**ACTIVITY OF INSECTICIDES AGAINST APPLE
LEAF CURLING MIDGE (*DASYNEURA MALI*) AND
WOOLLY APPLE APHID (*ERIOSOMA LANIGERUM*)**

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Apple leafcurling midge (*Dasyneura mali*) (ALCM) and woolly apple aphid (*Eriosoma lanigerum*) (WAA) are secondary pests of apples. Past field trials indicate that applications of azinphos-methyl, phosmet (MacKenzie 1971) or chlorpyrifos (Woon and Haydon 1973) provide some ALCM and WAA control. This paper reports on laboratory trials conducted to compare the efficacy of azinphos-methyl, chlorpyrifos and phosmet against these pests.

Two bioassays were conducted with ALCM using infested shoots collected from unsprayed apple trees. In the first bioassay, 40-50 infested shoot tips per treatment were dipped for 10 seconds in constantly agitated insecticide solution. Control insects were treated with tap water. The shoot tips were hung over night to air dry before placing them in open plastic bags to minimise leaf desiccation and control mortality. After 48 h, leafrolls were dissected and the larvae inside placed into four arbitrary age/size groups (small, medium, large, orange (pre-pupal)) before assessing their mortality by gently prodding to determine whether any muscle contraction typical of normal, healthy larvae occurred. In the second bioassay, 30-40 infested shoot tips per treatment were dipped for 5 seconds into a constantly agitated insecticide solution before air-drying overnight at ambient temperature. Larval mortality was assessed after 24 h.

Two WAA bioassays used shoots infested with at least 1 WAA from unsprayed apple trees which were held on trays covered with a plastic bag until used. Six-ten shoots per treatment were dipped for 5 seconds into a constantly agitated insecticide solution. Tap water was used for the control. Shoots were then air-dried and held under ambient conditions for 24 h before mortality assessment. Aphids were sorted into three arbitrary size ranges (small, medium, large) and then assessed as live, dead or parasitised. Aphids with obvious (ie. parasite exit holes visible) parasitism by *Aphelinus mali* were excluded from mortality calculations.

The insecticides and the rates used are shown in Table 1. Spreader/sticker (Supawett) was used at 25 ml/100 litres with all insecticide treatments in the WAA bioassay conducted on 16 March 1988.

Data were analysed using generalised linear models with logit link and errors proportional to those for a binomial model.

Apple leafcurling midge

The bioassays conducted on 9 and 12 December 1987 had 154-286 and 113-273 larvae per treatment of which 19, 51, 26 and 4% and 28, 43, 23 and 6% were small, medium, large and orange larvae respectively. Twenty four hours after treatment, some ALCM larvae were still alive (Table 1) but after a further 24 h all three insecticides used at recommended rates gave 100% control. The level of mortality was affected by the size of larvae.

TABLE 1: Percent mortality ($\pm$ SE) of different size ALCM larvae infesting apple cv. Red Delicious, Oratia Beauty shoot leaves 24 h after insecticide treatment, 12 December 1987.

Treatment	Rate (g ai/100 litres)	Small	ALCM size Medium	Large
control	-	36.3(7.1)	21.1(3.9)	4.4(2.2)
azinphos-methyl (Gusathion 50WP)	50.0	96.2(3.8)	98.6(1.4)	85.0(5.7)
chlorpyrifos (Lorsban 50WP)	37.5	100	98.4(1.6)	30.6(7.7)
phosmet	75.0	87.5(3.4)	84.8(4.0)	68.8(8.2)
(Imidan 75WP)	90.0	86.9(3.7)	93.5(2.4)	89.1(4.6)
	112.5	98.7(1.3)	92.3(3.7)	95.2(2.7)

Woolly apple aphid

The bioassays conducted on 23 February and 16 March 1988 had 14-189 and 58-347 aphids per treatment of which 15, 47 and 38% and 28, 38 and 34% were small, medium and large-sized aphids respectively. Chlorpyrifos gave the highest level of WAA control (Table 2, 3) with a higher level of efficacy than azinphos-methyl as found by Penman and Chapman (1979), with phosmet intermediate. The efficacy of all treatments was affected by aphid size (Table 2).

TABLE 2: Mean percentage ($\pm$ SE) of WAA dead (obvious parasitism excluded) which were still on apple cv. Red Delicious, Golden Delicious and Splendour shoots 24 h after insecticide treatment, 16 March 1988.

Treatment	Rate (g ai/100 litres)	Small	Aphid size Medium	Large
control	-	0	4(2)	0
azinphos-methyl	50.0	-	27(10)	28(10)
chlorpyrifos	37.5	100	92(12)	100
phosmet	75.0	54(16)	35(13)	24(11)
	90.0	83(17)	79(13)	58(17)
	112.5	53(15)	47(12)	38(11)
Significance ¹	NS	*	*	

¹ excluding control; NS = not significant, * = $P < 0.01$

During the 24 h post-treatment period, some WAA fell off shoots including those from the control but the proportion of aphids falling off was higher on insecticide-treated shoots. Aphid mortality was higher for insects falling off than for those remaining on shoots (Table 3).

In recent years, some insecticides that were applied specifically against WAA (Charles and White 1984) or other pests have been omitted from spray programmes. These treatments may have also contributed to ALCM control. Control of WAA and ALCM now relies on the insecticides used to manage key pests. However, these laboratory trials indicate that full season programmes of azinphos-methyl or chlorpyrifos may not be able to achieve complete control of all stages of these pests. This may partially explain why one of these pests, ALCM, has become more common in sprayed orchards (Tomkins *et al.* 1994).

TABLE 3: Mean percentage ($\pm$ SE) of WAA dead (obvious parasitism excluded) which were still on or had fallen off apple cv. Red Delicious, Golden Delicious and Splendour shoots 24 h after treatment, 23 February 1988.

Treatment	Rate (g ai/ 100 litres)	Aphid size			
		Medium		Large	
		Plant	Fallen off	Plant	Fallen off
control	-	0	33(14)	0	0
azinphos-methyl	50.0	21(19)	100	0	92(10)
chlorpyrifos	37.5	100	100	100	100
phosmet	75.0	15(15)	96(1)	15(9)	45(14)
	90.0	27(12)	100	17(10)	96(5)
	112.5	31(19)	100	22(10)	100
Significance ¹		NS	NS	**	***

¹ excluding control; NS = not significant, ** = $P < 0.001$, *** $P < 0.0001$

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