INSECT CONTROL TRIALS ON KIWIFRUIT 1980-82

P.R. SALE and D. STEVEN

Advisory Services Division, MAF, Tauranga, Entomology Division, DSIR, Auckland

SUMMARY

This paper presents results from a continuing series of trials examining new insecticides or changed uses of current materials which could be incorporated into the recommended spray programme for kiwifruit. Dichlorvos showed activity against the principal pests (the leafroller complex and greedy scale (*Hemiberlesia rapax*) but cannot be used close to harvest on export kiwifruit until residue tolerances are established. A micro-encapsulated formulation of diazinon gave good control of leafrollers as well as of greedy scale and will be further tested. Inserting three sprays of diazinon into the basic recommended programme did not increase the excellent control of greedy scale obtained using the basic schedule.

INTRODUCTION

The work reported here is from continuing trials which investigate modifications to the spray programme for kiwifruit currently recommended by the MAF. The objective is to provide growers with a programme that will ensure that they can harvest a crop which complies fully with the stringent export requirements of no damage, and freedom from insect contamination, and which is within permitted levels of pesticide residues. This should be achieved at minimal cost; with regard both to the actual cost of chemicals and their application, and also to possible long-term costs such as the risks of the development of insecticide resistance or the creation of new pest problems.

The first trials were set up to investigate the possible use of dichlorvos on kiwifruit. This insecticide, because of its vapour activity and non-persistence (Worthing 1979), is often used on other crops as a close-to-harvest spray. On kiwifruit with the MAF recommended programme (2 sprays of azinphos-methyl followed by 5 of phosmet) there must be at least 21 days between the last spray of phosmet and fruit harvest, and there have been some observations of leafroller* damage and greedy scale settlement during this interval. Because late season pest attack is variable and minor compared with damage occurring immediately after fruit set (Sale 1977; Steven unpublished), the specific activity of dichlorvos against leafrollers and greedy scale could be most efficiently tested during the period of maximum attack by these pests, that is during the post-bloom period. This efficacy trial was conducted in the 1980-81 season. Residues had been measured following a single application in April 1980.

In the following season two different approaches were tested. In the first we examined the effectiveness of inserting diazinon (wetttable powder formulation) applications between some of the phosmet sprays of the standard export spray schedule. This practice, or the replacement of one or more phosmet sprays by diazinon, is frequently followed by growers who are worried about greedy scale control. Phosmet will kill both greedy scale and leafrollers, but diazinon is more effective against greedy scale (Ferguson and Wallace 1979).

The second test in 1981-82 was of a new micro-encapsulated formulation of diazinon. In this the active ingredient is enclosed in minute capsules of permeable resin and so is released slowly into the environment. The greater persistence of this formulation offered the possibility of increased activity against leafrollers.

***The primary pests of kiwifruit are a group of leafroller species; principally the brown-headed leafroller (*Ctenopseustis obliquana*) and the lightbrown apple moth (*Epiphyas postvittana*); others include *Cnephasia jactatana* and *Planotortrix excessana*. Two species of *Stathmopoda* cause similar damage and so are included with leafrollers in damage assessments.**

Proc. 37th N.Z. Weed and Pest Control Conf.

METHODS

Trials were carried out on mature kiwifruit vines, cultivar 'Abbott', grown in a fence-row system at Tauranga. Applications were to run-off (7-10 litres per vine) using a motorised knapsack. The fruit was for the early-season domestic market so that harvesting was early (in April).

1980-81 Trials

In 1980-81 dichlorvos (Vapona Concentrate) was applied pre-blossom (10.11.80), three times after petal fall (8.12.80, 22.12.80, 9.1.81), and finally on 30.3.81 shortly before harvest. A rate of 108 g ai/100 litres was used. This dichlorvos treatment was compared with an unsprayed control, using two-vine plots in a four replicate, randomised block design.

Leafroller damage was assessed on 100 fruit per plot after the January spray (fruit examined *in situ*) and again at harvest (8.4.81). The harvested fruit were examined in the field and again in the laboratory. On the latter occasion a sub-sample of 10 damaged fruit per plot was used to record the severity of the leafroller damage in three categories:

light — superficial damage totalling <5 mm diameter

moderate — between light and heavy

heavy — superficial damage totalling >10 mm diameter, or deep damage (>2.5 mm into the flesh).

Greedy scale control was assessed in December and January (50 leaves per plot) and on the fruit at harvest, by recording the presence or absence of this pest, and then counting all scale on a sub-sample of 10 infested leaves or fruit per plot.

Dichlorvos residues resulting from a single pre-harvest spray on 8.4.80 were sampled from four single-vine plots. Application details were as in the efficacy trial above. Samples of 10 fruit per plot were taken at intervals. Analysis of flesh and skin separately showed 95% of total dichlorvos to be present in the skin, so only the skins were used and the results expressed on a whole fruit basis.

1981-82 Trial

In the 1981-82 season other vines on the same property were used in a randomised block trial with three replicates of four treatments using single-vine plots.

The treatments were:

1. the MAF recommended export programme of azinphos-methyl (Gusathion M50 at 50 g ai/100 litres — 2 sprays) followed by phosmet (Imidan 75 at 112 g ai/100 litres — 5 sprays);
2. the above with three extra diazinon sprays (Basudin 50WP at 50 g ai/100 litres);
3. diazinon — encapsulated formulation (Knox Out 2FM at 50 g ai/100 litres - 7 sprays);
4. unsprayed control.

Application methods were as in the first trials but the sprays were applied on the following dates (* = extra diazinon only); 9.11.81, 14.12.81, 28.12.81, 8.1.82*, 25.1.82, 8.2.82*, 22.2.82, 10.3.82*, 22.3.82, 5.4.82. Fruit were assessed at harvest (14.4.82) for both leafroller damage and greedy scale infestation, and greedy scale on the leaves were counted before and after harvest, using the same methods and sample sizes as in the dichlorvos efficacy trial.

RESULTS AND DISCUSSION

1980-81 Trials

Dichlorvos reduced both leafroller damage and greedy scale infestation (Tables 1-3), but leafroller damage was still unacceptable. The difference between field and laboratory results reflects the greater discrimination of damage achieved using a microscope. The severity of damage (Table 2) highlights the control achieved using dichlorvos. The much higher proportion of light damage in dichlorvos-sprayed fruit than in unsprayed also explains why the two harvest assessments were more different for the dichlorvos treatment than for the control (Table 1). With largely minor damage present on the sprayed fruit the chances of it being missed in the field would be greater.

The small change in leafroller damage in the control between the midseason and harvest checks (Table 1) confirms that the period immediately after blossom is critical for leafroller control (Ferguson 1980). It may be possible therefore to reduce spraying mid-to-late season.

TABLE 1: 1980-81 Trial. The mean percentage of leafroller-damaged fruit.

Treatment	Mid-season	Harvest-field	Harvest-laboratory
dichlorvos	8.3 B	8.8 B	14.5 B
untreated	42.0 A	47.3 A	54.5 A
% reduction	80.2	81.5	73.4

TABLE 2: 1980-81 Trial. The degree of leafroller damage to fruit.

Treatment	Damage score (%)		
	Light	Moderate	Heavy
dichlorvos	62.5	32.5	5.0
untreated	12.5	35.0	52.5

TABLE 3: 1980-81 Trial. Greedy scale control.

Treatment	Leaf assessments				Fruit assessment		
	(1) 10.12.80	(2) 12.1.81	(1) 10.12.80	(2) 12.1.81	%infested	No./fruit	No. live
dichlorvos	46	2.03	40.5 B	1.93 b	6.0	1.50 b	0.41 b
untreated	63	3.48	71.0 A	3.55 a	33.8	8.08 a	3.46 a
% reduction	27.0	41.7	43.0	45.6	82.2	81.4	88.2

The greedy scale counts (Table 3), particularly on the leaves, seem to indicate that dichlorvos was less efficient against greedy scale than against leafrollers. However, leaf infestation by the scales would have started before the spray programme began, and dead or live scale were not distinguished here. The combined effect of the reductions in both the percentage of fruit infested and the number of scale per fruit is cumulative so that the live greedy scale population on the dichlorvos-sprayed fruit was reduced by 97% when compared to that on untreated fruit (2.5 and 116.9 live scale per 100 fruit respectively).

TABLE 4: Dichlorvos residues in fruit after a single spray (8.4.80).

Time (days)	Mean residue $\pm$ standard deviation (mg/kg)
0	2.34 $\pm$ 0.18
1	0.59 $\pm$ 0.17
3	0.17 $\pm$ 0.09
7	0.13 $\pm$ 0.06
14	0.03 $\pm$ 0.01
21	0.01 $\pm$ 0

The efficacy shown by dichlorvos indicated that this product could still warrant consideration for late season use if it was non-persistent as is generally considered (Worthing 1979). Unfortunately the residues were persistent (Table 4), and there are no permitted tolerances.

1981-82 Trial

Despite a high population of leafrollers in the trial area, damage was largely prevented by the encapsulated diazinon programme (Table 5). Control was only slightly below that given by the recommended programme (significant only in the laboratory assessment).

TABLE 5: 1981-82 Trial. Leafroller damage to fruit at harvest.

Treatment	Field assessment % damaged	Lab assessment % damaged
MAF programme	1.0 b	1.0 c
MAF + 3 diazinon sprays	0.0 b	0.0 c
encapsulated diazinon	3.7 b	6.0 b
unsprayed	51.3 a	47.3 a

The cumulative reduction of the greedy scale population by all three spray regimes at harvest gave control values of 98.9%, 99.3% and 99.7% for the MAF, the MAF-plus-extra-diazinon, and the encapsulated diazinon programmes respectively (Table 6). Similar very high reductions were also apparent from the leaf assessments, when the numbers of live greedy scale are considered. At such high levels differences between treatments could not be distinguished, so that there was no apparent advantage in the extra diazinon sprays in the second treatment. In view of the high scale pressure maintained in the trial block the control achieved was extremely successful.

TABLE 6: 1981-82 Trial. Greedy scale counts

Treatment	Leaves						Fruit	
	Pre-harvest 18.3.82			Post-harvest 19.4.82			Harvest 14.4.82	
	% infested	No./leaf Total Live		% infested	No./leaf Total Live		% infested	No./fruit
MAF programme	14.0	4.2	0.3	28.0	4.4	0	2.0	1.2
MAF + 3 diazinon	12.7	6.1	2.0	22.7	2.9	0.03	0.7	2.0
encapsulated diazinon	2.0	4.8	0	16.7	1.6	0	0.7	1.0
unsprayed	68.0	12.8	9.5	86.7	17.9	14.7	75.7	2.8

(No significant differences in final column (No./fruit); in every other case all treatments differed significantly (1% level) from the unsprayed but not from each other; Duncan's Test.)

In the 1980-81 trial leaf samples in December and January showed no population build-up of greedy scale, while in 1981-82 there was considerable increase between the March and April leaf samples. Berry (1983) similarly found an increase in March when monitoring greedy scale populations on kiwifruit in Auckland. However it is important that greedy scale be killed before they settle on the fruit because of the concern of some markets even with dead scale.

ACKNOWLEDGEMENTS

We wish to thank I. Craig for use of his property, Dr P. Holland of Ruakura Agricultural Research Centre, MAF, for residue analyses and D. Sawden, O. Green and P.A. Brown for technical assistance. The New Zealand Fruitgrowers Federation Ltd and BP Chemicals Ltd provided the insecticides.

REFERENCES

- Berry, J.A., 1983. Aspects of the ecology and control of the greedy scale (*Hemiberlesia rapax* (Comstock)). *Unpublished M.Sc. Thesis, University of Auckland*: 112 p.
- Ferguson, A.M., 1980. Are there critical periods of caterpillar damage to Bay of Plenty kiwifruit? *Proc. 33rd N.Z. Weed and Pest Control Conf.*: 96-99.
- Ferguson, A.M. and Wallace, A.R., 1979. A laboratory technique to evaluate pesticides for control of greedy scale on kiwifruit. *Proc. 32nd N.Z. Weed and Pest Control Conf.*: 220-224.
- Sale, P.R., 1977. The greedy scale problem and pest control of kiwifruit. *Proc Kiwifruit Seminar, Tauranga*: 29-35.
- Worthing, C.R., 1979. (Ed). The pesticide Manual (6th Edition). *British Crop Protection Council*: 665 p.