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SUPERVISED SPRAYING OF LEPIDOPTEROUS PESTS OF KIWIFRUIT IN THE BAY OF PLENTY

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Summary

Lepidopterous pests and their damage were monitored on sprayed and unsprayed kiwifruit (*Actinidia chinensis* var *chinensis*) vines over three seasons in the Bay of Plenty. The monitoring was used to determine the timing of spray applications, particularly against the dominant leafroller species, the brownheaded leafroller (*Ctenopseustis obliquana*) and a native moth *Stathmopoda skelloni*. This supervised spraying provided export quality fruit, with respect to insect damage and presence, using only three or four organophosphate sprays.

INTRODUCTION

The export of crops such as kiwifruit demands extremely low tolerances of both pests and their damage in order to meet the stringent quarantine requirements of importing countries. In these circumstances integrated control programmes which incorporate biological control are difficult to develop but there is scope in the short term for increasing the efficiency of pest control through supervised spraying. In this technique applications of broad-spectrum chemicals are timed in relation to the occurrence of susceptible stages of the pests above a specified threshold density in the crop. Pesticide residues on the fruit at harvest can be minimised in this way by reducing spraying to essential occasions.

The key pests of kiwifruit in the Bay of Plenty are the leafroller complex, a native moth *S. skelloni* and greedy scale (*Hemiberlesia rapax*) (Ferguson 1976). The main leafroller species is the brownheaded leafroller (BHL) but the greenheaded leafroller (GHL) (*Planotortrix excessana*) and light brown apple moth (LBAM) (*Epiphyas postvittana*) are also important. Ferguson and Stratton (1978) noted discrete periods of damage by leafroller larvae on kiwifruit and recommended timing of insecticide applications. This present paper describes supervised spraying of kiwifruit based on the monitoring of leafrollers and the stathmopodid, and the resulting damage to the fruit by these pests and greedy scale.

METHOD

A 0.3 ha plot of kiwifruit cv 'Hayward' (Te Puke) comprising 10 rows and trained on the three-wire system was split into two equal blocks of four rows each, the two central rows being guard rows. One block remained unsprayed while the other was sprayed with phosmet (113 g/100 litres). In the first season (1976-77) the sprays were applied at low volume by motorised knapsack. In 1977-78 and 1978-79 a wetter (Agral LN 125 mls/100 litres) was added to the sprays to improve coverage and application was again by hand but using portable high volume equipment with orchard guns delivering 3750-4000 litres/ha.

To monitor the insects and their damage ten fruit clusters and their associated leaves and ten vegetative shoots on each of eight vines per block (two vines per row) were examined fortnightly from October to May. Larvae were retained on artificial diet (Singh 1974) and reared to confirm their instar and species and to determine parasitism. Pupae were kept for moth or parasite emergence.

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Sprays were applied when sampling showed the presence of larvae at the time of fruit set (pre- and post-flowering); thereafter spraying was recommended only when there was a marked increase (about five-fold or greater) in the numbers of young larvae in the unsprayed block and/or larvae were detected in the sprayed block. In addition to spraying, normal summer pruning was maintained and this removed leafroller larvae on shoots as in commercial practice.

At harvest monitoring was supplemented to include 100 fruits per vine and a subsample of 10 or 20 fruits per vine was examined microscopically for greedy scale and other pests.

In 1976-77 a 0.5 ha block of cv 'Hayward' on T-bars at Te Puke Research Orchard was monitored as described above using five vines in each of five blocks. Two sprays of azinphos-methyl (50 g/100 litres and Agral LN 25 ml/100 litres) were applied 'routine' pre-flowering by air-blast machine but post-flowering spraying of the same insecticide or phosmet (113 g/100 litres) was determined from sampling. In 1978-79 an unsprayed 0.7 ha commercial block of cv 'Hayward' on T-bars (Pyes Pa site) was monitored as described above as part of a wider study of the relationship between pest density and damage (four vines in each of six blocks). Data from these two plots are included to provide some comparison between different sites.

RESULTS AND DISCUSSION

The numbers of leafroller and stathmopodid larvae found at the Te Puke site over three seasons are shown in Fig. 1. The stathmopodid numbers declined from 1976 to 1979 whereas leafrollers reached peak number in 1977-78. Nevertheless, at the start of each season similar numbers were present in the sprayed and unsprayed blocks, indicating movement of moths throughout the whole area during winter and spring. Larvae were present on the vines from the start of spring growth but, because only vegetative growth was affected at that time, spraying was not considered until just before flowering.

Fig. 1 Total numbers of leafroller and stathmopodid larvae and pupae found in all samples on eight kiwifruit vines at each sampling occasion, Te Puke site. A. 1976-77, B. 1977-78, C. 1978-79.

Three sprays were applied each year in response to the monitoring. The first spray, either just pre-flowering (1978) or just post-flowering (1976, 1977) was to protect

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the young setting fruit from damage by leafroller larvae found to be present at that time. The second and third sprays in January and March respectively were aimed at increases in the numbers of both leafroller and stathmopodid larvae. The application of this arbitrary threshold usually resulted in spraying before even minor fruit damage occurred because the leafrollers fed preferentially on the shoots. However, the stathmopodid fed particularly on the fruits so that early detection of its presence there was important to minimise damage.

In the first season, the timing of sprays did not take full account of the stage of development of the larvae and there was also delay in following recommendations. Each spray was about two weeks late for maximum effect on the early instars. This was reflected in the higher damage at harvest in 1977 compared to the later years (Table 1). Allowing for this adjustment to spraying in 1976-77, the correct timing of applications was similar in all three seasons. At Pyes Pa in 1978-79 peak numbers of larvae were also obtained prior to flowering, and then attacking the fruit in mid-January (mainly leafroller) and early March (mainly *S. skelloni*) so that similar timing of sprays would have been suitable at that site.

TABLE 1: Percentage damage to harvested kiwifruit cv 'Hayward' by lepidopterous larvae and greedy scale in the monitored blocks

Year/Site	Pest	Treatment	
1976-77		Sprayed	Unsprayed
Research Orchard*	Leafroller/ <i>Stathmopoda</i>	3.2 ± 0.4	
	Greedy scale	0.5 ± 0.2	
1976-77			
Te Puke	Leafroller/ <i>Stathmopoda</i>	4.5 ± 0.7	3.10 ± 1.6
	Greedy scale	15.0 ± 4.0	28.8 ± 5.1
1977-78			
Te Puke	Leafroller/ <i>Stathmopoda</i>	3.2 ± 0.6	27.0 ± 1.7
	Greedy scale	0.0	35.6 ± 5.4
1978-79			
Te Puke	Leafroller/ <i>Stathmopoda</i>	2.4 ± 0.5	19.6 ± 1.4
	Greedy scale	0.0	60.0 ± 5.5
1978-79			
Pyes Pas	Leafroller/ <i>Stathmopoda</i>		35.3 ± 1.0
	Greedy scale		37.5 ± 3.1

* azinphos-methyl 5.11, 19.11, 28.1 phosmet 31.3, 21.4. The last two sprays were applied against greedy scale and not in response to leafroller monitoring.

With the exception of 1976-77 at the Te Puke site the damage by lepidopterous larvae and greedy scale in the sprayed blocks was within or below the range experienced commercially for export from 1974 to 1977 (Ferguson 1980). Most damage was minor and could have been eliminated only by excessive and wasteful spraying. More important for export was the complete absence of larvae on harvested fruit (6-800 per block) from these sprayed blocks (one stathmopodid was found on 800 fruits at harvest 1977, Te Puke site). Many larvae were present on the unsprayed fruit at harvest, particularly *S. skelloni* in 1976-77 and 1978-79 and leafrollers in 1977-78.

These data indicate that export quality fruit at May 1st can be obtained with good spray coverage from three well-timed sprays against lepidopterous pests combined with regular summer pruning. However, picking may extend into May and in 1977-78 and 1978-79 the Te Puke sprayed block was treated with phosmet at the end of April (after harvest assessment) because the bulk of the crop was not to be picked until the end of May. Leafroller and *S. skelloni* populations may be high in May (see Fig. 1B) so that a fourth spray may be required when harvest is delayed.

Greedy scale was controlled by all three sprays in 1977-78 and 1978-79 but particularly by the pre- or post-flowering applications, at which time the first generation

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of greedy scale was primarily in the settled crawler stage (Ferguson 1979). If the summer spray programme described here could be combined with the use of oil in winter (Steven unpublished) greedy scale should be controlled to export standards and with a margin for error. In 1976-77 the high level of greedy scale damage at the Te Puke site was probably due to the lateness of the December spray and poor spray coverage from a lack of wetting agent in the sprays. In addition, scale populations were high throughout the Bay of Plenty in 1977 (Sale 1977).

A complex of six leafroller species attacked the vines in these experiments and the proportions of the various species were similar in the various sites and blocks (Table 2). The BHL was the dominant species comprising 70-90% of the larvae. However, GH, LBAM and to a lesser extent *Cnephasia jactatana* assumed importance at certain times, notably close to harvest. Although the low numbers of larvae in the sprayed blocks makes interpretation difficult there was no evidence of differential susceptibility of the species to the spray programme (see Table 2). The distribution of larvae in the samples suggested that the preferred site of feeding of all species was the shoots, followed by the fruit-leaves and lastly the fruits. This contrasts with *S. skelloni*, over 80% of which were found on fruits, giving this pest greater importance than its numbers alone would suggest. The important species for determining spraying strategy were, therefore, BHL and *S. skelloni*. The seasonal and spatial distributions of the various species on the vines will be described in detail elsewhere.

TABLE 2: Species composition of leafroller larvae found in all samples from the monitored blocks of kiwifruit cv 'Hayward'

Year/Site	Treatment	Leafroller species (%)				
		BHL	GH	LBAM	<i>Cnephasia jactatana</i>	<i>Planotortrix notophaea</i>
1976-77						
Research Orchard	Sprayed	88.6	5.7	2.9	2.9	0
Te Puke	Sprayed	82.1	6.0	10.4	0	1.5
	Unsprayed	71.5	15.1	6.7	4.5	2.2
1977-78						
Te Puke	Sprayed	80.0	5.5	1.8	10.9	1.8
	Unsprayed*	70.8	15.3	10.0	2.2	1.4
1978-79						
Te Puke	Sprayed	68.0	16.0	8.0	4.0	4.0
	Unsprayed	78.3	10.8	10.2	0.7	0
Pyes Pa	Unsprayed	79.9	9.2	9.0	1.5	0.4

* One larva of *Epalxiphora axenana*

The present work has shown that the occurrence of lepidopterous larvae on kiwifruit in the Bay of Plenty is sufficiently discontinuous to allow supervised spraying to reduce considerably the number of sprays required to give export quality fruit. The MAF recommended spray schedules in 1977-78 and 1978-79 included nine to ten and seven summer insecticide applications respectively. Supervised spraying should permit reduction of this to four sprays, particularly if winter oils can be used against greedy scale. Achievement of this reduction under commercial conditions will depend on the development of a practicable method of monitoring low populations of leafrollers and *S. skelloni*. Research is in progress to determine the sex pheromones of these pest species for later use of these chemicals in traps to monitor the numbers of adult moths in orchards (Galbreath, R.A. pers comm). Supervised spraying should in future provide valuable economic advantage over existing calendar schedules, reduce environmental contamination and, in particular, minimise pesticide residues on this important export crop.

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