EFFECT OF PIRIMICARB CONTROL OF ROSE-GRAIN APHIDS ON CEREAL YIELD

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SUMMARY

The effect of pirimicarb sprays applied at aphid threshold densities of 10 and 50/tiller on yield of wheat, oats and barley was studied in autumn and spring sown trials. No yield effect was found with insecticides applied at flowering, but applications up to the booting stage significantly increased yields in oats and winter wheat, irrespective of aphid threshold density used.

INTRODUCTION

The cosmopolitan rose-grain aphid *(Metopolophium dirhodum)* appeared in New Zealand in 1982, and Canterbury cereal crops supported dense populations of 50-150 aphids/tiller by December (Stufkens, unpublished). A 10-15% loss of yield in winter wheat infested from the flowering stage by rose-grain aphid (RGA) has been reported (Drew *et al* 1983; Rabbinge *et al* 1981). In Chile, barley yield loss associated with pre-flowering infestation was reported by Carillo (1973). The trials here were set up to obtain information on the choice of crop growth stage and aphid density thresholds for insecticidal control of RGA in cereals sown in autumn and spring.

METHODS

The trials were conducted at the DSIR Research Centre, Lincoln. Six blocks each 30 x 25 m were used for winter and spring crops of Rongotea wheat, Omihi oats and Illia (winter) or Triumph (spring) barley. Seed rates for the blocks were respectively 67-136 kg, 90-180 kg and 120-150 kg. Seed was drilled at 15 cm between rows on 30 May 1983 (winter) and 5 September 1983 (spring).

Five treatments, including combinations of two insecticide spray starting dates and two aphid density thresholds, were used in all blocks:

1. Early start - any stage + 10 aphids/tiller (E10)
2. Early start - any stage + 50 aphids/tiller (E50)
3. Late start - at flowering + 10 aphids/tiller (L10)
4. Late start - at flowering + 50 aphids/tiller (L50)
5. Untreated

These treatments were replicated five times in a Latin square design with plots 6 x 5 m. Pirimicarb (Pirimor 50) was chosen because of its low toxicity to natural enemies (Hellpap 1982) which may regulate RGA numbers on cereals after flowering (Chambers *et al* 1983). This material was applied at 125 g ai/ha with a controlled droplet application boom sprayer. For stripe rust control, triadimefon (Bayleton 25 wp) was applied to wheat blocks, at the same rate, on 7, 16 and 25 November. Urea was broadcast onto all blocks on 2 November, providing 25 kg N/ha.

For aphid sampling, random samples of 10 tillers were collected from each plot at weekly intervals from 8 November to 26 December. Sampling was, however, restricted to one replicate in oat and barley blocks on 28 November, and one replicate in barley and wheat blocks on 5 December.

Aphid days/tiller (aphid numbers x days of infestation) were calculated for each treatment from areas under curves of aphid numbers between 20 October and 31 December. Plant growth stages (GS) were recorded at weekly intervals, using the Feekes scale (Large 1954).

Header yields were taken from the central 4.2 m x 3.2 m (13.5 m^2) portion of each plot at harvest. Yields were dressed to remove chaff and foreign matter, and weighed. Sub-samples were taken for determination of moisture content and grain weight.

RESULTS

Winged RGA appeared on the trials at the tillering stage (GS 2-3) in early October. Populations on unsprayed plots increased to peak numbers at the start of flowering in early December, when counts of 10-15 (wheat), 20-30 (barley) and 60-110 (oats) *M. dirhodum*/tiller were recorded in winter and spring crops respectively.

Aphid numbers fell in December, in the presence of heavy entomophthorous fungus infection and numerous insect predators. Few aphids were found at the grain-filling stage (GS 10.5.4) and later. In the case of Illia barley, flowering occurred early in the season (11 November), and peak aphid numbers were found at the milky-ripe stage (GS 11.1).

Table 1 shows the schedule of pirimicarb applications, with crop growth stage at time of spraying. Aphid control by pirimicarb was observed to be effective, but the increase of aphids in winter wheat and oats 2 weeks after spraying on 11 November was followed by a repeat spray in the E10 treatment on 29 November.

TABLE 1: Schedule of pirimicarb applications to treatments (Feekes growth stage in parenthesis).

Date of Spray:	11 Nov.	16 Nov.	29 Nov.	13 Dec.
Barley, autumn	E10*(10.5.1) L10			
Barley, spring		E10 (8.0)	E50 (10.0)	L10 (10.5.2)
Wheat, autumn	E10 (10.0)		E10 (10.5.2) L10	
Wheat, spring		E10 (9.0)		L10 (10.5.2)
Oats, autumn	E10 (9.0)		E10 (10.5.1) E50	
Oats, spring		E10 (7..)	E10 (10.0) E50	L10 (10.5) L50

* see Methods

TABLE 2: Aphid day values (above) and grain yields (t/ha) (below).

Treatment	E10	E50	L10	L50	Untreated	LSD (P:0.05)	CV %
Barley, autumn	120	-	-	-	580		
	7.57				7.20	n.s.	9.7
Barley, spring	90	200	490	-	570		
	3.55	3.60	3.41		3.38	n.s.	20.6
Wheat, autumn	80	-	230	-	300		
	7.59*		6.97		6.93	0.45	4.7
Wheat, spring	130	-	320	-	350		
	2.78		3.02		2.76	n.s.	13.0
Oats, autumn	120	710	-	-	1310		
	6.25*	5.88			5.60	0.41	5.1
Oats, spring	100	280	1480	1480	2340		
	2.66*	2.94**	2.42	2.26	2.08	0.49	14.4

* $P < 0.05$ ** $P < 0.01$ for comparison with untreated.
- no insecticide applied: plot values included in untreated mean.

Grain yield and aphid day (AD) data in Table 2 show that in no case was a significant yield increase achieved with late spray treatments, a result to be expected from the decline in aphid numbers after flowering. Early sprays gave a significant ($P < 0.05$) yield increase in both oat crops, where grains of 0.65-0.76 t/ha resulted from control of 1200-2000 nett AD respectively (i.e. AD control - AD sprayed). In winter wheat a significant ($P < 0.05$) yield increase of 0.66 t/ha was associated with control of only 220 nett AD.

Comparisons of results from the use of two aphid density thresholds can only be made with the data for oats (Table 2). Delay of spray application until the E50 threshold resulted in loss of significant spray effect in autumn-sown, but not in spring-sown, oats. Thus as shown with late treatments, first spray application at flowering was too late to prevent a substantial loss of yield. All significant spray effects in the trial were achieved with applications at GS 10.0 or earlier. No significant spray effects were found in spring wheat or barley trials. Yields were poor and highly variable in spring sown crops (Table 2).

Grain weights were not significantly affected by any insecticide treatments, and these data are not presented.

DISCUSSION

Significant yield increases were obtained in winter wheat and oats sprayed before or at the boot stage (GS 7.10.0), but not when spraying was delayed until the flowering stage (GS 10.5.1). The results for winter wheat must be treated with caution as the yield increment (0.66 t/ha) was associated with the control of only 220 nett AD/tiller. This is greater than expected from overseas work on winter wheat, where equivalent values of 0.70 t/ha and 500 AD (Rabbinge *et al* 1981) and 1.31 t/ha and 1000 AD (Drew *et al* 1983) were reported from work on RGA.

There was no yield response to the control of RGA (460-480 nett AD) in barley. This contrasts with Carillo (1973) who obtained significant yield increases of over 25% from the control of RGA (600-1300 AD) in spring barley in Chile.

Data from suction trap catches and crop surveys (Farrell and Stufkens unpublished) suggest that RGA population levels on cereals in the Lincoln area were lower, and that populations declined earlier - at flowering - in 1983-84 than in 1982-83, when infestations persisted to the milky-ripe stage (GS 11.1). November weather was cooler and wetter in 1983 than in 1982, and this weather may have resulted in a lower rate of increase of RGA, and higher incidence of entomophthorous fungal disease in 1983. Weather more favourable to aphids might be expected to result in denser RGA populations, persisting until the milky-ripe stage, as reported in European work (Drew *et al* 1983).

It is clear that oats had heavy infestations of RGA, and that yields were increased by spraying before the boot stage. Further work is needed to clarify the yield response to RGA control in wheat and barley, and the need for a second spray at the flowering stage.

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