Seasonal Abundance of Different Stages of the Citrus Thrips, *Scirtothrips aurantii*, on Two Mango Cultivars in South Africa

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The citrus thrips, *Scirtothrips aurantii* Faure (Thysanoptera: Thripidae), is a pest of mango in South Africa. The aim of the study was to monitor the different stages of *S. aurantii* in mango orchards throughout the year. Populations of *S. aurantii* were monitored using different methods, *i.e.*, yellow sticky traps, dispersal/emergence traps, counts on fruit and in flowers. Eggs and emergence holes on the new leaves were recorded. The number of adults increased at the end of flowering (September) and remained at high levels until fruiting (November). Low numbers were present from May to August. Much higher population levels were present during 1995/96 than during the 1996/97 season. There was higher infestation present on the cultivar 'Sensation' than on 'Zill'. *S. aurantii* was present on the fruit for only a short period (less than 10 weeks) during the season and the population was maintained on flush that was present throughout the year.
KEY WORDS: Citrus thrips; mango; *Scirtothrips aurantii*; yellow sticky traps; dispersal/emergence traps.

INTRODUCTION

The South African citrus thrips, *Scirtothrips aurantii* Faure (Thysanoptera: Thripidae), has been an important pest of citrus in southern Africa for more than 60 years (2,3,5,7,13). *S. aurantii* severely scars young mangoes (*Mangifera indica* L.) (1) and fruit with lesions are not suitable for export. They also cause leaf malformation and stunting of growth.

The biology and habits of *S. aurantii* in citrus orchards in Zimbabwe were described by Hall (7) while the life cycle on citrus at Rustenburg was described by Bedford (2). The eggs are laid separately in soft tissue of green fruit, tender leaves and shoots. The newly hatched first instar is colorless but becomes yellow before molting. At maturity, most second instars drop to the ground and pupate beneath the trees. The prepupa possesses short wing pads and does not feed. The pupa has longer wing pads.

There are 9.4 generations per year in citrus and the number of individuals is usually highest during September to February (5). The population declines from the end of April to the beginning of August due to cooler weather and a diminishing food supply (13). Although cooler weather lengthens developmental time, *S. aurantii* does not diapause (2,7). Larvae and adults are present all year round if food is available. Populations in citrus trees are closely related to the flushing rhythm of the trees (11). In Mpumalanga Province, where

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mild to hot conditions prevail all year round, the indirect effects of rainfall in promoting flushing and subsequent population increase are particularly important. Flushing of citrus trees and the setting of out-of-season fruit late in autumn following relatively high rainfall in March and April, allow a large population of *S. aurantii* to develop during winter (4). Infestation in the following spring is usually high. Numbers are therefore not always at the lowest in winter, although this is usually the case (4). On Reunion Island, the population on citrus increases after flowering, remains at a high level until the end of the summer and then decreases. No captures were registered from March until the beginning of September (9).

Little information is available on the seasonal occurrence of *S. aurantii* in mango orchards. The aim of the study was to monitor the different stages of *S. aurantii* in mango orchards. Data on population fluctuations are essential in developing management strategies for this pest.

MATERIALS AND METHODS

Site

The 1 ha orchard in which the study was conducted, is located on the Friedenheim Experimental Farm of the Institute for Tropical and Subtropical Crops (25'27"S 30'58"E) in the Mpumalanga Province of South Africa. Half of the orchard consists of the cultivar 'Zill' while the other half is cv. 'Sensation'. Trees were planted in 1985 and were more than 3 m high at the time of the study. As this was a commercial operation fungicide sprays were applied against powdery mildew, anthracnose and bacterial black spot. Bait sprays containing trichlorfon were used for management of fruit flies.

Yellow sticky traps

Yellow sticky traps were used for monitoring *S. aurantii* adults from October 1995 until February 1997. The traps were non-fluorescent yellow polyvinyl chloride (140 mm $\times$ 76 mm $\times$ 0.2 mm), developed for monitoring *S. aurantii* population levels in citrus orchards (6). Both sides of the traps were coated with a sticky adhesive, Fly-tac. Each trap was suspended on the northern side of a tree, 1.5–2 m above the ground, using a clip attached to a piece of wire. Three traps were placed diagonally across the area with Zill trees, as well as across the area with Sensation trees. One trap was placed in the center and the two other traps near the opposing corners, for both of the cultivars. Traps were approximately 40 m apart. Traps were changed weekly and wrapped in clear polyethylene plastic wrap. Counting was done with a stereo microscope using a 10 $\times$ 25 magnification. *S. aurantii* males can be recognized easily by the presence of a comb of black setae on the hind femur and by the hooked drepana on the abdomen, while the females can be recognized by dark lines and patches on the abdominal tergites (3).

Dispersal/emergence traps

Mature larvae and emerging adults were sampled using dispersal/emergence (D/E) traps from October 1995 until February 1997. D/E traps were used by Reed and Rich (10) and Tanigoshi and Monero (12) for monitoring *Scirtothrips citri* (Moulton). This method was also used by Gilbert (4) for monitoring *S. aurantii* in citrus orchards. Each trap consisted of a polyvinyl chloride irrigation pipe with a diameter of 130 mm and a height of 100 mm.

The trapping surface was a square glass plate 250 mm × 250 mm × 3 mm, placed on top of the pipe. Both sides of the glass plates were covered with a sticky adhesive, Fly-tac. Three Zill and three Sensation trees were randomly chosen and traps were placed 300 mm from the trunk on the northern side of each tree. As the trap prevented larvae from reaching the ground, it was necessary to change its position in order to enable the continued monitoring of emerging adults. Therefore glass plates were changed weekly and moved to an adjacent tree. After covering the plates with clear polyethylene plastic wrap, *S. aurantii* counts were made using a stereo microscope at 10 × 50 magnification.

Fruit counts

For each cultivar, ten fruits on each of ten trees were visually inspected and the number of *S. aurantii* larvae and adults present on the fruit was recorded. Trees were chosen at random; fruits were randomly chosen in the canopy at a height of between 1.5 and 2 m. Fruits were inspected on the tree to minimize disruption of *S. aurantii*. The length of ten randomly chosen fruits was also measured, using a calliper, in order to determine how the population changed as the fruit matured. Counting was conducted weekly, commencing during October of each year (1995 and 1996) and continued until harvest.

Emerging larvae on fruit

Ten fruits were inspected weekly for the presence of emerging larvae from fruit set in October (in 1995 and 1996) until harvest in February. The fruits were picked at random from one randomly chosen tree, from between 1.5 and 2 m in the canopy. In the laboratory, fruits were inspected using a stereo microscope at 10 × 25 magnification and all the remaining thrips on the fruit were removed. Fruits were then placed in plastic jars at room temperature. The number of larvae that emerged from the eggs was counted after one week.

Flower counts

The number of *S. aurantii* in the flowers was determined by shaking ten inflorescences over a white tray and collecting the thrips with an aspirator. They were placed in a mixture of 60% ethyl alcohol and acetic acid (9:1) and later identified in the laboratory. This was done weekly from July 22 until October 7, 1996.

Eggs and emergence holes

The eggs and emergence holes on leaves were counted monthly from February 1996 until January 1997. Three young, soft leaves were sampled from each of ten trees. On each sampling occasion, trees were randomly chosen. Leaves were placed in N,N-dimethylformamide for 72 h to dissolve the chlorophyll so that the eggs and emergence holes could be seen easily. A stereo microscope at 20 × 50 magnification was used.

Flushing rhythm

The flushing rhythm of cv. Zill and cv. Sensation trees was noted. At weekly intervals a wooden frame (300 mm × 300 mm) was held 1.5 m above the ground against ten randomly chosen trees. The number of new flush points touching the frame was counted.

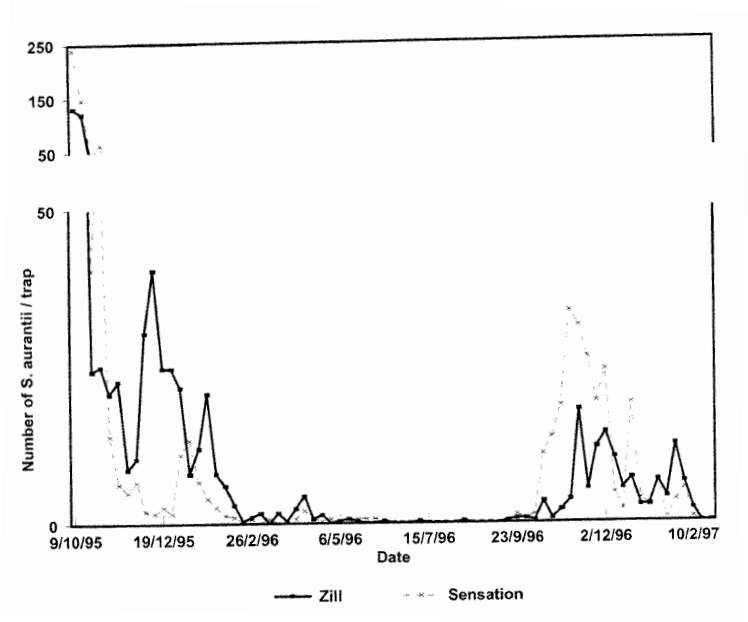

Fig. 1. The number of adult *Scirtothrips aurantii* recorded on yellow card traps.

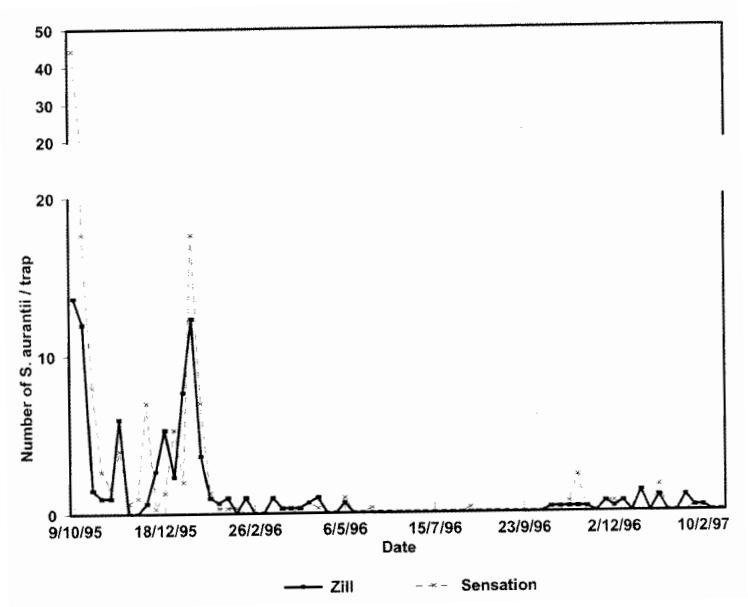

Fig. 2. The number of adult *Scirtothrips aurantii* recorded on D/E (dispersal/emergence) traps.

Yellow sticky traps

Adult *S. aurantii* were present in high numbers during October to December 1995 on both cultivars (Fig. 1). The population remained low from February until September 1996. Afterwards numbers started to increase, reaching a peak during the beginning of November 1996. This was true for both cultivars. The infestation level was higher on cv. Sensation than on cv. Zill, and much higher during October to December in 1995 than during the same period in 1996.

D/E traps

A number of problems were experienced. The top surface of the glass was often covered with fallen flowers, leaves, weeds and grass, making it difficult to see the thrips. In addition, it was not always possible to distinguish between larvae of *S. aurantii* and flower-dwelling thrips, such as *Thrips tenellus* Trybom. Similar problems were experienced by Gilbert (4). Therefore, only the adults of *S. aurantii* were counted.

As with the yellow sticky traps, the D/E traps also showed high numbers in October 1995 (Fig. 2). In both cultivars large numbers of thrips were present from the beginning of October 1995 to January 1996, after which numbers remained low. D/E traps in the Sensation orchard trapped higher numbers of *S. aurantii* than in the Zill orchard, and numbers followed a similar pattern to that recorded for the yellow sticky traps.

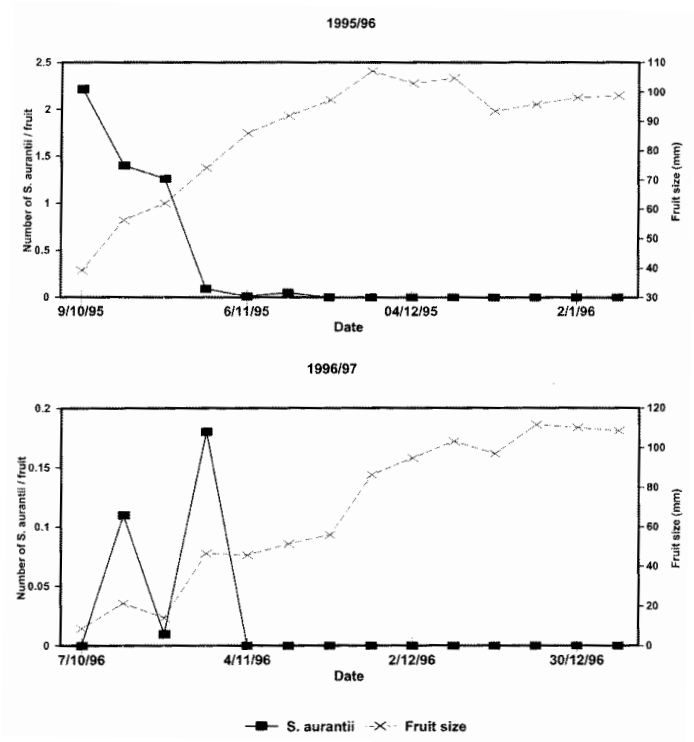

Fig. 3. The seasonal distribution of *Scirtothrips aurantii* adults and larvae on cv. Zill mango fruit.

Fruit counts

The numbers of *S. aurantii* on the fruit of both cv. Zill and cv. Sensation were much higher during October 1995 than during October 1996 (Figs. 3 and 4). A similar pattern was observed with the yellow card traps and the D/E traps. In both years no *S. aurantii* was recorded on either the Zill or the Sensation fruit after December. When the peak number of *S. aurantii* was present on the Zill fruit, the mean fruit length was 39.16 mm and 46.54 mm during 1995 and 1996, respectively. For Sensation fruit, the respective figures were 21.81 mm and 30.98 mm (Figs. 3 and 4).

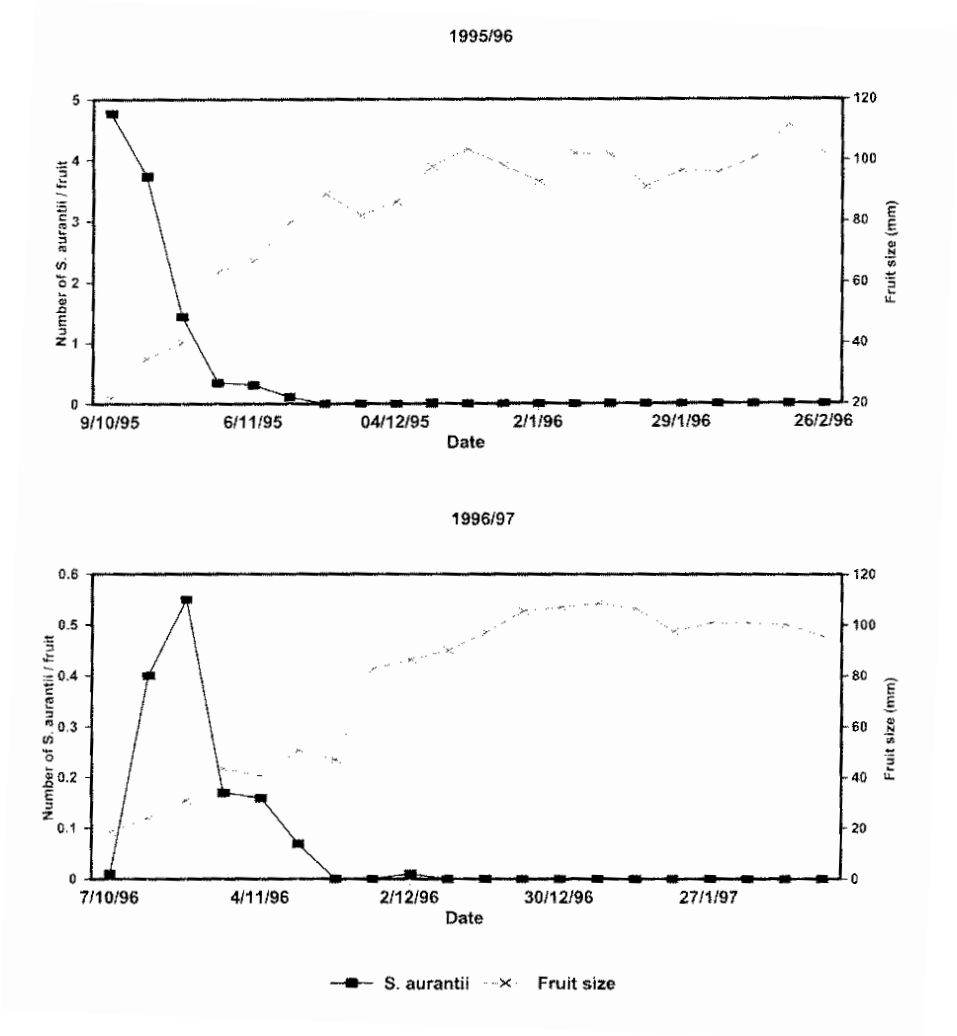

Fig. 4. The seasonal distribution of *Scirtothrips aurantii* adults and larvae on cv. Sensation mango fruit.

Emerging larvae on fruit

The number of larvae emerging from the fruit of both cultivars was much higher during 1996 than during 1997 (Fig. 5). In cv. Zill fruit, larvae were found to emerge from October until the beginning of November in 1995, and during October in 1996. Larvae emerged from cv. Sensation fruit from October to November in 1995 and from October to the beginning of December in 1996.

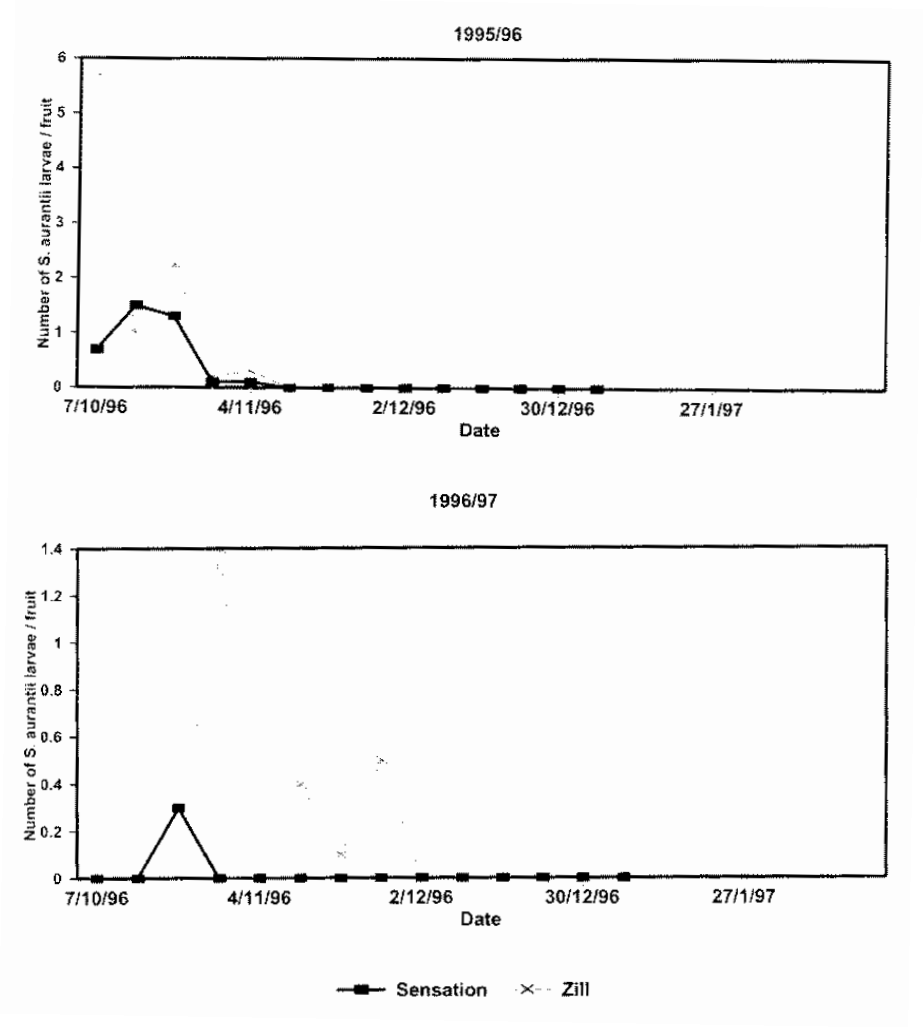

Fig. 5. The number of *Scirtothrips aurantii* larvae emerging from cv. Zill and cv. Sensation mango fruit.

Flower counts

No *S. aurantii* were collected from the flowers. *Thrips tenellus* Trybom and *Thrips acaciae* Trybom were the dominant species found in the flowers.

Eggs and emergence holes

In cv. Zill, the highest number of eggs and emergence holes on the leaves was observed during November (Fig. 6); none was present during July and August. In cv. Sensation, the highest number was found during October (Fig. 6); high numbers were present between May and July, and no eggs were present during August.

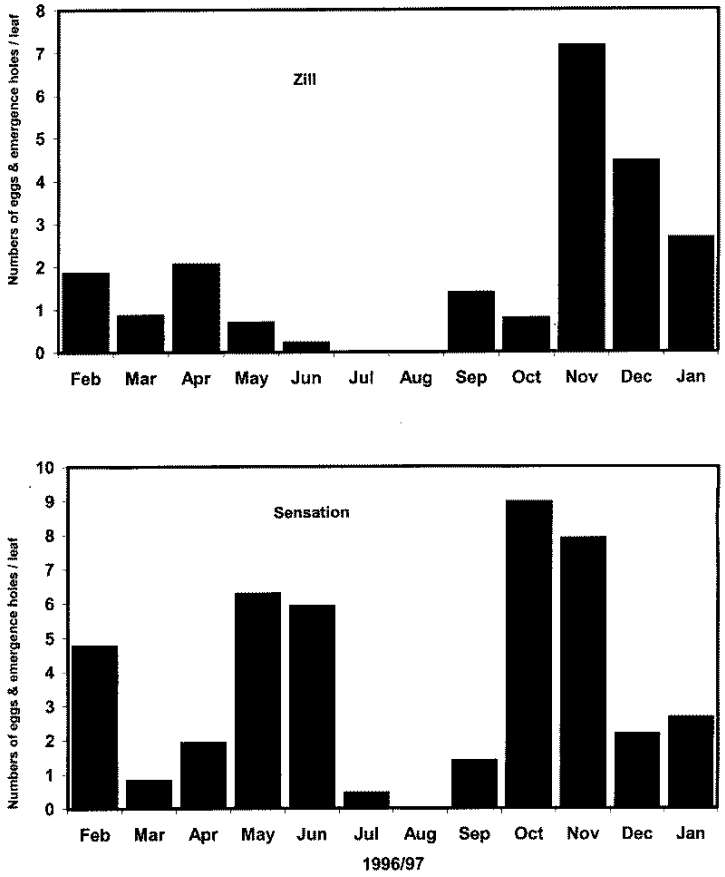

Fig. 6. The number of *Scirtothrips aurantii* eggs and emergence holes present on the leaves of mango cultivars Zill and Sensation.

Flushing rhythm

New growth was present throughout the year in both cultivars (Fig. 7).

DISCUSSION

High numbers of *S. aurantii* were present during October to December and low numbers from May until August. With all trapping methods, numbers were higher from September to December in 1995 compared with the same period in 1996. This was probably due to the

higher daily temperatures for those months in 1995. Bedford (2) recorded less economic damage by *S. aurantii* during cooler and wetter seasons in citrus orchards.

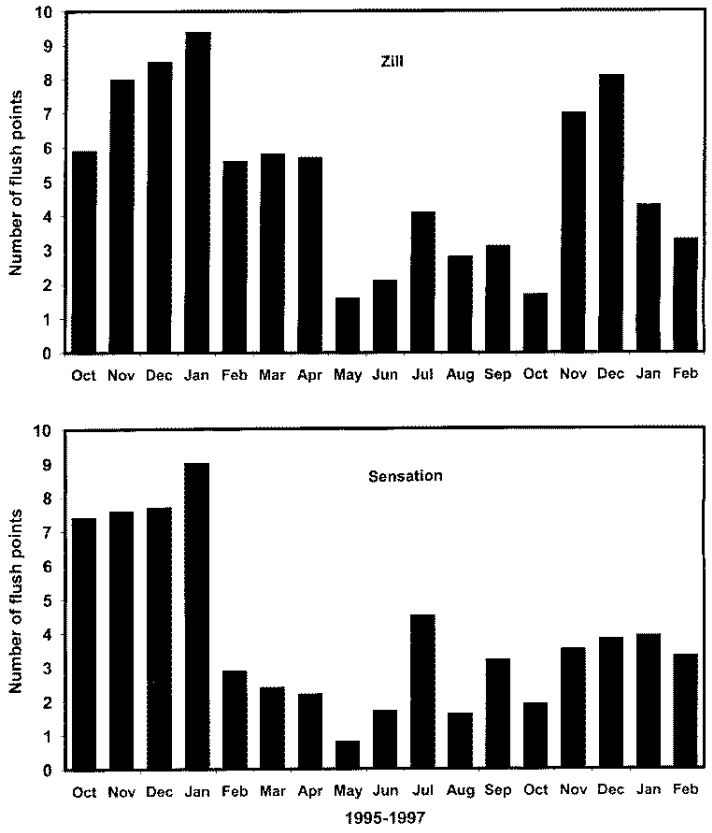

Fig. 7. The number of flush points per tree on mango cultivars Zill and Sensation.

Cultivar Sensation maintained higher numbers of *S. aurantii* than did cv. Zill. In the former, flowering between trees and among individual branches within a tree, is often conspicuously uneven. Consequently, the time of fruit set and the stage of fruit development at any point in time show pronounced variation (8). This may explain the higher *S. aurantii* numbers that persisted on cv. Sensation because the insects had constant access to fruits that were within their preferred size range (from fruit set until fruit 50 mm in length) for feeding and breeding.

Scirtothrips aurantii adults and larvae were present only on the young fruit from which larvae emerged during October and November. In controlling *S. aurantii* to prevent scarring of the fruit, the latter period is important and scouting is therefore essential from fruit set until the end of November.

New flush was constantly present throughout the year on trees of both cultivars and provided continuous breeding and feeding sites. During the spring, *S. aurantii* was found

to feed and breed on both the fruit and the flush. Although *S. aurantii* had been collected from the flowers on other occasions, it was not found in the flowers during the observation period, possibly due to the small population. Numbers present in the mango orchards fluctuated widely between the two seasons and between cultivars. It is therefore essential that any control program for *S. aurantii* on mango be based on thorough inspections and monitoring.

Yellow sticky traps and counts on the fruit are effective and practical methods for use by producers to monitor thrips population activity. A stereo microscope is needed in order to count *S. aurantii* on sticky traps, and this can probably be justified only by larger estates and not by small-scale farmers. Trap catches measure only flying adults, whereas counts on the fruit include both adults and larvae. Trap catches are also influenced by the number of *S. aurantii* present on new growth and are more likely to be influenced by weather patterns. Since traps measure the flying adults, they are of potential use for the early warning of infestations. On sticky traps, flower-dwelling thrips must be distinguished from *S. aurantii*. Counts on the fruit can be done by both smaller producers and larger estates and is a less time-consuming method than the yellow sticky traps.

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