inspected in each of three grape growing areas in the Western Cape Province of South Africa. Sampling was conducted throughout the year for two seasons at intervals of one to four weeks depending on the time of year. Mealybugs were counted physically and yellow sticky traps were used for trapping parasitoids. In addition, mealybug infested butternuts was used as an additional method to monitor natural enemy populations. Mealybug colonies occupied the main stem of vines during the start of season and moved to the new growth areas, leaves and eventually bunches at harvest. Predatory beetles did not play an important role in the biological control of *Planococcus ficus* (Signoret) pest populations. The hymenopteran parasitoids, *Coccidoxenoides perminutus* Girault and *Anagyrus* spp., however, played a major role in biological control of *P. ficus*. Biological control was however not effective, as it was only achieved towards the end of the season and when damage to the crop had already been done.

**INTRODUCTION**

Vine mealybug, *Planococcus ficus* (Signoret) (Homoptera: Pseudococcidae), is a key pest in vineyards worldwide (Whitehead 1957, Berlinger 1977, Urban 1985, Duso 1989, Trjapitzyn & Trjapitzyn 1999). The tendency of *P. ficus* to penetrate into hidden places, and to cluster beneath the bark as well as the large amounts of wax excretions made chemical control of this pest exceedingly difficult (Berlinger 1977). Natural enemies of *P. ficus* (Whitehead 1957, Berlinger 1977, Urban 1985, Duso 1989, Trjapitzyn & Trjapitzyn 1999) and temperature (Berlinger 1977, Copland 1983, Duso 1989) were the major factors affecting population development during the growing season. These factors made it important to place focus on biological control of *P. ficus*.

As there was little recent information on phenological trends of *P. ficus* and its natural enemies in South Africa, this work aims to address this shortfall with specific focus on when in the year natural enemies became effective. Further to this, little information was available regarding prey-natural enemy relationships. Identification of specific relationships between pests and natural enemies such as density dependence (May et al. 1981) need to be identified as this will aid to determine the importance of each group of natural enemies in relation to *P. ficus*.

**MATERIAL AND METHODS**

**Trial sites**

One hectare was regularly inspected in each of three grape growing areas, namely Stellenbosch (33°54′E, 18°52′S, alt. 146 m) (Merlot, 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).

**Chemical control**

Pesticide applications against mealybugs included two applications of chlorpyrifos EC at 200 ml/100ℓ before bud break at an interval of two weeks in all blocks. Stem barrier treatments with alpha-cypermethrin SC at 20 mlℓ for ant control were applied where necessary.

**Sampling for mealybugs**

Sampling was conducted in twenty evenly spaced plots each consisting of five vines. Therefore, a central systematic sampling system was used. The lateral branches of each of these vines were inspected for *P. ficus* for a distance of up to 20 cm from the main stem where new growth occurred. One basal leaf in the same area was inspected for mealybugs on the same vines. All bunches on the fifth vine in each of these plots were inspected for the presence of *P. ficus*. The proportion of each infested plant part (lateral branches, leaves and bunches) was recorded in each block. Therefore, in each plot, five vines, five leaves and all bunches on the fifth vine were classified as infested or uninsected. Sampling was conducted throughout the year for two seasons at intervals of one to four weeks depending on the time of year.
Sampling for natural enemies

Yellow sticky traps have been used for trapping parasitoids and predatory beetles. Yellow rectangular Agribiol® (200 mm x 100 mm) sticky traps were used to sample adult parasitoids and predators. In addition, mealybug infested butternuts, each containing at least one hundred mealybugs at various stages of development were placed in polystyrene containers with entry holes smeared with petroleum jelly which effectively excluded ants. This was used as an additional method to monitor natural enemy populations as described by Urban (1985). Two butternuts and two sticky traps were used; one on the edge and one in the middle of each trial block. Both butternuts and yellow sticky traps were placed in the cordon area of the vines between 1.2 and 1.5 m above ground level. 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 predatory beetles and parasitoids was conducted using a stereoscopic microscope.

Data analysis

Interaction between both groups of natural enemies (parasitoids and predators) and *P. ficus* were analyzed by plotting natural enemy population levels on *P. ficus* population levels. These plots aided in the identification of density dependant relationships (May *et al*. 1981). An anti clockwise trend indicated a density dependent relationship. Clockwise and other trends indicated a density independent relationship (May *et al*. 1981). Percent parasitism (%PA) was estimated using (van Driesche 1983),

\[
\text{%PA} = \frac{\text{EMP} + \text{LP}}{\text{EMP} + \text{LP} + \text{UMH}}
\]

where EMP = emerged parasitoids, LP = all live parasitoids, and UMH = unparasitized mealybug hosts.

RESULTS

*P. ficus* occurred on the vine trunk in all areas throughout the year. The lowest *P. ficus* population levels were recorded during the winter months. As temperatures started to increase during November, mealybug colonies appeared on the new growth of the stems. The highest percentage stem infestation was recorded during February in the Hex River Valley and Stellenbosch and during January in Robertson. A successional trend of mealybug colonization was observed on the stems, leaves and bunches in all three grape-growing areas. Early in the season vine mealybugs colonized new growth on the stems, followed by the leaves and eventually bunches towards the end of the season. The highest percentage infestation of leaves and bunches was recorded during March in the Hex River Valley (1999/2000 season), Stellenbosch (1999/2000 season) and Robertson (both seasons) areas. This was followed by a rapid decline in infestation in most cases. Initial high stem infestations early in the season usually resulted in corresponding high bunch infestation levels at harvest and can therefore be an early indication of potential bunch infestation and crop loss towards the end of the season.

In most cases the highest numbers of predatory beetles were recorded during early December. *Nephus* spp. was the most abundant, supporting the findings of Whitehead (1957) and Berlinger (1977). Peak population levels of *P. ficus* (February) occurred after those of the predatory beetles (December), suggesting that predatory beetles did not have a major effect on reducing vine mealybug population levels. The parasitoid population peak in most cases was during March, about one month after the population peak of their host. Data from yellow sticky traps in all three areas indicated that *Coccidoxenoides perminutus* Girault (Hymenoptera: Encyrtidae) and the *Anagyrus* sp. were the dominant parasitoids, followed by *Leptomastix dactylopii* (Howard). The former two species could therefore be seen as the major contributors to biological control during the season.

By plotting parasitoid numbers on their host numbers, a density dependent relationship was evident in all areas and during both seasons. This further supports the notion that parasitoids are the main biological control agents for *P. ficus*. *L. dactylopii* numbers increased later in the season in all three areas, but were in the minority during this period, suggesting that they play a minor role in the biological control of *P. ficus*.

Plots of predator numbers on the numbers of their prey showed a clockwise trend, suggesting that there was not a density dependent relationship between the predators and their prey. This supports the contention that they were not as important as the parasitoids (Berlinger 1977) in the regulation of *P. ficus* populations, contrary to the conclusions made by Whitehead (1957). Mealybug population levels declined from February until the end of each

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season in each of the three areas despite suitable temperatures. The major mortality factor of *P. ficus* at this time of the season may have been the high parasitoid populations which resulted in high percentage parasitism.

**DISCUSSION**

A successional trend of mealybug colonization was observed between the different positions on vines in all three grape-growing areas. Vine mealybugs colonized new growth on the stems early in the season, followed by colonization on the leaves and eventually bunches towards the end of the season. Initial high stem infestations early in the season usually resulted in correspondingly high bunch infestation levels at harvest. Mealybug infestation of new growth on the stem early in the season can therefore be an early indication of potential bunch infestation and crop loss toward the end of the season.

Predatory beetles did not play an important role in the biological control of *P. ficus* pest populations. The hymenopteran parasitoids, *C. perminutus* and *Anagyrus* spp., however, played a major role in biological control of *P. ficus*. Biological control was however not effective as it was only achieved towards the end of the season and when damage to the crop had already been done.

**REFERENCES**


Whitehead, V.B., 1957. A study of the predators and parasites of *Planococcus citri* (Risso)(Homoptera) on vines in the Western Cape Province, South Africa. M.Sc., Rhodes University, Grahamstown.