Basis for a practical technique for monitoring thrips in avocado orchards

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Abstract Greenhouse thrips *Heliothrips haemorrhoidalis* (Bouché) and red-banded thrips *Selenothrips rubrocinctus* (Giard) (Thripidae) are sporadic but potentially serious pests of avocado fruits in South Africa. A simple monitoring technique for these little-understood pests is described. At low population levels, both thrips showed a distinct preference (93%) to feed between touching fruits, which resulted in damage to 22–33% of the touching fruits in the orchard studied, whereas only 1–3% of the single fruits were damaged. The percentages of touching and single fruits in the orchard were 17.5% and 82.5%, respectively, and it could thus be calculated that 6% of the fruits in the orchard would be unsuitable for export. It is suggested that the fruits be used as 'traps', as this obviates the use of the conventional sticky yellow traps and gives an immediate and more direct assessment of crop loss. It took only 6.5 h to sample 20% of the 180 trees in the study orchard. Using this technique, the individual farmer can decide when chemical control measures are warranted.

Keywords Thrips; *Heliothrips haemorrhoidalis*; *Selenothrips rubrocinctus*; avocados; pest monitoring

Introduction

Avocado orchards in South Africa comprise ~800 ha, which generate R100 × 10^6 and R30 × 10^6 on the export and local markets, respectively (1 rand ≈£0.2). Until recently, avocados in South Africa have had few serious insect pests because (a) the industry is relatively young – avocados were established as a crop between 1920 and 1930 (Durand, 1990) – and (b) the avocado industry is small relative to other South African crops, including fruit crops (Garbers, 1987). However, the South African export avocado industry has grown by > 25% per annum over the last decade (Kotze, 1990) and nine insect taxa currently cause lesions on the fruits (Dennill and Erasmus, 1991). This number illustrates a threefold increase in these pests since 1982 when Annecke and Moran (1982) recorded only three insect taxa causing lesions on avocado fruits.

A recent packhouse survey of 16265 unsorted fruits from 32 orchards in the Nelspruit-Hazyview area of the eastern Transvaal lowveld indicated that insects accounted for damage to ~10% of the fruits, implying a financial loss of R10 13 × 10^6 (Dennill and Erasmus, 1991). The four most important pests were coconut bug [*Pseudotheraptus wayi* (Brown)], the two thrips [*Heliothrips haemorrhoidalis* (Bouché) and *Selenothrips rubrocinctus* (Giard)], fruitfly [(*Pterandrus rosa* (Karsch)] and stink bugs [including *Nezara viridula* (L.)] which caused culling of 4.7, 2.1, 1.9 and 1.8% of the fruits, respectively. Although the two thrips species together were the second most important in the above-mentioned survey, they caused losses of up to 80% in some orchards in the Hazyview area during 1989.

By feeding on pericarp, these thrips extract chlorophyll and cause a bronzing of the surfaces of the fruits, while the skin of severely damaged fruits may crack (Annecke and Moran, 1982; de Villiers and van den Berg, 1987; de Villiers, 1990). Black dots, caused by deposition of their excreta, are also visible on the discoloured parts of the pericarp (de Villiers and van den Berg, 1987; de Villiers, 1990). Such fruits are unattractive and unsuitable for export (de Villiers, 1990). The nature of the damage that these thrips cause to avocado fruits is unlike that caused by thrips attacking other fruits, e.g. citrus. In the latter case, the citrus thrips *Scirtothrips aurantii* Faure feeds at the base of the developing, pea-sized fruit under the calyx, and the damaged area eventually becomes a characteristic ring of scarred tissue on the mature fruit (Annecke and Moran, 1982). In the case of avocados, the thrips do not feed on the fruit base of developing fruit under the calyx, but feed mainly on the sides of more mature fruit and no rings of damaged tissue occur. This is unusual, as both species attacking avocados are members of the family Thripidae, whose members are specially adapted for living in protected, hidden situations, e.g. flowers, or, characteristically, under the calyces of developing fruits (Hartwig, 1985).

Although most avocado fruits hang singly, many fruits do touch each other. The aim of the present study was to determine whether thigmotaxis in *H. haemorrhoidalis* and *S. rubrocinctus* caused them to prefer touching fruits and whether this could be used as a basis for a technique to monitor these sporadic yet potentially dangerous pests. Some farmers and consultants had mentioned that the thrips were most likely to be found between touching fruits. As yet there is no monitoring technique for thrips on avocados.

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Table 1. Percentage of single and touching avocado fruits (cv. Hass) infested and/or damaged by *H. haemorrhoidalis* and *S. rubrocinctus*

Date (1990)	Sample	Percentage fruits infested/damaged: Single ($n = 144$)	Percentage fruits infested/damaged: Touching ($n = 144$ pairs)
9 June	1	1.48	23.53
9 June	2	0.69	22.92
4 July	3	2.78	33.33

Methods

During the winter of 1990 (May–July), fruits were examined in various orchards in the Hazyview area (25 degrees S, 31 degrees E) to locate thrips. The Hazyview area was selected because it was in this area that outbreaks had occurred during the winter of 1989. The thrips were difficult to find because they are sporadic pests, but were eventually located on East Farm. This farm is close to the Sabie forestry area, and it is thought that the occurrence of thrips in this region may be the result of its proximity to forests. Pine trees are a well-known alternative host to *H. haemorrhoidalis* (Annecke and Moran, 1982).

In the orchard selected for the study, rows of cv. Hass were separated by three rows of cv. Fuerte. Because most of the earlier-ripening Fuerte fruits had been picked by the time that this study was initiated, and because most farmers, extension officers and consultants had complained that cv. Hass was usually most seriously affected by both thrips, these insects were monitored only on the Hass trees. Using stratified random sampling, three independent samples of 36 trees each were selected. The 36 trees covered the entire Hass orchard, and represented 20% of the total number of Hass trees present.

On each tree, one single fruit (a fruit not touching another fruit or a leaf) and one pair of touching fruits on the eastern, northern, western and southern sides of the tree, were examined for damage by, and/or presence of, thrips. There was thus a total of four single fruits and four pairs of touching fruits per tree. The fruits were randomly selected at a height between 0.5 m and 2.0 m. The nymphs and adults of both species were counted separately, and the degree of damage to the fruit was scored from 1 to 10 (1, 1–10% fruit surface damaged; 2, 11–20% fruit surface damaged, etc.). Once it had been found that the thrips had a distinct preference for touching fruits, the proportion of touching to single fruits was determined by counting the number of single and touching fruits on two major branches, one on the northern side and one on the southern side of each of another independent sample of 36 trees in the same orchard. By this means it could be determined how long it would take to estimate the percentage of fruits damaged by thrips in the orchard.

Results and discussion

In the three independent samples, the percentage of single fruits damaged or infested by thrips was consistently low (0.7–2.8%) whereas the percentage of touching fruits infested or damaged was consistently high (22.9–33.3%) (*Table 1*). The thrips showed a distinct preference (93%) for feeding between touching fruits (*Table 2*), even though the number of thrips sampled was relatively low (to be expected as this is a sporadic pest) (*Table 3*). The number of thrips per touching pair of fruits was consistent in all three samples, ranging between 0.6 and 0.9 (*Table 2*) and the sampling technique revealed that *S. rubrocinctus* was consistently most abundant, comprising 72.4–76.2% of the two-species thrips community (*Table 3*). Of the fruits in the orchard, 17.5% were touching fruits, and the time taken to count the total 4791 fruits used to arrive at this figure was 3.5 h.

The results indicate that the thigmotactic behaviour of *H. haemorrhoidalis* and *S. rubrocinctus*, which results in these species feeding preferentially between touching avocado fruits, can be used as a basis for monitoring these pests in avocado orchards. This technique is quick, as it took only 3 h to examine the trees for the thrips, while it took a further 3.5 h to determine the proportions of single and touching fruits in a sample that represented 20% of the trees in the orchard. It is suggested that the fruits themselves be used as 'traps', as this would obviate the necessity for the conventional sticky yellow traps that are used, for example, to monitor thrips in citrus (Samways,1986; Samways, Tate and Murdoch, 1986). Monitoring the thrips and the damage they cause on the fruit would also give an immediate and more direct indication of losses that could be incurred. The median score for damage inflicted by thrips to the avocado fruits was 1 on both sampling dates ($n = 39$ and 49, respectively), and 3 was the maximum score

Table 2. Occurrence of avocado thrips, *H. haemorrhoidalis* and *S. rubrocinctus*, on single and touching fruits, and the number of thrips, per pair of touching fruits

Date (1990)	Sample	Percentage thrips: Single fruits	Percentage thrips: Touching fruits	n^a	No. thrips per 'trap'[b]
9 June	1	11.11	88.89	18	0.63
9 June	2	2.94	97.06	34	0.96
4 July	3	7.69	92.31	48	0.66
Mean		7.25	92.75	33	0.75

[a]the number of fruits (single or pairs) on which thrips occurred; [b]the number of thrips of both species per pair of touching fruits ('traps', $n = 144$) sampled in the orchard

Table 3. Percentage of nymphs and adults of *H. haemorrhoidalis* (Hh) and *S. rubrocinctus* (Sr) and the species composition of this two-species thrips community on avocado fruits

Date (1990)	Species	Nymphs (%)	Adults (%)	n	Percentage of each species
9 June	Sr	83.00	17.00	100	72.46
	Hh	60.53	39.47	38	27.54
4 July	Sr	51.81	48.19	83	76.15
	Hh	69.23	30.77	26	23.58

recorded. Although the degree of damage to the fruits was low, the proportions of single and touching fruits damaged could be used together with the proportion of single versus touching fruits in the orchard examined, to determine that 5.82% of the fruits would not be suitable for export. (In the absence of evidence to the contrary, the proportional damage caused by the two thrips species was assumed to be similar.) This figure could be expected to increase if the avocados hung on the trees for longer, because the fruits ripened earlier than usual during 1990 and terminated this study prematurely.

Using this technique, the individual farmer can decide when it is worth controlling the thrips chemically. This technique can also be used to monitor the seasonal population fluctuations and the relative abundance of both species attacking avocados.

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