EARLY SEASON CONTROL OF TWO-SPOTTED MITE IN STRAWBERRY PRODUCTION BEDS

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SUMMARY

Phytoseiulus persimilis (Acari; Phytoseiidae) reproduced throughout the winter and controlled *Tetranychus urticae* (the two-spotted mite, TSM) in a strawberry runner bed. Predator mites did not survive the move from runner to production beds, probably due to cultural management practices. In production beds, TSM broke diapause earlier than those in runner beds, and very low numbers in early winter increased to damaging levels by fruit harvest. TSM increase was delayed by 6 weeks when strawberry plants came from runner beds subjected to integrated pest management rather than acaricides.

INTRODUCTION

The two-spotted mite, (*Tetranychus urticae* Koch (Acari : Tetranychidae, TSM)) is a frequent pest in strawberry production beds. Mites are usually controlled by repeated applications of acaricides, especially during the export harvest period from October to December. This strategy increases the chance of resistance developing to the very limited range of acaricides registered for use on export strawberries. It is also expensive. To produce export quality fruit, production beds are usually replaced annually, using plants grown in runner beds isolated from the production beds to prevent carry over of pests and diseases.

Workman (1986) showed that the predatory mite *Phytoseiulus persimilis* Athias Henriot (Phytoseiidae) could control TSM in strawberry runner beds and that a few predators were present on harvested plants. This paper reports on subsequent studies in production beds, in Hawkes Bay and Auckland, to determine whether *P. persimilis* on harvested runners could survive the winter and contribute to mite control during the following season. Termination of diapause in TSM in strawberry beds was also investigated.

MATERIALS AND METHODS

In Hawkes Bay the grower produced his own runners and established his production bed with these plants. In Auckland, the grower purchased runners from two different commercial suppliers. Only their general growing history was known.

Hawkes Bay runner bed: TSM and *P. persimilis* were monitored fortnightly from 1 May 1985 on a 40 m² block of dicofol treated strawberry runners (cv. 'Tioga') located 5 km SW of Havelock North. Thirty compound leaves were collected randomly from the block from mother plants and runners. The block was treated with a range of insecticides until harvest in May and June to control aphids and leafrollers. In late July, the remaining plants were ploughed in, but further sampling continued until early September from plants which survived within the furrows.

Hawkes Bay production bed: Harvested runners from the monitored bed were transplanted to a 1 ha production bed about 100 m away, in double rows on raised, black-plastic covered ridges. TSM and natural enemies were monitored from June to November 1985 by randomly sampling 30 compound leaves per week from the block, which was managed commercially. Old leaves were removed in early July, and from late July to late October the plants were protected by clear plastic tunnels about 0.3 m high. The sides of the tunnels were raised for spraying and for bee pollination from early

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August. The pesticide spray programme was modified to minimise toxicity to natural enemies by using only pirimicarb (Pirimor 50 DG) against aphids, and *Bacillus thuringiensis* (Thuricide H.P.) against leafrollers (Lep. Tortricidae).

Sample leaves from both the runner and production beds were examined in the laboratory, and the total number of TSM (active stages only) and *P. persimilis* (eggs and active stages) and the number of leaves with these mites present were recorded. Diapausing TSM females (which are orange-coloured) were recorded separately.

Auckland production beds: Mites and natural enemies were monitored on the cv. 'Tioga' at a property 25 km NW of Auckland. Runners were purchased from two separate commercial suppliers. One supplier had sprayed the runners with acaricides throughout their development and these were planted in the "spray" block. The other supplier had controlled TSM in the runners with *P. persimilis* under an integrated control programme (Workman 1986). These were planted in the "IPM" (integrated pest management) block. In each block, samples were collected either weekly or fortnightly from early July 1986 until late-November. Samples contained 50 leaves, collected randomly from the same sub-blocks of about 40,000 plants on each occasion. Leaves were examined in the laboratory for mites and their predators, as in Hawkes Bay, except that numbers of eggs of TSM were also recorded. The spray programme on the sampled group of plants in the IPM block was modified up to harvest in order to protect any *P. persimilis* that may have survived on the runners, and pirimicarb and *Bacillus thuringiensis* were the only insecticides applied. On all the 'spray' block, the remainder of the 'IPM' block, and over all production beds after harvest began, the grower decided to follow the recommended MAF export spray programme.

RESULTS AND DISCUSSION

Hawkes Bay TSM and predator population development.

The total number of TSM on an infested leaf was given a rating of 1-13 (1 = 1 mite/leaf, 2 = 2-4 mites/leaf, 3 = 5-8 mites/leaf etc) and the average rating/leaf from each sample was used to measure TSM population trends in both beds. The *P. persimilis*

Fig. 1: TSM population development and control by *P. persimilis* in runner and production beds in Hastings. The TSM rating is a measure of the number of TSM/leaf. See text for details.

population development was measured by the proportion of TSM infested leaves that also contained these predators. (For further details see Charles *et al* 1985).

The proportion of TSM-infested leaves containing *P. persimilis* in the runner bed increased through June and July and the predator controlled TSM by the end of August (Fig. 1a). The mite predator *Stethorus bifidus* Kapur (Col. Coccinellidae) was also found occasionally in every month except June but did not contribute noticeably towards TSM control. TSM occurred on 63-100% of sample leaves taken from runners transplanted in May and June, so the potential for TSM infestation from runner to production beds was very high. Many of these leaves also contained *P. persimilis*, but biological control in the new beds was disrupted in early July, when the old leaves (which contained most *P. persimilis*) were removed as part of the standard crop management programme. *P. persimilis* was not recovered from leaf samples again until early September (Fig. 1b). Although fewer TSM also remained after the old leaf removal, those that survived were nearly all young, fertile females, freshly out of diapause, which began to lay eggs in early June. Young mites matured slowly through July and August, and initiated a rapid population increase in September when the weather became warmer. The proportion of sample leaves with *P. persimilis* also increased rapidly through September (probably resulting from new immigration to the block), but the predators could not prevent TSM from exceeding damaging levels. However, after a single application of acaricide dramatically reduced the TSM population in October, *P. persimilis* retained control of the pest until sampling stopped.

Diapause. Eggs and active stages of *P. persimilis* were found in the runner bed samples proving that at least some females were reproductively active throughout the winter which supports Overmeer's (1985) statement that *P. persimilis* is incapable of entering diapause. In the TSM population, about 40% of mites from the runner bed samples were in diapause at least until the end of August (Fig. 2). In the production bed, however, TSM began to break diapause almost immediately after transplanting in June, and the proportion of overwintering females declined rapidly through July and August (Fig. 2). The factors that terminate diapause in TSM can be complex (Hussey 1972), but here it was probably due to higher temperatures provided by radiation from the black plastic to the underside of leaves, and by shelter and heat accumulation in the plastic tunnels. TSM in the new production beds which broke diapause much earlier than those on surrounding vegetation provided a food source for any winter-active *P. persimilis*, and a nuclei for early season mite infestations.

Fig. 2: Diapausing TSM (adult females) in runner and production beds in Hastings.

Fig. 3: Comparison of TSM numbers in "spray" and "IPM" blocks in Auckland.

Auckland production beds.

Workman (1986) reported that, at harvest, TSM infestations on IPM managed runners were considerably lower than on acaricide treated runners. Low levels of *P. persimilis* were also present at harvest on both groups of plants. During this trial, *P. persimilis* were not recorded in any sample from the Auckland site. As in Hawkes Bay they probably did not survive the cultural management of the production bed which included removal of old leaves. TSM were uncommon in July and August, but they were more frequent on samples from the "spray" plants than from the "IPM" plants (Fig. 3). All of the TSM from samples in July and August were found in isolated colonies composed of a single adult female and/or her developing progeny. The population increased rapidly on the "spray" plants in early September when the progeny matured and reproduced, but two applications of cyhexatin (Plictran) on 1 and 15 October reduced mite numbers to a very low level (Fig. 3a). The grower, to minimise further risk, then applied cyhexatin over the harvest period until mid-December. TSM was rare on the IPM plants in winter, and only seven eggs were found on one sample leaf during July and August (Fig. 3b). The TSM population in the IPM block did not begin to increase until late October, at the beginning of harvest. The grower applied cyhexatin, as an insurance, on 3 November, which was a month after the first application to the "spray" block. Regular applications were then made until mid-December, but sampling on both blocks ceased in mid-November, when TSM numbers were very low.

CONCLUSIONS

Although *P. persimilis* from runner beds can survive on TSM through winter in New Zealand, they are unlikely to make the transition to production beds to help control TSM in spring, due mainly to removal of old leaves soon after planting. TSM problems in production beds are minimised when the TSM infestation on runner plants is extremely low. The Auckland results indicated that IPM in runner beds delayed TSM outbreaks in spring by 6 weeks. Thus the runner bed IPM programme, which is cost effective in greatly reducing TSM numbers compared with miticide-treated plants (Workman 1986) should be implemented by all runner producers.

Three strategies for TSM control are now available to berry producers:

- 1) Continue the present practice of applying pre-harvest and harvest acaricides, and face the possibility of resistance to cyhexatin. Also accept lower yields because of the phytotoxicity of cyhexatin to strawberries (La Pré *et al* 1982).

2) Use IPM runners containing fewer TSM, and delay the first applications of acaricide in spring. This strategy should lead to better TSM control throughout the season using fewer sprays.

3) Apply a total integrated pest management strategy. IPM has been successfully adopted by strawberry runner producers (Workman, pers. comm.). IPM in strawberry production beds could reduce the number of acaricide applications considerably. This would reduce pesticide costs, minimise the risks of resistance, improve plant quality and reduce the problems associated with waiting periods and pesticide residues. Presence of *P. persimilis* and *S. bifidus* in the strawberry beds can be encouraged by only using chemicals which are non-toxic to the predators and by making mass releases of commercially available supplies of *P. persimilis* to control TSM. Acaricides would then be used only if TSM numbers escaped predator control. This would almost certainly provide better long term control of TSM than by using acaricides alone. Further research is required to find the optimum time to introduce *P. persimilis*, and to study the control of other strawberry pests, such as strawberry aphid, using methods compatible with IPM.

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