THE TOXICITY OF METHIDATHION AGAINST ARMOURED SCALE PESTS ON KIWIFRUIT

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SUMMARY

Laboratory toxicity tests found methidathion was highly toxic to greedy scale (*Hemiberlesia rapax*) with LC_{50} values of 0.08 g/100 litres for white cap and 0.6 g/100 litres for mature scale stages. A comparison with critical concentration values obtained in earlier studies for diazinon showed that at label rates methidathion is on average five times more toxic than diazinon to white cap and twice as toxic to mature stages. A field study using methidathion as a dormant season spray against latania scale (*H. latania*) on kiwifruit gave 96% control compared to 79% using diazinon. These findings suggest methidathion will give more effective control of armoured scale on kiwifruit than diazinon.

INTRODUCTION

Methidathion has been used in many overseas countries for controlling armoured scale (Hemiptera: Diaspididae) on a wide range of crops. Whilst extremely effective as a scalicide, this chemical can be disruptive to integrated pest control programmes on apples and citrus (Smith and Papacek 1985; Bower 1987). However, with careful timing methidathion can still be used successfully on both these crops (Angerilli and Logan 1985; Reissig *et al* 1985).

Methidathion has long been considered a potential candidate insecticide for control of armoured scale on kiwifruit with preliminary screening trials giving variable results (Ford 1971; Sale 1972; Ferguson and Wallace 1979).

Work is currently underway in both the USA and New Zealand to obtain registration for methidathion use on kiwifruit (Anon. 1988; T.M. Patterson pers. comm.). The objective of this study was to confirm the effectiveness of methidathion against the main armoured scale pests found on kiwifruit. It was also of interest to know the efficacy of this material relative to diazinon which has been commonly used for armoured scale on kiwifruit.

MATERIALS AND METHODS

Laboratory toxicity tests

The toxicity testing procedure employed in this study was similar to that used to determine the toxicity of diazinon and lime sulphur to greedy scale (Blank and Olson 1987, 1989). Greedy scale infested potatoes were dipped for 5 seconds in a range of methidathion (Ultracide 40WP) concentrations in addition to a water control. Potatoes were held at 20 ± 2°C for 14-21 days before mortality assessment.

Determination of 10 day old white cap dose responses were obtained from two test runs carried out on separate occasions. Determination of mature scale dose responses were obtained from three separate test runs using potatoes with a mixed age scale population. Additional test runs incorporating Citowett spreader-sticker (25 mls/100 litres) and Orthospray sticker (50 mls/100 litres) were run concurrently with the third run using methidathion alone. Each test run involved at least five concentrations of insecticide as well as the water control and there were two repeats per concentration. Mortality was assessed from 50 scale per potato.

Log probit regression analysis was used to calculate LC_{50} and LC_{90} critical concentrations and 95% confidence intervals. This analysis took into account Abbott's formula (Busvine 1971) for correcting for control mortality which did not exceed 10%.

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Efficacy against field populations

This study used a pergola block of 7 year old kiwifruit vines in Kerikeri which were no longer in commercial production. Vines had not received any insecticide sprays for at least two seasons and had developed high populations of armoured scale. Plots comprised single female vines at 5.5 m spacings.

There were four replicates per treatment with treatments arranged in a randomised block design. Methidathion at 50 g/100 litres and diazinon (Basudin 800 EC) at 48 g/100 litres were applied to the vines on 17 August 1989 using a Braglia Varigun at 800-1000 kPa using a 2 mm nozzle. A relatively high water rate of 8 litres/plot was used to ensure complete coverage of all parts of the vine. The weather was fine at spraying and was dry for the following 2 days.

Scale mortality was assessed by destructively harvesting 1 and 2 year old wood from the vines 54-74 days after spraying. Harvested wood was kept in plastic bags in a cool store (4 °C) for up to 2 weeks. The mortality and stage of scale were assessed under a microscope. Thirty five of each of the four scale stages were assessed giving a total of 560 scale assessed per treatment. Seventy two mature scale were collected from untreated plots for species identification (Lo and Blank 1989). A precise analysis of results was done using angular transformed data, but for presentation purposes an analysis of percentage mortality was also carried out. Actual mortalities were adjusted for natural mortality using Abbott's correction to obtain corrected percentage kill.

RESULTS

Laboratory toxicity tests

The plots of the logarithm of the methidathion concentration against corrected percentage mortality on a probit scale for the white cap and mature stages are presented in Figure 1. The toxicity of methidathion against mature stages was not significantly different in tests incorporating Citowett and Orthospray spreader/sticker compared with methidathion alone, so the results of all five tests have been combined. The critical concentration levels and slopes are presented in Table 1. The log concentration probit regression for the mature stages flattened out markedly near the LC_{90} levels and this was reflected in the wide 95% confidence limits.

Efficacy against field populations

Latania scale (*Hemiberlesia latania*) was the dominant armoured scale species present comprising 88% of the population, with greedy scale (*H. rapax*) at 11% and oleander scale (*Aspidiotus nerii*) at 1% comprising a minor part of the population.

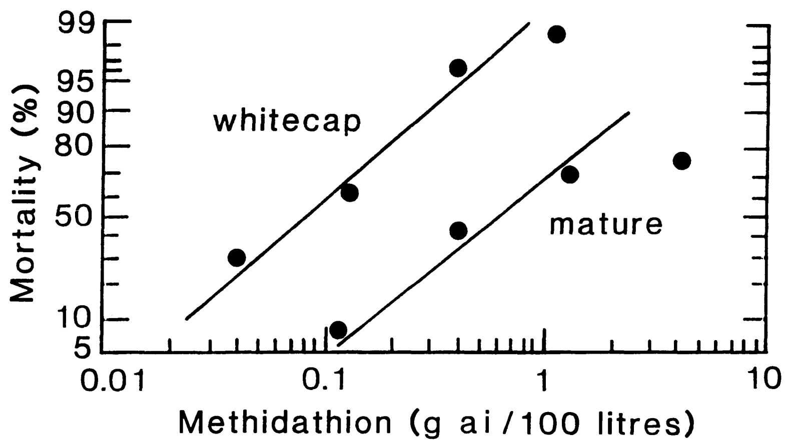

Fig. 1: **Plots of the logarithm concentration of methidathion against percentage mortality on a probit scale for white cap and mature stages of greedy scale.**

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TABLE 1: Critical concentration levels, 95% confidence intervals, slopes of the logarithm concentration probit regression curves, and total numbers of greedy scale tested (n) using methidathion.

Stage	n	LC_{50} (95% CI) (g ai/100 litres)	LC_{90} (95% CI) (g ai/100 litres)	Slope ± SE
white cap	1850	0.08 (0.07-0.09)	0.28 (0.23-0.38)	2.36 ± 0.14
mature	4200	0.61 (0.50-0.76)	2.36 (1.67-4.00)	2.18 ± 0.10

TABLE 2: The effect on latania scale mortality of methidathion and diazinon applied as dormant season sprays to kiwifruit.

Treatment	Rate (g ai/100 litres)	% Mortality					Corrected % kill
		White cap	Yellow cap	Black cap	Mature	All stages	All stages
methidathion	50	97	99	97	97	98	96
diazinon	48	85	91	95	85	89	79
untreated	—	51	54	58	30	48	—
SED (approx)	—	8.5	6.4	5.8	7.7	4.3	—

Methidathion and diazinon at recommended rates gave significantly ($P<0.001$) higher mortality of latania scale than was found in untreated plots (Table 2). Methidathion over all stages gave significantly ($P<0.05$) higher mortality than diazinon.

DISCUSSION

Mature scale required eight times the methidathion concentrations of the ten day old white caps to obtain equivalent LC_{50} or LC_{90} values. This difference in concentration is similar to that found with diazinon and lime sulphur (Blank and Olson 1987, 1989). Based on these other studies, the critical concentration values for the yellow cap and black cap stages will lie between values obtained for the most sensitive white cap and most tolerant mature stages.

The flattening out of the concentration probit curve at about the 90% mortality level for the mature stages is also similar to responses found for diazinon (Blank and Olson 1987). Additional test runs using spreader-stickers failed to change mortality responses suggesting that incomplete coverage of scale during dipping was not causing this effect. We can only speculate at this stage as to whether this effect was caused by some other artifact (unknown) of the testing methods or is indicative of a true heterogeneity of the scale population.

Laboratory toxicity tests are useful for predicting the relative toxicity of chemicals and hence field efficacy. At currently recommended label rates methidathion was on average 5.1 times more toxic than diazinon to white cap stages and 2.3 times more toxic to mature stages (Table 3). These findings suggested that methidiathion should give more effective control of scale in the field than diazinon.

TABLE 3: A comparison of the relative toxicity to greedy scale of methidathion and diazinon at label rates using the LC_{50} and LC_{90} data from this study and from Blank and Olson (1987).

Stage	Ratio label rate : LC_{50}		Relative toxicity	Ratio label rate : LC_{90}		Relative toxicity
	Methidathion	Diazinon		Methidathion	Diazinon	
white cap	625	160	3.9	179	28	6.3
mature	82	44	1.9	21	8	2.7

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The field trial using latania scale, confirmed the findings of the laboratory toxicity tests using greedy scale, with methidathion giving slightly better levels of control than diazinon. In dormant season applications methidathion would therefore be preferred to diazinon in terms of effectiveness against both armoured scales.

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