APHID CONTROL WITH RH7988

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SUMMARY

RH7988 was found to be at least as toxic as pirimicarb to green peach aphid (GPA), *Myzus persicae* (Sulzer), and cabbage aphid (CA), *Brevicoryne brassicae* (L), both in laboratory tests and in the field. The field rate of RH7988 (100 g/ha) was more effective in maintaining low aphid populations than was pirimicarb (250 g/ha). While the LC₅₀ values of each chemical were not significantly different for GPA (RH7988 — 41.7 mg/litre, pirimicarb — 73.5 mg/litre), the slope of the regression line was greater for RH7988 (1.42 cf 0.69). RH7988 showed superior systemic activity than pirimicarb by causing 64% more CA to become moribund (87% cf 23%, respectively) on leaves emerging after spraying at 18 days post treatment. Otherwise the residual activities of the two chemicals were equivalent.

INTRODUCTION

Aphids are important pests in many different crops. The cabbage aphid (CA) and the green peach aphid (GPA) are two species commonly found in brassicas which are capable of reducing yield either by direct feeding or indirectly by virus transmission.

Chemical failure through resistance has been recorded for some aphids and insecticide resistance in GPA is common and widespread (McClanahan and Founk 1983). Some resistant populations have also been found in New Zealand (Cameron and Walker 1988). For this reason new chemicals are required to replace those that are no longer effective and to maintain a range of chemicals to help avoid resistance problems developing.

RH7988 is a new aphicide under development by Rohm and Haas Company, that has been shown to be highly selective and suitable for use in integrated pest management programmes (Murray *et al* 1988). It has excellent efficacy against a wide range of aphid species and is safe towards beneficial insects such as bees. It is translocated within plants and is able to control root aphids by foliar applications and leaf feeding aphids by soil applications.

This study investigated the efficacy of RH7988 against GPA and CA on brassicas in laboratory and field studies.

MATERIALS AND METHODS

Field trials

Three field trials were conducted. Each trial had five treatments replicated five times in a Latin square design. Each plot consisted of 49 (7x7) 'Golden Acre' Merit strain cabbage plants, planted at 0.5 m intervals with a 1 m buffer between plots.

Trial 1 (summer 1987) tested for phytotoxic effects of RH7988 in combination with surfactants. In a split plot Latin square, four surfactants were tested: Sunspray 6E, Triton B1956, Triton AG98 (all at 0.3 and 0.6 ml/litre) and Citowett (at 0.25 ml/litre). RH7988 (EC 480 g/litre) was applied at 100 g/ha to all treatments. One subplot had RH7988 applied without a surfactant. The fifth treatment was a water-only control. The treatments were applied in 500-550 litres/ha of water using a precision plot sprayer when the cabbages were beginning to form heads. Eight plants from each subplot were sampled 11 days post treatment for plant damage and aphid presence. Plant damage was assessed on a 0-5 scale, where 0 = no damage.

Trial 2 (autumn, 1988) tested RH7988 (480 g/litre EC) at three concentrations, 50, 100 and 200 g/ha, against a water-only control and pirimicarb (500 g/kg WDG) at 250 g/ha. Triton B1956 (0.3 ml/litres) was included with all treatments. Treatments were

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applied using a precision plot sprayer when the plants had an average of nine true leaves. Five plants per plot were randomly selected and the number of aphid colonies on them counted. Counts were made 1, 10 and 17 days prior to treatment and 2, 7, 14, 22 and 35 days post treatment.

Trial 3 (summer 1988) tested pirimicarb and a narrower range of RH7988 (25 g/kg WP) rates (Table 3). Again, Triton B1956 (0.3 ml/litre) was included with all treatments. On the borders of the main trial some observation plots were set up to monitor untreated aphid populations.

A count of aphid colonies was made 8 days prior to treatment. The number of colonies of each aphid species per plant were counted 2, 8, 15, 21 and 26 days post treatment. The same counts were also made in the unsprayed and RH7988 100 g/ha observation plots at 8, 15 and 26 days post treatment. Five cabbages per plot were harvested once the crop was considered to be of marketable size and total fresh weights, marketable fresh weights and marketable dry weights were recorded.

Laboratory experiments

Aphids for laboratory trials were reared in separate insectaries on cabbages. Leaf discs were obtained from pest-free cabbages also grown in an insectary.

LC50 determination: A range of concentrations of both RH7988 (25 g/kg WP) and pirimicarb (500 g/kg WDG) were sprayed on to aphids on leaf discs (five aphids per disc, four discs per treatment) using a Potter tower (2 ml volume at 103 kPa). Treated dishes were maintained at 20°C and counts of aphid mortality and those that were moribund (unable to walk when prodded) were made 24 and 48 h post treatment.

Residual activity: A pot trial was carried out to assess the residual activity of insecticides on cabbages in an insectary. Seven treatments were applied including a water-only control (Table 4). All treatments included 0.3 ml/litre Triton B1956 and were replicated five times. Applications were made using a precision plot sprayer when the plants had three to four true leaves. Cabbage aphids were caged (5 per cage) on treated leaves 1, 5, 10, 20 and 30 days post treatment and counts of mortality and those moribund were made 24 and 48 h after caging. A count on leaves which emerged after spraying was made 18 days post treatment.

An analysis of variance was carried out on the data from the field trials and the residual activity trial. Concentration-mortality data was analysed by probit analysis.

RESULTS

Field trials

Trial 1: RH7988, applied alone or in combination with a surfactant had phytotoxicity scores which were not significantly different to the control (mean phytotoxicity score of all treatments = 1.97). The control treatment had a 70 percent incidence of aphid-infested plants, which was significantly more than the other treatments (mean of 22 percent).

Trial 2: At all post treatment sampling dates, the mean number of aphid colonies per plant for each treatment was significantly less than untreated (Table 1). All three RH7988 rates had significantly fewer colonies than pirimicarb at 23 and 35 days post treatment. The RH7988 100 and 200 g/ha treatments also had significantly less aphid

TABLE 1: The mean number of aphid colonies per plant over five sampling dates in Trial 2.

Treatment	Rate (g ai/ha)	Days post treatment.				
		2	7	14	22	35
RH7988	50	0.20	0.96	1.28	2.76	3.80
RH7988	100	0.12	0.28	1.16	2.80	4.36
RH7988	200	0.08	0.16	0	1.08	2.92
pirimicarb	250	0.36	1.64	1.24	4.64	6.16
untreated		3.32	10.04	9.28	10.20	10.24
	LSD _{0.05}	0.36	1.22	1.45	1.03	1.49

colonies than the pirimicarb treatment 7 days after treatment. There were no significant differences between the three RH7988 rates at any sample date after treatment.

Trial 3: There was no significant difference between treatments for the number of GPA or CA colonies 2 days post treatment (Table 2). The mean number of colonies (both species) per plant for RH7988 at 25 and 50 g/ha was not significantly different from the pirimicarb treatment. RH7988 at 75 g/ha had significantly fewer GPA colonies 15 days post treatment and fewer CA colonies 8 and 15 days post treatment than did pirimicarb (Table 2).

TABLE 2: The mean number of green peach aphid (GPA) and cabbage aphid (CA) colonies per cabbage plant over three sampling dates in Trial 3.

Treatment	(g ai/ha)	Days post treatment					
		2		8		15	
		GPA	CA	GPA	CA	GPA	CA
RH7988	25	13.6	3.4	61.6	5.6	68.4	21.4
	50	12.6	3.2	41.4	8.8	63.2	15.4
	75	13.2	3.4	41.0	3.4	48.6	12.2
	100	2.2	1.6	23.2	2.0	40.6	11.4
pirimicarb	250	7.4	4.4	51.6	10.2	63.2	18.8
	LSD _{0.05}	6.16	3.27	12.42	5.69	13.81	4.67

RH7988 at 100 g/ha had significantly fewer colonies of both species 8 and 15 days post treatment than pirimicarb. A significant linear relationship between the four RH7988 rates was found for GPA 2, 8 and 15 days post treatment and for CA 15 days post treatment (Herman unpubl. data). Treatments were not significantly different for either species at 21 or 26 days post treatment (Herman, unpubl. data) and populations had begun to decline by the latter assessment date. The number of aphid colonies in the untreated observation areas around the trial was generally lower than on treated cabbages.

There were no significant differences between treatments for marketable fresh and dry weight yields of the cabbages (mean yield of 56.9 g/plant). The average percentage dry matter for all treatments was 7.1 percent.

Laboratory experiments

LC50 determination: The LC50 values for RH7988 and pirimicarb for GPA were 2-fold and 4-fold greater than the LC50 values for CA (Table 3). For GPA the slopes of the regression lines for the two insecticides and their intercepts were significantly different, with the line for RH7988 having a steeper slope and a lower intercept than pirimicarb. LC50 values of RH7988 and pirimicarb were not significantly different for CA. The slopes and intercepts of the lines for the two insecticides were not significantly different.

TABLE 3: The LC50s and gradients of the concentration-mortality lines for RH7988 and pirimicarb on green peach aphid (GPA) and cabbage aphid (CA).

Species	Chemical	LC50	(95% limits)	Slope	(sem)
GPA	RH7988	41.7	(25.66, 81.03)	1.42	(0.22)
	pirimicarb	73.5	(32.65, 169.75)	0.69	(0.12)
CA	RH7988	19.0	(7.70, 64.45)	1.1	(0.17)
	pirimicarb	16.5	(5.88, 54.30)	0.94	(0.11)

Residual activity: The treatments had a significant effect on the percentage of moribund CA exposed to chemical residues which had been aged for 1 and 5 days after treatment (Table 4). Thereafter residual activity declined and differences between treatments were not significant at 10, 20 and 30 days post treatment. Percentage of

TABLE 4: Percentage of moribund cabbage aphids 24 hours after exposure to treated cabbage leaves.

Treatment	(g ai/ha)	Days post treatment					
		1	5	10	20	30	18*
RH7988	25	0	0	0	0	0	0
	50	52	51	13	5	8	12
	75	63	19	20	0	0	29
	100	95	63	40	3	11	87
	200	90	78	23	7	11	64
pirimicarb	250	100	51	11	8	0	23
untreated		0	0	0	0	0	0
LSD _{0.05}		11.9	29.9	19.1	9.4	14.7	20.9

* – count on leaves that emerged after spraying

moribund CA for RH7988 at 25, 50 and 75 g/ha was significantly lower than for RH7988 100 and 200 g/ha and pirimicarb 1 day after treatment and this carried through for both RH7988 25 and 75 g/ha to 5 days post treatment.

More moribund CA were recorded on leaves which had emerged after spraying (18 days post treatment) than on leaves which had been sprayed 20 days previously. Both RH7988 100 and 200 g/ha had significantly more moribund CA than pirimicarb 18 days post treatment. The remaining treatments were not significantly different to pirimicarb.

DISCUSSION

These trials have shown RH7988 to be effective against GPA and CA on cabbages in the field and under laboratory conditions. The chemical was not phytotoxic to cabbages and did not cause any reduction in yield. In field trials RH7988 at the recommended field rate of 100 g/ha (G. Baynon, pers. comm.) controlled both GPA and CA as well as, or better than, pirimicarb at 250 g/ha. This is in agreement with results reported by Murray *et al* (1988). An observation noted in Trials 1 and 3 was that RH7988 by itself appeared to give control equivalent to that of RH7988 with a surfactant.

For both species the LC50 values for each chemical were not different. However, the response of GPA to an increase in chemical concentration was greater for RH7988 than that for pirimicarb. Laboratory experiments conducted by Furk and Murray (1988) on GPA populations that were susceptible or resistant to pirimicarb found that, for some of the populations (including the susceptible strain), pirimicarb had a lower LC50 than RH7988. The resistance factors Furk and Murray (1988) calculated showed that RH7988 was superior to pirimicarb in controlling resistant strains of GPA.

RH7988 has excellent systemic properties (Murray *et al* 1988). An indication of this was given in the residual activity experiment (Table 4) in which mortalities of 64 and 87% were recorded on newly emerging leaves 18 days after treatment with RH7988 at 100 and 200 g/ha respectively.

The low number of colonies observed in the untreated plots of Trial 3 compared to the treatment means of the main trial is explained when considering the size of the colonies (Herman, unpubl. data). In the main trial aphids were aggregated and many counts were of single aphids. By comparison, populations in the control observation plots were more aggregated and therefore fewer colonies were recorded. In both cases, however, the colonies usually contained fewer than ten aphids.

RH7988 shows the potential to be another insecticide available for aphid control in forage and vegetable brassica crops. With its good systemic properties, RH7988 can maintain control for a considerable time on leaves emerging after treatment.

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