INTEGRATED CONTROL OF TWO-SPOTTED MITE ON STRAWBERRY RUNNER BEDS

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SUMMARY

Three years of trial work in strawberry runner beds from 1983-86 showed that release of the predatory mite *Phytoseiulus persimilis* controlled two-spotted mite (*Tetranychus urticae*) (TSM) more effectively than repeated miticide sprays. In 1985/86 *P. persimilis* was released in three commercial properties producing strawberry plants (10.4 ha) at Katikati and at the time of harvest the percentage of leaves infested with TSM was consistently low (0-1.4%). On three other properties where miticides were used, TSM was present on 0-72% of leaves at harvest. TSM control by *P. persimilis* is cost effective compared to current miticide use and reduces the potential for the development of miticide resistance in TSM.

INTRODUCTION

Strawberry plants are produced in runner beds established in areas isolated from the fruiting beds to prevent the carry over of pests and diseases. However, many strawberry growers still receive strawberry plants that are infested with two-spotted mite (TSM). TSM are very difficult to control in strawberry runner beds even with regular miticide applications. This is because from January until May, when the plants are harvested, the leaves form a dense canopy close to the ground, making it very difficult to obtain complete spray coverage on the underside of the leaves. Repeated applications of miticides (often 9-14 per season) coupled with incomplete coverage provide favourable conditions for the development of miticide resistance in TSM. If resistant TSM are spread to fruit producing areas when the runners are distributed and planted out, problems of mite control arise in export crops where the range of permissible miticides is very limited. Only cyhexatin and dicofol are allowed at present on export fruit. TSM is already reported to be resistant to 56 pesticides (Georghiou 1981) and recently TSM from a Katikati strawberry runner bed was found to be resistant to propargite (B. Chapman *pers. comm.*).

An alternative to pesticides is to use predatory mites. One, *Phytoseiulus persimilis*, has been used to control TSM in strawberries in California (Oatman *et al* 1977). *P. persimilis* has also been established in outdoor crops in New Zealand and has successfully controlled TSM in raspberries in Hawkes Bay (Charles *et al* 1985). This paper reports the results of trials using *P. persimilis* to control TSM over a three year period on strawberry runner beds, culminating in the use of the predator on 10.4 ha by three growers at Katikati.

METHOD

P. persimilis was reared on TSM infested dwarf beans (*Phaseolus vulgaris* cv. 'Topcrop') grown in seed trays with the estimated population of the active stages of *P. persimilis* varying from 20,000 to 40,000 per tray. The method of rearing *P. persimilis* was adapted from the Glasshouse Crop Research Institute method (GCRI 1975) as described by Burgess (1984).

Preliminary trials were undertaken in 1983/84 in a strawberry-runner field cv. 'Tioga' (0.36 ha) at Cambridge and in 1984/85 in a mixed cultivar field cv. 'Brighton', 'Aiko', 'Pajaro', 'Douglas' and 'Tioga' (0.46 ha) at Katikati. *P. persimilis* was distributed when TSM populations began to increase by placing an infested bean leaf on

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every strawberry mother plant which were spaced at 1.83 m x 1.83 m intervals (2500 plants/ha). Runner beds that had received miticides to control TSM were sampled at harvest to check the level of control being achieved by spraying. In 1985/86 larger field trials were undertaken on three Katikati properties (A, B, C) of 2.3, 4.4 and 3.7 ha respectively. The management of *P. persimilis* was refined by encouraging natural infestations of the predator by using predator-safe miticides early in the season and by reducing the numbers of *P. persimilis* released. On property A and B one infested bean leaflet was placed on every second plant using 2.5 and 3.6 trays/ha respectively. On property C one bean leaf was put on every third plant in every third row (2.7 trays/ha). One field on each property was monitored closely and the growers were instructed in how to sample the rest of their fields. To assess the effectiveness of integrated mite control three other strawberry runner beds (D, E, F) at Katikati that had been sprayed throughout the season with miticides were sampled at the beginning of harvest.

The populations of TSM and *P. persimilis* were estimated every 14 days by recording their presence on a leaflet randomly collected from every third mother plant in every third row (275 leaflets/ha). In the first two seasons the numbers of mites on each leaflet were counted under a microscope. In the third season estimates of mite numbers on each leaflet were made in the field.

Pests and diseases in runner beds were controlled by pesticides compatible with *P. persimilis*. In 1983/84 and 1984/85 the insecticides used were azinphos methyl and pirimicarb. In 1985/86 *Bacillus thuringiensis* and diazinon were also used. The main fungicide was captafol while cupric hydroxide, dimethirimol and vinclozolin were also used.

RESULTS

P. persimilis consistently gave very effective control of TSM in strawberry-runner beds. In 1983/84, at Cambridge, TSM did not appear in leaf samples until 18 January (Fig. 1). *P. persimilis* was released on 29 February when TSM was on 5% of leaves, and rapidly controlled them. TSM levels reached a maximum of 14% of leaves infested on 28 March. At harvest TSM was present on 4% of leaves. On two strawberry runner fields at Katikati, which received regular miticides through the season TSM was present on 33% and 43% of the leaves at harvest.

In 1984/85 at Katikati TSM appeared on 17 December (Fig. 1). *P. persimilis* appeared naturally at this time but did not prevent TSM from increasing rapidly. *P. persimilis* was released on 14 January when TSM was present on 18% of leaves. TSM numbers peaked on 13 February when TSM were present on 70% of leaves with TSM numbers reaching 414 TSM per leaflet. *P. persimilis* reduced the infestation so that at harvest TSM was found on 1.5% of leaves. In contrast 35% of leaves were infested with TSM in another field in the same property which had received nine miticide applications.

In the extensive field trials of 1985/86 TSM was first found on property A on 23 October, four weeks after the strawberry mother plants were planted (Fig. 1). Over the next 6 weeks the strawberries were sprayed three times with predator compatible miticides (azocyclotin and fenbutatin oxide). Although TSM persisted, there was no natural infestation of *P. persimilis*, which was released on 4 December. TSM and *P. persimilis* persisted at low levels for the rest of the season. At the beginning of harvest no TSM were found on the leaf sample.

On property B TSM numbers began to increase on 18 December and the predators were released 2 weeks later when TSM infested 6% of leaves (Fig. 1). At the beginning of harvest (23 April) 1.4% of the leaf sample had TSM present with no leaf having more than 1 TSM. *P. persimilis* was present on 0.5% of the leaves.

TSM appeared on 6 November on property C and *P. persimilis* was released on 13 January when TSM was on 12% of the leaves (Fig. 1). No natural invasion of the predator occurred within this ten week period even though this property was the site of the 1984/85 trial. TSM peaked on 12 February (20% of leaves) but at the beginning of harvest no TSM were found in the leaf sample. On all three properties the restricted use of pesticides that were compatible with the predator gave acceptable control of other pests and diseases.

Fig. 1: Percentage of leaves infected with TSM in field trials Cambridge 1983/84, Katikati 1984/85, Katikati 1985/86.

Control of TSM on the three properties (D, E, F) which had received miticides was very variable (Table 1). Property D had been sprayed ten times for the control of TSM with propargite (2x), mevinphos (2x), clofentezine (2x), demeton-s-methyl (2x) and azocyclotin (2x). The grower of property E had not kept spray records but indicated that demeton-s-methyl had been used early in the season followed by methamidophos every three weeks. Clofentezine was also applied in January and a field of 'Red Gauntlet' had received an extra application of cyhexatin and demeton-s-methyl. Property F had been sprayed 11 times with clofentezine (7x), mevinphos (2x), dicofol (1x) and azocyclotin (1x). Two litres of clofentezine were used at a cost of \$240/ha for this material alone. While grower F had achieved very good results, the mite infestation in some fields of the other two properties was very high, exceeding 50 TSM/leaf on many plants. It is of interest that low levels of *P. persimilis* were found on all three properties using miticides even though pesticides toxic to the predator had been used.

DISCUSSION

Although *P. persimilis* survives the winter in the North Island and has been found to persist on kiwifruit shelter in the Katikati area (D. Steven pers. comm.) it did not establish in strawberry beds early in the season. It is expected that it will be necessary to

TABLE 1: Percentage of leaves infested with TSM at the beginning of harvest (24.4.86) on three properties using miticides to control TSM.

	Field 1	Field 2	Field 3
Property D	44.4	49.2	72.5
Property E	3.7	12.3*	69.3
Property F	0	0	0.9

*Field of 'Red Gauntlet' strawberries which received extra cyhexatin and demeton-s-methyl.

release the predator on runner beds each year and this release should be when 5-10% of the leaves are infested with TSM which, these trials indicate, is usually in late December/early January. Growers will need to monitor their plants in order to detect these levels of infestation. The availability of predator-safe miticides provides flexibility to the programme, allowing natural infestations of the predator to be encouraged early in the season and control TSM if predator numbers are too low.

The excellent results obtained in 1985/86 with the lower release rates of *P. persimilis* indicate release rates may be reduced even further. But even at the 1985/86 rates the use of the predator is very cost effective. At \$40 per tray (DSIR charge in 1985/86) the cost to the growers was \$100-140/ha. Commercially produced *P. persimilis* may cost more, and may include an initial technical service fee to teach growers how to use the predators most effectively, but the total cost/ha is expected to compare favourably with the cost of miticide applications. Discussion with growers during these trials indicated that the cost of miticides for one season was about \$300/ha.

In addition to the immediate cost advantages of integrated mite control there are other substantial benefits to both the runner producers and the fruit growers. In these trials use of *P. persimilis* consistently produced runners with very few TSM, providing the fruit producers with plants with a low inoculum of this pest. Moreover, because few or no miticides were used by the runner producers there was a much reduced risk of developing and transferring resistant mites to the strawberry fruit producers. If the use of integrated mite control can be developed and extended to the strawberry fruit producing fields, then *P. persimilis* may provide a long term solution for TSM control for both strawberry fruit and plant producers.

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REFERENCES

- Burgess, E.P.J., 1984. Integrated control of two-spotted mite on glasshouse roses. *Proc. 37th N.Z. Weed and Pest Control Conf*: 257-261.
- Charles, J.G., Collyer, E. and White, V., 1985. Integrated control of *Tetranychus urticae* with *Phytoseiulus persimilis* and *Stethorus bifidus* in commercial raspberry gardens. *N.Z. J. Expt. Agric.* 13: 385-393.
- Georghiou, G.P., 1981. The occurrence of resistance to pesticides in arthropods, an index of cases reported through 1980. In FAO of UN, Rome, 172 pp. FAO Plant Protection and Production Series.
- Glasshouse Crop Research Institute, 1975. Biological pest control. Rearing parasites and predators. *GCRI Growers Bulletin No. 2*: 12 pp. Glasshouse Crop Research Institute, Littlehampton, Sussex.
- Oatman, E.R., McMurtry, J.A., Gilstrap, E.E. and Voth, V., 1977. *Phytoseiulus persimilis* and *Typhlodromus occidentalis* on the two-spotted spider mite on strawberry in South California. *J. Econ. Entomol.* 70 (1): 45-47.