USING *PHYTOSEIULUS* TO CONTROL TWO-SPOTTED MITES IN STRAWBERRIES

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SUMMARY

Inundative releases of the predatory mite *Phytoseiulus persimilis* were made in two blocks of an Auckland strawberry (*Fragaria* sp.) garden, one on 2 September, the other on 3 November 1987. Predators from both releases successfully established. Two-spotted mite (*Tetranychus urticae*) did not reach damaging levels in either block, and were completely controlled by *P. persimilis* by the end of December. More experience is needed to determine the optimum timing and rates of release of the predator to individual strawberry gardens, and to confirm that the predators can operate effectively within an integrated control programme for all strawberry pests and diseases.

INTRODUCTION

The acaricide cyhexatin was the most effective pesticide for the control of *Tetranychus urticae*, the two-spotted mite, TSM, in export strawberries (*Fragaria* sp.) until August 1987 when it was withdrawn from sale in New Zealand. Other acaricides on the market are not as useful. Some are not registered for use on strawberries after flowering (eg clofentezine); others provide unreliable control because of widespread TSM resistance (eg dicofol).

The predatory mite, *Phytoseiulus persimilis*, has given excellent control of TSM when released into strawberry runner beds (Workman 1986). In subsequent study in a strawberry fruiting bed (Charles *et al* 1987) TSM populations were found to increase rapidly in September. However, if the TSM population on runners was very low when they were harvested, as on runners produced under an integrated pest management (IPM) regime, then the TSM population in the production bed did not noticeably increase until late October, a delay of up to 6 weeks. The same study also indicated that any *P. persimilis* on the harvested runners did not survive the transition to production beds, so that, for the purpose of biological control of TSM in strawberries, predators must be released into the production beds in spring.

If large numbers of predators are to be released into strawberry beds to control TSM - in effect using them as a "biological acaricide" - then a "rate of release" must be determined. The release rate has at least two components; the timing (i.e. the date that the predators are released), and the number of predators released per unit area. The number of prey (TSM) at the time of release is also important, but if numbers of TSM are consistently very low until September or October then predator releases can be made on a 'preventative' calendar schedule.

This contribution reports on an investigation into the rate of release of *P. persimilis* into strawberry production blocks.

METHODS

The trial was carried out in Auckland at a single commercial property, on two similar-sized (c. 0.5 ha) strawberry blocks, one of the cv. Tioga, the other mainly cv. Pajaro. Strawberry plants in each block came from IPM runner beds, and were vigorous and appeared disease-free. They were planted out in double rows on black plastic-covered earth mounds. Each block consisted of about 45 rows. The row direction in one block was at right angles to that in the other. The blocks were sheltered on two sides by TSM-free shelter belts (one of bamboo, the other *Cryptomeria*), and exposed to bare, cultivated land or pea and bean crops on the other two sides.

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Mite populations were monitored in each block from 26 August until 30 December on leaf samples collected at fortnightly intervals. Leaves were picked at random, but from the same V-shaped transect path across each block on each occasion. As the transect path was followed, two leaves were picked from each mound as it was crossed, so that the same number of leaves (about 90) was collected on each occasion. This sampling method was designed to minimise the variation that might occur between sampling occasions if there was a very patchy distribution of TSM in the blocks. Leaves were examined under a binocular microscope in the laboratory, and the numbers of TSM and predators recorded.

P. persimilis were reared at Mount Albert Research Centre, DSIR, on TSM-infested bean plants, and were then taken to the strawberry blocks on bean leaves. Each block was divided into a grid by five imaginary transect lines drawn at right angles across the rows. One *P. persimilis* infested bean leaf (with about 10 adult female predators) was then stapled to one strawberry plant on each row across each transect, so that each block received about $(5 \times 45) = 225$ point sources of *P. persimilis*. This release rate equalled about 4000 adult females/ha, but the total number of predators released, when considering eggs and nymphs, was probably several times higher. The predators were released on 2 September in the "Tioga" block, and 3 November in the "Pajaro" block. This gave an "early" and a "late" release date.

TSM were also monitored briefly at a second Auckland property. A single block became badly infested with TSM early in the season, probably because of the higher temperatures experienced in spring when the grower had grown the crop under plastic cloches. An application of cyhexatin (Plictran) on 7 November killed most of the active mite stages. A fortnight later, on 17 November, 88% of leaves sampled from the block were infested with mainly young TSM nymphs (which had hatched from the eggs which survived the cyhexatin spray) and an inundative release of *P. persimilis* was made. Because of the high TSM infestation, the predators were released at three times the rate of the first property i.e. c. 12000 adult females/hectare.

RESULTS

TSM were first recorded in the "Tioga" block on 26 August, but were not found on the "Pajaro" block until the 14 October — 7 weeks later (Fig. 1). This may have been because the "Tioga" block was better sheltered, and warmer winter and spring temperatures increased the rate of TSM population growth.

TSM were found on increasing numbers of the sample leaves taken from each block until December. Peak populations of TSM were recorded on 2 and 16 December in the "Tioga" and "Pajaro" blocks respectively when 83 and 66% of the leaves were infested with TSM. The numbers of TSM/leaf (mean $\pm$ SE of mean) at these peaks were 45 ± 17.5 and 11 ± 2.8 respectively (Fig. 1). Despite the presence of a few leaves with high numbers of mites (typical of TSM populations), these infestations were considerably lower than the c. 100 mites per leaf needed to damage strawberry plants (Gunson 1984).

P. persimilis had successfully controlled TSM in each block by the end of December (Fig. 1). Despite the 8 week difference in release dates of the predator to the two blocks, peak numbers of *P. persimilis* were found in both blocks on 16 December, when they were present on 87% and 75% of TSM infested leaves in the "Tioga" and "Pajaro" blocks respectively. Two weeks later, TSM had been virtually eliminated (Fig. 1), and only a few leaves supported any mites at all.

In the heavily infested block on the second property, no acaricides were applied after 7 November. By 2 December TSM were found on 100% of the leaves sampled, but *P. persimilis* had successfully established on 34% of those leaves. Another phytoseiid predator of *Tetranychus* spp., *Amblyseius womersleyi*, was found on 68% of leaves. This predator, considered by Collyer (1982) to be synonymous with *A. longispinosus* is common on low herbaceous plants in both New Zealand and Australia. The TSM population was completely controlled by 26 December when only 20% of the leaves were infested with a few TSM. Although there were also a few *A. womersleyi* no more *P. persimilis* were recovered. Since the plants were healthy and vigorous with many new leaves it seemed that deteriorating plants were not the cause of the TSM decline; more

probable was that the population had been suppressed by the activity of the predatory mites. It was not possible to determine the relative contribution of the two predator species to TSM control. However, *A. womersleyi* has been recorded many times throughout New Zealand on strawberry plants, usually associated with TSM, and has been studied in Australia (Schicha 1987) and Taiwan (Lo 1984) for use in integrated control of strawberry mites. Interestingly, Lo (1984) demonstrated that *A. longispinosus* (= *A. womersleyi*) provided control of TSM only at a low prey density.

Fig. 1: TSM population development and control by *P. persimilis* in strawberries a) cv. Tioga and b) cv. Pajaro.

DISCUSSION AND CONCLUSION

In the absence of chemical acaricides, strawberry growers have little choice but to rely on inundative releases of natural enemies to control TSM. Because most strawberries are grown annually, there is little prospect that predators will carry over from one season to the next, and so they must be introduced artificially every year. *P. persimilis* is ideally suited for this role. It is amenable to commercial mass production and is a voracious and active predator which spreads quickly through a strawberry block and rapidly controls TSM.

Although it can be argued that growers should not release predators until they can determine if they are going to have a TSM problem or not, this may be an impractical option for three reasons. Firstly, monitoring the size of TSM populations in a strawberry garden is time-consuming and the results may be difficult to interpret, especially if there are predators such as *A. womersleyi* already present. Secondly, experience with a range of crops has shown that *P. persimilis* are most effective if they are introduced when TSM numbers are very low. Finally, TSM is a major pest in strawberry gardens so frequently that there is little risk of being wrong if one assumes that it will be a pest every year. On this basis, the most practical way of using commercial supplies of *P. persimilis* would be to release them at the same time each season, when they are likely to be most effective.

The results of this trial show that *P. persimilis* can control TSM in unprotected strawberry production beds in Auckland when released in spring at a rate of about 4000 adult females/ha. The predators released on 3 November gave equally as good control of TSM as those released on 2 September. In practice, there may be significant advantages in releasing *P. persimilis* during the last 2 weeks in October, because spring infestations of aphids can then be controlled by aphicides (most of which are toxic to *P. persimilis*) before the predators are released.

The reasons for the initial differences in size of populations of TSM in the two blocks is not known. TSM populations may develop at different rates on different strawberry cultivars (Gunson 1984) due to features such as nutrition and canopy shape. These differences, although usually minor, may influence the optimal time for release of predators onto different cultivars.

Further refinements to the "rate of release" for inundative releases of *P. persimilis* to strawberry gardens will need to be made by growers on their own properties over several years. Releases will probably have to be made several weeks earlier where protected (cloched) strawberries are grown, but each property may have topographical features or management practices that will influence TSM population development and therefore optimum timing of *P. persimilis* releases. The success of the "triple rate" of predator release to the second property in this study shows that *P. persimilis* may also be used to control unexpected outbreaks of TSM in strawberries. Growers also need to understand that predator mites are killed by some fungicides and insecticides, so that biological control of TSM must be carefully integrated with the control of other pests and diseases of strawberries.

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