INSECT CONTROL TRIALS ON PERSIMMONS

D. STEVEN and P.R. SALE

*Entomology Divison, DSIR, Auckland and
Advisory Services Division, MAF, Tauranga*

SUMMARY

In 1983-84 a preliminary trial to control insect pests on persimmons (*Diospyros kaki*) highlighted the importance of the longtailed mealybug (*Pseudococcus longispinus*), with leafrollers and thrips of lesser significance. In 1984-85 a more extensive trial emphasised early season control of mealybug. No advantage could be shown from two rather than one pre-blossom spray, and pre-blossom applications alone failed to reduce mealybug infestations. *Bacillus thuringiensis* gave inadequate control of leafroller damage. Full-season schedules of chlorpyrifos or diazinon plus carbaryl achieved good control of all insect pests, but did not reduce the quarantine hazard of fruit contamination by mites.

INTRODUCTION

Persimmons are a new crop to New Zealand, but one currently of great interest because of the export potential. Japan, the centre of persimmon cultivation, has a well established market (Kitagawa and Glucina 1984) and the newer non-astringent varieties are also commanding much interest in North America.

There are however, a number of production problems to be solved before the full potential of this crop can be reached, and pest control is one of these. None of the serious pests of persimmon culture overseas occur here. In New Zealand the important pests are mealybugs (mainly longtailed mealybug), leafrollers (brown-headed leafroller *Ctenopseustis obliquana*); light-brown apple moth (*Epiphyas postvittana*); green-headed leafroller (*Planotortrix excessana*); and *Cnephasia jactana* and the greenhouse thrips (*Heliothrips haemorrhoidalis*).

Mealybug populations concentrate under the sepals and can give rise to prolific sooty mould. Damage by leafroller caterpillars is superficial, but often begins under the sepals. A narrow curved mark under the edge of the sepals is caused by thrips feeding, as is a silvery marking of the fruit skin. Passenger mites are commonly found under, as well as on, the sepals. Scale insects, including oleander scale (*Aspidiotis nerii*), black scale (*Saissetia oleae*) and greedy scale (*Hemiberlesia rapax*), occasionally occur on the fruit causing black marks.

The major pests thus occur under the sepals, a place that is difficult to penetrate with sprays. Also persimmons, particularly the currently preferred variety "Fuyu", appear prone to the disorder known as calyx cracking or dehiscence. With this disorder the fruit under the sepals cracks open during the final month of growth, creating a cavity eminently suitable for both mealybugs and leafroller caterpillars. It has also been suggested that insects could precipitate cracking.

The local insecticide spray programme for persimmons has been designed from overseas usage and limited New Zealand experience rather than from specific local trials. We tested the recommended MAF spray programme for export persimmons (Sale 1985) of chlorpyrifos or diazinon plus carbaryl applied pre- and post-blossom and thereafter at approximately 3 week intervals until 2 to 3 weeks from harvest. This was compared with the use of insecticides early in the season to control mealybug, which has been successful on other crops (Charles 1982).

METHODS

Both trials were conducted at Te Puna in the Bay of Plenty in a block of persimmons, variety "Fuyu", grown as free-standing trees. The preliminary trial
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inadvertently included two pollinator trees. Single tree plots were used in randomised block designs. Sprays were applied by motorised knapsack to run-off.

In preliminary work in 1983-84 two insecticide programmes (chlorpyrifos at 25 g ai/100 litres and *Bacillus thuringiensis* (Bt) at 100 g product/100 litres) were compared with untreated trees using four replicates. Both treatments had a chlorpyrifos spray at pre-flowering. Then the Bt programme of seven sprays began at mid-blossom, while the six chlorpyrifos sprays began after flowering. At harvest (14.5.84) 25 fruit per tree were assessed.

In 1984-85 there were five insecticide treatments (Table 1), replicated eight times. Each treatment in four replicates was applied only once pre-blossom, whereas in the other four replicates there were two pre-blossom sprays. The extra spray was at greentip. Three treatments received early applications of insecticides active against mealybugs, followed by Bt for leafroller control from mid-flowering to harvest. Spray dates were 4.10.84, 5.11.84, 23.11.84 (mid-blossom Bt), 10.12.84, 21.12.84, 9-10.1.85, 4.2.85, 25.2.85, 25.3.85, and 15.4.85.

TABLE 1: 1984-85 Spray Programmes.

Chemical	Product	Rate (g ai/100 litres)
chlorpyrifos	Lorsban 50W	37.5 pre-blossom 25 post-blossom
diazinon + carbaryl	Basudin 50W + Ispray Carbaryl 80W	50 80
prothiofos/Bt	Tokuthion 500/*	50
pirimiphos-methyl/Bt	Actellic 50/*	50
buprofezin/Bt	Applaud 50W/*	50

*Bt = Thuricide HP

100 (product)

Four replicates were assessed on 18.3.85 sampling 20 fruit/tree, and 50 fruit/tree were harvested on 8.5.85. On both occasions damage and the presence of insects and mites were recorded. At harvest calyx cracking and the crop load (yield relative to tree size) were also scored. Damage data were transformed to arcsine values before analysis and, unless stated, a significance level of 5% has been used.

RESULTS AND DISCUSSION

Preliminary trial

Results showed that mealybug was a severe problem which the chlorpyrifos schedule only reduced by half (Table 2). Vegetative growth in 1983-84 was dense, reducing the ability to obtain thorough spray coverage. Chlorpyrifos sprays also reduced leafroller damage ($p < 0.06$). Half the fruit damaged by leafrollers (16/34) had a live caterpillar present, indicating a late season attack and the need to spray closer to harvest.

TABLE 2: Average damage levels in the preliminary trial.

	Percent damaged fruit		
	Mealybug	Leafroller	Thrips
chlorpyrifos	48.4 b	4.6	1.2
Bt	93.5 a	17.4	6.5
untreated	100 a	27.5	6.1

Bt only slightly reduced leafroller damage, although shorter intervals between applications may be more effective. Bt does not kill mealybugs and the small reduction of this pest was attributed to the early chlorpyrifos application.

Thrips damage was low overall, and oribatid and tydeid mites were noticed on only five fruit.

Interesting varietal differences were observed. The pollinator variety "Gailey" has a fruit shape with a more exposed calyx than "Fuyu", allowing better spray coverage of this critical area. The "Gailey" tree sprayed with chlorpyrifos had fruit completely free of mealybugs (cf. "Fuyu" 46% infested). "Gailey" is as susceptible to mealybug as "Fuyu", as was shown by the tree sprayed only with Bt ("Gailey" 90% infested, "Fuyu" 96%). "Gailey" also had no calyx cracking while the mean for all other fruit was 85.7%.

Two trees of "Twentieth Century", a variety very close to "Fuyu", were unsprayed and gave results equivalent to unsprayed "Fuyu", except that far more fruit had thrips damage (43% against 6%). This could indicate a greater sensitivity to marking or a growth habit favouring high thrips populations.

1984-85 Trial

The two full programmes of broad-spectrum insecticides gave good pest control, while the selective programmes failed (Table 3). Mid-season (March) results mirrored those from the larger harvest samples and so are not given in detail. At harvest in May there was more leafroller damage than in March (approximately double in those unsprayed plots sampled both times ($p < 0.01$)). Mealybug levels were effectively unchanged in unsprayed plots, while in plots sprayed with insecticide/Bt programmes mealybug damage doubled between March and May (average increase 194%, $p < 0.01$) indicating that the early insecticide had an initial transient effect.

TABLE 3: Average damage levels in 1984-85 assessed at harvest in May 1985.

	Percent damaged fruit			Undamaged
	Mealybug	Leafroller	Thrips	
chlorpyrifos	6 c	6 d	0.6 b	86 d
diazinon + carbaryl	2 c	10 cd	0.1 b	85 d
prothiofos/Bt	54 b	15 bc	10.6 a	34 c
pirimiphos-methyl/Bt	66 ab	22 b	12.9 a	19 b
buprofezin/Bt	55 b	17 bc	15.6 a	30 bc
untreated	79 a	43 a	12.1 a	8 a

(Analyses on arcsine transformed data).

Mealybug infestation in 1985 was severe, but still less than in the previous year. Chlorpyrifos and diazinon plus carbaryl were effective in spite of the difficulties in getting thorough spray coverage under the calyx. No programme using insecticides pre-flowering, followed by Bt, resulted in a worthwhile reduction of mealybug infestation. Similarly there was no improvement from the extra pre-blossom spray.

Leafroller damage was worse than in the previous season (cf. Tables 2 and 3), but on the unsprayed fruit, fewer live caterpillars were present at harvest ($9/170 = 5.3\%$), indicating relatively less late season attack in 1985. However, in sprayed treatments, a greater proportion of damage occurred close to harvest (chlorpyrifos 10.3%, Bt 13.1%, diazinon + carbaryl 21.4%), so that better protection is still needed at this time. All treatments reduced leafroller damage, although even in the best, chlorpyrifos, 6% of fruit was blemished (Table 3). Bt, as used, did not give sufficient control for normal orchard practice.

Relatively few fruit were damaged by thrips, and chlorpyrifos or diazinon plus carbaryl reduced this to insignificance (Table 3).

The mean severity of calyx cracking was 1.04 using a scale from 0 (= undamaged) to 3 (= severe cracking). There was no correlation between this phenomenon and insect damage. Crop load (scored from 1 = light to 5 = heavy) was related to calyx cracking, but only accounted for 19% of the tree-to-tree variation in cracking.

Table 4 records the contamination of the fruit by both live pests and "passenger" mites and spiders. Pests found were leafrollers, thrips, and scale (greedy scale and black scale). Chlorpyrifos or diazinon plus carbaryl decreased pest contamination, but the

incidence of “passengers” was not lowered by any spray programme. Fewer “passengers” were recorded at harvest than in March. However, while the earlier examination was done in the laboratory, the harvest assessment was carried out in the field with three observers who varied in their ability to find mites. About half of all fruit examined in March carried oribatid or tydeid mites. This high incidence indicates a quarantine hazard. Although the best insecticides used should effectively control the pests, oribatid mites in particular cannot be controlled by these sprays, and they are also difficult to eliminate with post-harvest fumigation (Batchelor *et al* 1985).

TABLE 4: Insect and mite infestation found on persimmon fruit.

	Leafroller	Thrips	Scales	Mites			Spiders
				Tydeid	Oribatid	Predator	
Harvest							
%Fruit infested	2.2	3.6	0.3	2.5	1.9	2.9	3.5
%Trees infested	50	44	10	42	17	35	75
Mid Season							
%Fruit infested	3.1	1.7	0.8	29.2	23.6	7.5	2.3
%Trees infested	38	25	17	96	71	75	38

CONCLUSIONS

In these two trials, mealybugs, leafrollers and thrips were the main pests of persimmons in decreasing order of importance. Control of all three was achieved by a full season programme of either chlorpyrifos or diazinon plus carbaryl. Using a mealybug-active insecticide before flowering, followed by Bt sprays against leafrollers, reduced damage to fruit without giving adequate control. Mealybug control was not improved by an extra spray at greentip. There was a need for better leafroller control just before harvest.

The incidence of “passenger” mites was high, pointing to a need for great care to meet quarantine standards.

Calyx cracking was associated with crop load but not insect damage.

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