EVALUATION OF SILWET L-77 AS AN ADJUVANT FOR SPRAYS TO CONTROL APPLE PESTS AND DISEASES

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SUMMARY

The organosilicone compound, Silwet L-77, was evaluated as an adjuvant for reducing the rate of conventional pesticides (azinphos-methyl and captan) applied to apples. Trials were conducted over two seasons using both airblast and hand spraying methods of application. The trials demonstrated that the use of Silwet L-77 as an adjuvant may permit lower application rates of insecticides, necessary for leafroller and scale control on apples. Another major advantage was that its use with half rate pesticide programmes lowered azinphos-methyl and captan residues on fruit at harvest by 40-95%, depending on the withholding period.

INTRODUCTION

The most serious pests in New Zealand apple orchards include several species of leafrollers; the most important of which are: the lightbrown apple moth *Epiphyas postvittana*, brownheaded leafrollers *Ctenopseustis* spp. and greenheaded leafrollers *Planotortrix* spp.. Frequent applications of insecticide are required to reduce the risk of leafroller infestation in export apple crops. The principal disease of apples in New Zealand is apple black spot (*Venturia inaequalis*). While this does not represent a major quarantine risk to export produce, it requires an intensive fungicide programme to prevent serious crop loss.

The current use of pesticides within our apple industry complies with the residue tolerances established in all major export markets. However, consumers have become alarmed at the perceived risks associated with the presence of pesticides on fresh produce, and this has become an important issue in many consumer markets. Consequently, exporters want to develop control strategies which minimise pesticide residues on fruit crops. However, any such strategy must not compromise pest and disease control as quarantine requirements must be achieved to ensure market access.

The aim of this trial was to determine the value of Silwet L-77 (as an adjuvant) in reducing the rate of conventional pesticides applied to apples. This paper reports on insect and disease control with Silwet L-77 added to half rates of pesticide. It also reports on the impact of these treatments on the pesticide residues present on fruit at harvest.

METHODS

Two trials using Silwet L-77 were conducted on the apple cultivar 'Sturmer' at the DSIR Research Orchard, Appleby, Nelson. Trial 1 was completed during the 1989-90 season and Trial 2 was completed in the 1990-91 season.

Trial One.

There were three treatments; a full rate pest and disease control programme based on azinphos-methyl (Gusathion) and captan; a half rate programme with Silwet L-77; a half rate programme without Silwet L-77 (Table 1). There was no untreated control so references to control are in comparison with a full rate programme. The treatments were not replicated and were applied to blocks, each consisting of approximately 50 trees. The experimental programmes were applied by airblast sprayer at 2000 litres/ha; a total of nine sprays were applied at 11-18 day intervals from November 13 until

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Trial Two.

The two parts to this trial were completed in the same block which was also the site of the 1989-90 trial. Both plots received a standard insect and disease control programme until late November, 1990. Part 1 of the trial consisted of two unreplicated airblast treatments while Part 2 consisted of four replicated treatments which were hand sprayed (Table 1). The airblast trial consisted of two treatments; a half rate pest and disease control programme with Silwet L-77 and a half rate programme without Silwet L-77 (Table 1). There was no full rate comparison and no untreated control. Each block consisted of about 25 trees which were separated by guard rows and sprays were applied at 2,000 litres/ha at 14-18 day intervals.

The hand sprayed trial included four treatments, a half rate azinphos-methyl programme with Silwet L-77, a half rate programme without Silwet L-77, a full rate programme and an untreated control (Table 1). Each treatment consisted of five single tree replicates which were arranged in a randomised complete block design. Sprays were applied to run-off (5-7 litres per tree) using a high pressure hand gun. Spraying commenced on December 7, 1990, and a total of eight applications were applied at 14-18 day intervals in both airblast and hand sprayed trials until March 23, 1991. The fungicides (captan and metiram + nitrothal isopropyl) in this trial were applied separately by airblast sprayer, at the full rate to all treatments.

TABLE 1: Method of application, product and adjuvant rates.

Trt	Application method	Product	Rate g ai/100 litres	Silwet L-77 mls/100 litres
Trial One				
1	Airblast	azinphos-methyl	19	50
		captan	40	
2	Airblast	azinphos-methyl	19	nil
		captan	40	
3	Airblast	azinphos-methyl	38	nil
		captan	80	
Trial Two				
1	Airblast	azinphos-methyl	19	50
		captan	40	
2	Airblast	azinphos-methyl	19	nil
		captan	40	
3	Hand gun	azinphos-methyl	19	50
4	Hand gun	azinphos-methyl	19	nil
5	Hand gun	azinphos-methyl	38	nil
6	Nil	untreated	nil	nil

In both trials the effectiveness of the treatments was determined by recording insect damage to fruit at harvest (Trial 1: March 19, 1990, Trial 2: April 8, 1991). Disease control in Trial 1 was not evaluated due to the low levels (<5%) of black spot infection in unsprayed trees in the orchard. Insect damage was assessed by randomly sampling 100 fruit from each of 15 trees (1500 fruit per treatment). In Trial 2, airblast treatments were assessed for pest and disease control. Samples consisted of 100 fruit taken from each of 10 trees (1000 fruit per treatment). In the hand sprayed trial each treatment was assessed for insect damage and fruit finish. Samples of 100 fruit were taken from each replicate (500 fruit per treatment).

Data for the airblast trials were analysed using a t-test to compare mean damage levels in each block. Data for the hand spray trial were analysed separately using ANOVA for mean separation of arc-sin transformed percentages of damaged fruit. Significant differences cited are at $P \leq 0.05$. An analysis of insecticide and fungicide residues on fruit from Trial 1 was completed to determine the impact of Silwet L-77 on their degradation. Two 1.5 kg samples of fruit were analysed for the presence

of azinphos-methyl and captan residues at 7, 14, 21 and 28 days after the final spray. The residue analysis method used multi-residue methanol/toluene extraction and gas-liquid chromatography.

RESULTS

The percentage of fruit downgraded at harvest due to the presence of either insect damage or disease in Trials 1 and 2 is given in Table 2. The Silwet L-77 treatments in Trial 2 had no significant effects on fruit finish so these data are not presented.

Codling moth was not found in any of the treatments in either Trial 1 or 2. The number of fruit infested with mealybugs or woolly apple aphid was too low for statistical analysis. Leafroller damage occurred in both trials. In Trial 1 significantly more leafroller and scale damage occurred in the half rate insecticide treatment than in the full rate programme. When Silwet L-77 was added to a half rate insecticide programme, leafroller and scale control was not significantly different to that achieved by the full rate programme.

In Trial 2 high levels of leafroller damage occurred in the half rate only insecticide programme applied by airblast sprayer. In contrast, a low level of leafroller damage was found in the half rate insecticide + Silwet L-77 programme. A similar trend was evident for scale insect infestation but the differences were not significant at the 5% level. In Trial 2 hand-sprayed treatments, slightly more leafroller damage was found in the half rate insecticide only programme than in the Silwet L-77 programme. The best leafroller control was achieved with the full rate azinphos-methyl programme but none of the treatments were significantly different. The same trend was also evident in the number of scale infested fruit.

TABLE 2: The percentage of fruit downgraded for insect and disease damage in both airblast and hand spray trials. Treatments with no letters in common are significantly different at P≤0.05.

Treatment	Leafroller -bugs	Mealy	Scale spot	Black
Trial One				
1 Half rate + L-77	0.4ab	0.0	0.3a	-
2 Half rate only	1.0b	0.2	1.7b	-
3 Full rate	0.2a	0.1	0.7a	-
Trial Two				
1 Half rate + L-77	0.4a	0.2	0.2a	0.6
2 Half rate only	2.9b	0.0	0.7a	0.2
3 Half OP + L-77	0.8a	0.0	0.8a	-
4 Half OP only	1.2a	0.0	1.4a	-
5 Full OP	0.2a	0.0	0.6a	-
6 untreated	22.6b	0.6	11.8b	-

Pesticide residues present on the fruit following the final spray application, are given in Figures 1 and 2. Residue analyses found the lowest levels of azinphos-methyl to be present in the half rate insecticide programme. The addition of Silwet L-77 to a half rate programme resulted in slightly increased azinphos-methyl residue levels. Both half rate programmes had approximately 40 and 80% lower azinphos-methyl residues after 14 and 21 days, respectively, than the full rate programme. A greater reduction in captan residues occurred in half rate programmes, where levels after 21 days were >95% lower than those on fruit from the full rate programme.

DISCUSSION

These trials demonstrated that Silwet L-77, used as an adjuvant, may allow lower application rates of insecticides for leafroller and scale control to be used on apples without significantly increasing fruit damage. Another major advantage is that its use with half rate pesticide programmes lowered azinphos-methyl and captan residues

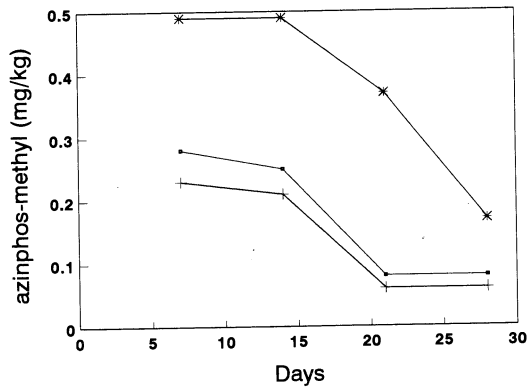

Fig. 1: The azinphos-methyl residues (mg/kg) on Trial 1 fruit 7, 14, 21 and 28 days after the final application. Treatments are: full rate (*_____*); half rate + Silwet L-77 (O_____O) and half rate only (+_____+).

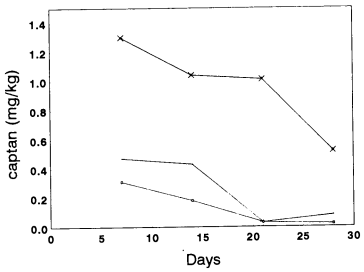

Fig. 2: The captan residues (mg/kg) on the Trial 2 fruit 7, 14, 21 and 28 days after the final application. Treatments are: full rate (*_____*); half rate + Silwet L-77 (O_____O) and half rate only (+_____+).

on fruit at harvest by 40-95% depending on the withholding period.

In this study Silwet L-77 appeared to give better control when applied by an airblast sprayer probably because of improved coverage and greater spray penetration. In the hand spray trial, where sprays were applied to run-off, the benefits of Silwet L-77 were reduced and were not significantly different from other treatments.

San José scale was the only other pest whose numbers were high enough to provide analysable data. In both Trial 1 and Trial 2 scale control in half rate azinphos-methyl programmes was improved by the addition of Silwet L-77, to a level comparable to a full rate programme.

There were two main benefits from the addition of Silwet L-77 to half rates of azinphos-methyl and captan. It maintained leafoller control at levels similar to those in a full rate programme, and it substantially reduced azinphos-methyl residues on fruit at harvest. The improved control of these two pests achieved with Silwet L-77 is probably the result of enhanced spray coverage and penetration, particularly with airblast application. This conclusion is supported by the reduction in the treatment differences in the hand-sprayed treatments.

The apparent success of this trial, showing the potential of an adjuvant to reduce pesticide use and residues on fruit, raises dilemmas for orchardists and the agricultural chemical industry alike. The cost of such an adjuvant based programme would offset any savings from lower pesticide rates. The real issue, then, is to what extent these sectors are prepared to re-examine current pesticide recommendations and practices in order to satisfy consumer demand for less pesticide on fresh produce.

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