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INTEGRATED CONTROL OF APPLE PESTS IN NEW ZEALAND 12. COMMERCIAL IMPLEMENTATION OF INTEGRATED CONTROL OF EUROPEAN RED MITE IN NELSON

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Summary

Integrated control of European red mite (*Panonychus ulmi*) combines the actions of azinphos-methyl-resistant *Typhlodromus pyri* and minimal use of selective miticides. Commercial implementation of an integrated mite control programme began in Nelson in the 1976-77 season. In preparation for this grower-education courses were provided and mite monitoring services developed. In 1976-77 growers using integrated mite control saved an average of more than two miticide applications over the season equivalent to \$75-80/ha. In 1977-78 a saving of only one miticide application was estimated for orchards using mite counting services compared with more than two in orchards monitored by DSIR. Faults were evident in the commercial application of sampling methods and thresholds for spraying in both seasons.

INTRODUCTION

The problems of mite control in apple orchards have long been recognised as the consequence of using broad-spectrum chemicals for insect pest control. The destruction of the natural enemies of phytophagous mites by insecticides resulted in an upsurge of mites to major pest status (Collyer 1964). Among the most important predators destroyed were the phytoseiid mites. However, in recent years the appearance of phytoseiids resistant to organophosphate insecticides has permitted the development of integrated mite control. This technique combines the action of the predators with minimal use of selective miticides.

Integrated mite control for several species of phytophagous mites is standard commercial practice in some areas of the USA and Canada (Croft 1975). In New Zealand European red mite (ERM) is the most important mite pest of apples and *Typhlodromus pyri* is its most important phytoseiid predator (Collyer 1976). *T. pyri* with resistance to azinphos-methyl were first found in Nelson in 1967 (Collyer 1976). Their distribution and resistance have increased since that time (Penman *et al* 1976) and with it their potential for use in an integrated mite control programme. Research from 1973 onwards and pilot commercial trials from

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1975 have confirmed this potential (Collyer 1978; Wearing *et al* 1978).

Full scale implementation of integrated control of European red mite was begun in Nelson in 1976. This paper describes the procedures involved and the results obtained in the first two seasons of operation.

METHOD

The early responses of growers to integrated mite control indicated that two types of extension services were required, those to enable growers to operate their own programme and those for growers wishing to pay for support facilities.

Grower education

The first step in grower education was a mite and predator demonstration day in February 1976 (Cook 1976a) attended by large numbers of growers. The Nelson Polytechnic then offered two parallel courses of four lectures and practical classes on integrated mite control during the winter of 1976 by Dr E. Collyer which were attended by 35 growers (+ 10 others). The lectures covered all aspects of mite and predator recognition, their life histories and the operation of an integrated mite control programme. Information was provided on sampling, spray thresholds, timing of sprays, choice of chemicals and the latest research results, as well as pointing out the advantages and problems of integrated control. A similar updated course given in winter 1977 was supported by 30 growers (+ 2 others), and a one-day course was given in Blenheim (14 attended).

Other grower education was provided through existing channels by MAF horticultural advisory officers, N. Z. Fruitgrowers Federation Ltd field men, chemical company representatives and DSIR entomologists. Advisory leaflets were prepared each season (Cook 1976b, 1977).

Mite counting services

The successful operation of integrated mite control depends on regular monitoring of the levels and ratios of ERM and *T. pyri*. Counts are taken on samples of 50 leaves per block (up to 2 ha) on a regular schedule. Spray applications of selective miticides (e.g. cyhexatin) are recommended when specified thresholds are reached.

In 1977-78 these were:

1. *End of October/early November*. A ratio of 1 *T. pyri*: 7 ERM with 2 ERM/leaf maximum. If no *T. pyri*, threshold is 1 ERM/leaf.
2. *In summer*. At the times of hatching of each generation of ERM, a ratio of 1 *T. pyri*: 7 ERM. At other times a ratio of 1 *T. pyri*: 10 ERM. If no *T. pyri*, threshold is 2 ERM/leaf. From December to February an upper limit of 5 ERM/leaf, while *T. pyri* is in a minority, probably needs spraying, certainly if ERM is increasing at the time.

These threshold figures refer to the active stages of both ERM and *T. pyri*. In 1976-77 a two-weekly schedule of 8-10 samples was adopted but in 1977-78 samples were timed particularly to coincide with the hatching eggs of the overwintered (early November) and early December generations of ERM. When sprays were applied samples were taken ten days later (for further details see Wearing *et al* 1978).

While some growers monitored their own blocks, particularly in 1977-78 (no data available), others supplied samples of 50 leaves from selected blocks to mite counting services provided principally by the Cawthron Institute and Ispray Ltd. In the Cawthron Institute service, spray advice was supplied (and in 1976-77 leaf samples were collected) by field men of the N.Z. Fruitgrowers Federation Ltd. Representatives of Ispray Ltd visited the orchards to collect samples and provide spray advice.

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Mite data for this paper were supplied principally by the Cawthron Institute which serviced 20-30 growers each season and by Ispray Ltd (1977-78, data from 5 orchards). In addition, the results are briefly presented from 10 commercial blocks monitored by DSIR which were a continuation of the pilot trials begun in 1975-76 (Wearing *et al* 1978).

RESULTS

Cawthron Institute 1976-77

Although *T. pyri* was known to be widely distributed and common in Nelson commercial orchards (Wearing and Penman 1975) their presence could not be guaranteed in the blocks of trees selected for monitoring by the growers. Predators were totally absent from three of the 28 monitored orchards in Nelson and remained rare throughout the season in five others. In Blenheim all four monitored orchards contained only scarce predators despite their presence in commercial orchards in the district (Wearing and Gunson 1976). These 12 orchards were unable to use integrated mite control and their average number of miticide applications was 4.4 (range 3-7) compared with a district average of 3.8 (range 1-14) in Nelson in 1975-76 (Penman and Ferro 1977).

These results contrast with those from the 20 orchards where *T. pyri* was sufficiently abundant to influence the thresholds for spraying (Table 1) i.e. where integrated mite control was used. The average number of miticide applications, mainly cyhexatin, was only 1.4 (range 0-4) (Table 1). In the orchard sprayed three times the thresholds were not in fact exceeded; similarly, two of the four applications to the most heavily sprayed orchard (Table 1) were sub-threshold and at times which were least effective for mite control.

TABLE 1: Number of miticide sprays applied to Nelson orchards using integrated mite control, 1976-77.

No. of miticide applications	No. of orchards
0	3
1	8
2	6
3	1
4	1
Mean 1.4	Total 19*

* One orchard did not keep records

Integrated mite control was used on six cultivars, 'Sturmer Pippin', 'Cox's Orange Pippin', 'Delicious', 'Red Delicious', 'Golden Delicious' and 'Granny Smith' and two examples are figured (Fig. 1). Spot-spraying of miticides by hand was used by growers on some varieties with mite 'pockets', notably 'Sturmer Pippin'.

All blocks received applications, usually fortnightly, of azinphos-methyl at 37-50 g/100 litres and a variety of fungicides from among dodine, captan, metiram, dinocap, binapacryl, thiram, bupirimate, benomyl and mancozeb. Many growers applied carbaryl for thinning and

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almost all applied oil at green-tip. Although *T. pyri* survived all of these chemical treatments any subtle effects on the predator populations could not be determined from the samples.

Despite the clear reduction in miticide usage where integrated mite control was used, closer examination of the data revealed a number of recurring faults by growers in implementing this new technique. These faults related either to spray timing or the use of thresholds. Of the 28 Nelson orchards there were 11 in which sprays were applied when thresholds were not exceeded and nine in which the reverse occurred (Fig. 2). There were 19 faults related to spray timing (e.g. too late for the hatch of an ERM generation), half of which resulted from the fortnightly sampling. Avoidance of these faults would have reduced the mean level of ERM in the orchards and may have decreased further the number of miticide sprays required.

Cawthron Institute and Ispray Ltd 1977-78

As in 1976-77 predator populations in 1977-78 varied between orchards but they were absent or scarce throughout the season in only four (two were in their first season of monitoring). However, with rare exceptions, *T. pyri* remained low up to mid-January even in those orchards able to use integrated mite control. In particular, predator densities failed to increase in the second generation in December which was cold with mean temperatures at Appleby 1-2°C below those of December 1976. Although *T. pyri* populations increased later, the low initial numbers and hot dry weather from January to March enabled ERM to increase rapidly and more miticide applications were required than in the previous season.

The average number of sprays applied to the orchards able to use integrated control monitored by both services was three (range 1-5) in a season in which the district average was estimated at four (random sample of fifty orchards). Most orchards in the district now contain *T. pyri* which contributes to mite control with or without assistance from the grower. In the monitored orchards where *T. pyri* was absent or scarce the number of miticide sprays averaged greater than five.

Despite modified sampling recommendations in 1977-78 to improve spray timing, similar faults occurred in the use of integrated mite control as were observed in 1976-77. In addition, irregular sampling by growers led to as many problems in spray timing as had occurred in 1976-77 and because of the hot dry conditions in 1978 they led to late-season spray applications.

Insecticide and fungicide use in the monitored orchards was similar to that in 1976-77. In addition to cyhexatin, the growers used in 1977-78 fenbutatin oxide, azocyclotin, benzoximate, propargite and bromopropylate which are known to be selective miticides (Ashley 1976 and unpublished).

Orchards monitored by DSIR 1977-78

The ten blocks monitored by DSIR were also characterised by low numbers of *T. pyri* up to mid-January. However the average number of miticide applications to these orchards was only 1.8 (range 0-4). This marked improvement on the commercial/grower monitoring was the result of more stringent application of the recommended thresholds and sampling procedures. This is the third consecutive season in which an average of more than two miticide applications have been saved through integrated mite control on these orchards.

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FIG. 1:
Population estimates of *P. ulmi* and *T. pyri* on two cultivars in two orchards at Nelson 1976-77. Arrows indicate miticide applications (P = cyhexatin). All trees were sprayed with two-weekly 0.0375-0.05% azinphos-methyl from petal fall to harvest.

FIG. 2:
Population estimates of *P. ulmi* and *T. pyri* in an orchard at Nelson 1976-77. Threshold for spraying was exceeded in January but no spray applied until February (Arrow, P = cyhexatin). All trees were sprayed with two-weekly 0.0375-0.05% azinphos-methyl from petal fall to harvest.

DISCUSSION

T. pyri has been increasing in abundance and contributing to mite control in commercial orchards in Nelson since the discovery of azinphos-methyl-resistant strains and the introduction of selective miticides. Prior to this, efficient chemical control of ERM used up to 6

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miticide applications (Collyer and Geldermalsen 1975). Similarly, where *T. pyri* was absent from orchards in 1976-77 and 1977-78 respectively 4-7 and 5-7 miticide sprays were applied. Depending on the season, therefore, chemical control of ERM in Nelson relies on 4-6 spray applications, and the estimates of savings from integrated mite control presented here are conservative. Integrated mite control has a second major role in delaying or, hopefully, preventing the development of resistance to selective miticides. Cyhexatin has been used since 1971 and remains effective.

The weather conditions during the first two seasons of commercial integrated mite control were very different. In 1976-77 the timing of mite generations was the latest since records began in 1962 while in 1977-78 the months of January to March were among the driest recorded.

The major savings from the commercial use of integrated mite control in 1976-77 were similar to those obtained in orchards monitored by DSIR in the same and previous season (Wearing *et al* 1978). The monetary return from using two less miticide (cyhexatin) sprays was estimated as \$75-80/hectare in materials. Similar savings in 1977-78 in the orchards monitored by DSIR were not matched by the commercially monitored orchards. This result shows the critical need for growers to implement fully the recommended sampling procedures and thresholds for spraying (Cook 1977), particularly in hot dry seasons. Only then will they derive full benefit from *T. pyri*, from the timing of sprays and from the counting services available.

The final test of ERM control is the number of eggs on the fruit at harvest. To be commercially acceptable integrated mite control must provide fruit sufficiently clean of eggs to meet export standards. In practice no fruit from areas under integrated control has been rejected from export because of mite eggs.

It will take several years to incorporate integrated mite control into standard orchard management practice. Growers educated to monitor their own orchards will then be the best practitioners of integrated mite control. Mr H. Yuill, an orchardist with several years experience of integrated mite control (Yuill 1975) used none or only one miticide application on different cultivars in the 1977-78 season and ERM did not exceed two per leaf.

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