Horticultural Crops

INSECT CONTROL ON KIWIFRUIT, PART II

A. M. FERGUSON and A. E. STRATTON

*Entomology Division, DSIR, Christchurch and
Shell Chemicals (N.Z.) Ltd, Hamilton*

Summary

During the 1976-77 season a high population of greedy scale (*Hemiberlesia rapax*) developed on untreated kiwifruit (*Actinidia chinensis* var. *chinensis*) vines in the Bay of Plenty. The standard MAF schedule of insecticides (four applications of azinphos-methyl followed by two of phosmet) and cypermethrin at 10 g/100 litre gave acceptable control but the scale population was inadequately controlled by a similar schedule of the following pyrethroids: permethrin, fenvalerate and cypermethrin at 5 g/100 litres. No between-treatment differences were found for lepidopteran damage. This was probably because a low level of damage was recorded from unsprayed vines which prevented the derivation of reliable data from a spray-application timing trial.

INTRODUCTION

The general insecticidal success of a single cypermethrin application to kiwifruit late in the 1975-76 season (Ferguson and Stratton 1978), prompted further evaluations of the pyrethroid chemical group.

Cypermethrin at a relatively high rate (30 g/100 litres) in the 1975-76 season failed to control an established population of mixed aged greedy scales. It was therefore considered essential to evaluate the pyrethroids on a multiple application basis (Trial 1).

Research conducted in the Bay of Plenty in 1975-76 suggested that there were distinct periods when lepidopterous larvae damaged kiwifruit. Hence the aim of Trial 2 was to further examine and verify this using a block of vines adjacent to Trial 1.

METHOD

Relevant site and experimental details were outlined by Ferguson and Stratton (1978).

Trial 1 was sprayed six times (9/12, 24/12/76, 27/1, 24/2, 24/3, 10/4/77) with the chemicals shown in Table 1. This table also lists the same information for the second trial which was sprayed on 9/12, 24/12/76, 24/2 and 10/4/77.

In contrast with practice in the previous season, the first spray was applied as soon as possible post-blossom when 5% of the flowers remained and beehives had been removed. Although a pre-blossom application was considered necessary, this was not undertaken because it was impossible to determine vine sex until the plants had flowered, and therefore impracticable to lay out the trials.

Proc. 31st N.Z. Weed and Pest Control Conf.

Horticultural Crops

RESULTS AND DISCUSSION

TABLE 1: The insecticides applied and their effects on lepidoptera† feeding from 216 fruit clusters (field) and 36 kg of fruit (harvest) per regime, 1976-77.

Sample location (date)	Field (17/1/77)			Harvest (9/5/77)	
Days post spray/ No. applications	24/2			29/6	
Regime, formulation (rate g/100 litres)	% Damaged clusters	No. fruit	% Fruit damaged	% Damage	No. fruit
Trial 1					
untreated	17.2 a	556	8.7 a	4.3 a	765
standard programme*	2.8 b	659	1.0 b	0.3 b	661
permethrin 40EC (10)	1.9 b	491	0.8 b	0.8 b	951
fenvalerate 30EC (10)	3.2 b	628	1.1 b	0.7 b	920
cypermethrin 40EC (10)	1.4 b	618	0.5 b	0.5 b	990
cypermethrin 40EC (5)	2.8 b	549	1.6 b	0.8 b	914
CV%	63.1		65.0	50.6	
Trial 2					
untreated	24.5 a	546	13.6 a	Not assessed at harvest	
standard programme*	2.8 b	494	1.4 b		
permethrin 40EC (20)	3.2 b	519	1.5 b		
fenvalerate 20WP (20)	2.3 b	513	1.0 b		
cypermethrin 40EC (20)	1.4 b	546	0.6 b		
cypermethrin 40EC (10)	4.1 b	448	2.4 b		
CV%	64.0		63.0		

* standard MAF programme of four sprays of azinphos-methyl 50WP (50) Dec. to Feb., then two applications of phosmet 75WP (112.5) March and April.

† includes leaf roller (mainly *C. obliquana*) and *S. skelloni*.

Sampling of the spray timing experiment (Trial 2) was continued only until the *in situ* field sample on 17/1/77 when, on control vines, a greater level of lepidopteran damage was found than in Trial 1. Therefore results from each trial are shown in Table 1 for comparison of chemical efficacy at two damage densities.

In the field neither larvae nor pupae were found on treated fruit. In the untreated regime of Trial 1 plus Trial 2 the numbers were: 10 early larval instars and 2 pupae of the common leaf roller (*Ctenopseustis obliquana*), 1 second instar larva of the light brown apple moth (*Epiphyas postvittana*) and three second instar *Stathmopoda skelloni* larvae. This species composition shows the predominant lepidoptera attacking kiwifruit and confirms the findings of the 14/1/76 field sample undertaken the previous season (Ferguson and Stratton 1978).

Horticultural Crops

Similarly, evidence of leaf roller larval parasitism was recorded only from untreated fruit but at a consistently low incidence per damaged fruit cluster (1.1% 1976-77 and 2.0% 1975-76) which suggests the necessity to increase the level of biological control of leaf rollers.

No additional insect counts were taken from Trial 2 and the following results are from Trial 1 only.

In this trial a greedy scale population developed to a high density on the leaves with a three-fold increase in the untreated regime and varying decreases in the treatments (Fig. 1 and Table 2). Seasonal population movements under each regime are also expressed on a "number of leaves infested" basis (Fig. 2). This method shows the trends apparent in Fig. 1 and therefore the time-saving "presence/absence" approach was applicable to this trial.

FIG. 1: Total number of greedy scale on 240 leaves from each of six regimes, 1976-77

Under conditions of excellent spray coverage, azinphos-methyl demonstrated good greedy scale control by the 18/2/77 (Table 2) but subsequently (7/5/77) its relative performance was apparently reduced perhaps because a significantly lower density of scales already existed on the 18/2/77 leaves (Table 2). These results suggest that azinphos-methyl produces superior mortality of early instar scales compared with pyrethroids over the December to February period.

Horticultural Crops

FIG. 2: Number of infested leaves from 240 leaves with greedy scale from each of six regimes, 1976-77

TABLE 2: Total number of greedy scale on 240 leaves from six regimes at three sampling dates (Trial 1).

Date	3/12/76	18/2/77	% Change Dec. - Feb.	7/5/77	% Change Feb. - May
Days post spray/ No. applications	pre-spray	22/3		27/6	
Regime (g/100 litres)					
untreated	530 a	690 a	+ 31.9	2104 a	+ 205.0
standard programme*	485 a	189 c	- 61.0	78 c	- 58.7
permethrin (10)	664 a	530 b	- 20.2	133 bc	- 74.9
fenvalerate (10)	431 a	450 b	+ 4.4	189 b	- 58.0
cypermethrin (10)	352 a	339 b	- 3.7	98 bc	- 71.1
cypermethrin (5)	354 a	304 b	- 14.1	67 c	- 77.9
CV%	30.3	21.6		26	

* azinphos-methyl Dec. - Feb., then phosmet March and April.

Horticultural Crops

However, from February until May, which encompasses second generation scale crawler activity, each pyrethroid caused increased scale mortality (Table 2). It appeared from each period of time that the pyrethroids are not highly effective against established scale populations but are relatively efficient against the unprotected crawler stage.

This prompted an examination of the physiological age structure of the total scale population found during the 18/2/77 leaf sample. The percentage of the scale population in the early instar stages, 1° plus 2°, (for definition, see Table 3) for each regime: untreated 36, standard programme 73, permethrin 47, fenvalerate 14, cypermethrin (10g) 59 and cypermethrin (5 g) 69. It was hypothesised that the higher percentages found in the standard and cypermethrin programmes were a result of each chemical causing relatively higher mortality to immature scales. These dead scales remained on the leaves for a period of time and obviously did not develop to maturity. Thus the immature proportion of the scale population was increased.

TABLE 3: Number of live greedy scale in five age groups on 240 leaves from each of six regimes, 7/5/77 (Trial 1).

Scale age	1°	2°	Total 1° + 2°	VYM	MM	M	Total M	Potential crawlers*
Regime (g/100 litres)								
untreated	319 a	1002 a	1321 a	103 a	45 a	80 a	228 a	11400
standard programme	2 cd	7 b	9 b	0 b	0 c	0 c	0 d	0
permethrin (10)	0 d	17 b	17 b	1 b	5 bc	5 c	11 c	550
fenvalerate (10)	16 d	15 b	31 b	0 b	9 b	20 b	29 b	1450
cypermethrin (10)	7 bc	5 b	12 b	0 b	3 bc	6 bc	9 c	450
cypermethrin (5)	3 cd	9 b	12 b	0 b	1 c	4 c	5 cd	250
CV%	39	47	40	86	68	69	41	

1° = settled crawler

2° = after initial moult

VYM = just after second moult (very young mature)

MM = eggs not fully formed (middle mature)

M = ripe eggs and/or crawlers present (mature)

* = total M x fecundity (50)

Further confirmation of this hypothesis was sought from the 7/5/77 leaf sample when the physiological age structure of the live and dead scale population was separately examined in each regime. The results for the live population (Table 3) show an absence of older scales in the standard regime which reinforces the concept that this regime was particularly effective against early instars. Similar results were obtained when the age distribution of dead scales was analysed. Dead mature scales were recorded in the standard regime which implies that this chemical may also be more active than the pyrethroids against this age group.

It is concluded that the standard programme consistently gave a higher mortality than the pyrethroids at all scale ages. The superiority of this programme was reflected by the potential number of crawlers for the following generation (Table 3).

At the 7/5/77 leaf sample, mortality due to parasitism in unsprayed scales was low at 29.0% and on harvested fruit 6.3%, the difference being attributed to the more hidden nature of the scale population on the fruit. Scale parasitism was not present on treated leaves and fruit.

Scale data derived from the harvested fruit (Table 4) generally reflected the performance of a chemical as found from leaf samples.

Horticultural Crops

TABLE 4: The effect of six regimes against three insect species on fruit harvested on 9/5/77 and on leaves picked on 18/2/77 (Trial 1).

Regime (g/100 litres)	No. greedy scale on 300 fruit	% Alive	% Fruit infested	Mite sacs of <i>A. baccarum</i> on 300 fruit	Tydeids on 240 leaves
untreated	1085 a	63.7 a	68.7 a	118	67
standard programme	11 d	45.5b	1.3 d	0	37
permethrin (10)	132 bc	29.5 b	12.3 c	0	0
fenvalerate (10)	221 b	31.2 b	30.0 b	0	0
cypermethrin (10 g)	13 d	61.5 b	2.7 d	0	0
cypermethrin (5 g)	39 c	23.1 b	8.7 c	0	0
CV%	27.4	*	23.2		

* weighted analysis necessary which prevented CV calculation but percent S.E. of Mean ranged from 7.1 (untreated) to 32.0 (standard programme)

During this trial, mites did not reach high densities (Table 4) but the few observations made demonstrated the effectiveness and broad-spectrum activity of the pyrethroids on populations not previously exposed to insecticides.

Other fruit-damaging factors, such as teardrop (dew drop), windrub, mechanical, disease and fasciation were unaffected by treatments in each season. The result of all fruit damaging factors was that only 29.5% (1975-76) and 24.3% (1976-77) of unsprayed fruit were of export standard. Sprayed fruit varied from 40-73%.

The field distribution of lepidopteran damage, with regard to fruit and fruit cluster, was examined using the combined figures from each season (Table 5).

TABLE 5: Frequency of fruit cluster size and lepidopteran* damage from untreated vines. Combined field sampling data for 1975-76 and 1976-77.

No. fruit / cluster	Total No.	No. damaged clusters	No. fruit damaged	Ratio: damaged fruit damaged clusters
1	161	43	43	1.0
2	191	42	49	1.2
3	183	42	71	1.7
4	119	29	57	1.9
5	40	12	27	2.2
6-14	38	15	29	1.7

* includes leaf roller (mainly *C. obliquana*) and *S. skelloni*

Irrespective of the number of fruit in a damaged cluster, only one to two fruits were damaged. This was possibly due to the 3rd and 4th larval instar dispersal phase in leaf rollers (Thomas pers comm). Damage incidence in single fruit clusters was higher than that generally found in similar research on apples, which probably reflects the greater shelter (under the calyx and hairs) available on kiwifruit fruit.

Horticultural Crops

CONCLUSION

Under conditions of excellent spray coverage the standard programme (azinphos-methyl, phosmet) and cypermethrin (10 g/100 litres) gave good control of greedy scale when compared with unsprayed vines.

ACKNOWLEDGEMENTS

We appreciate the assistance of many people during the course of these trials, especially Mr A. Wallace, Applied Mathematics Division, DSIR, Christchurch.

REFERENCE

Ferguson, A. M. and Stratton, A. E., 1978. Insect control on kiwifruit Part I. *Proc. 31st N.Z. Weed and Pest Control Conf.*: 135-136.