TOLERANCE OF WHEAT AND BARLEY TO FALLOW AND POST-SOWING APPLICATION OF CLOPYRALID

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Summary. Three trials were conducted on sandy soils in the eastern Mallee of Victoria to evaluate the tolerance of wheat and barley to fallow applications of clopyralid. With wheat, cv. Halberd, clopyralid at 2.5 kg/ha applied 31 to 21 weeks before sowing had no effect on yield. In a second trial with cv. Condor, 1.2 kg/ha applied 20 to 7.5 weeks before sowing or 3.5 weeks after sowing did not affect yield, but 2.4 kg/ha caused yield reductions. For this trial, a regression analysis indicated that 2.4 kg/ha applied closer than 25 weeks to sowing would reduce wheat yield. Yield of barley, cultivar Weeah, was not affected by 2.4 kg/ha when applied as close as 7.5 weeks before sowing or 3.5 weeks after sowing.

INTRODUCTION

In pot trials, wheat, barley and oats tolerated 0.8 kg/ha clopyralid applied 1 day before sowing or at the 3-5 leaf stage (5, 6). In Saskatchewan, clopyralid applied at 1.1 kg/ha (crop growth stage not specified) did not reduce the yield of barley or oats relative to hand-weeding, but wheat yields were decreased by 60% at this rate and by 35% at 0.56 kg/ha (2). In Alberta, on a silt loam soil with 14% organic matter, application at the 3-leaf, 6-leaf or boot stage of two barley cultivars at rates up to 0.9 kg/ha did not produce visible symptoms or yield reductions (3). However on wheat the yield of one of the two cultivars tested was reduced by 17% with clopyralid at 0.6 kg/ha applied at the boot stage and by 15-20% with 0.9 kg/ha applied at the 6- and 3-leaf stage (4).

In Australia, clopyralid is applied in cereals at 0.09 kg/ha for the control of annual weeds, and at 0.15 to 0.45 kg/ha for perenial weeds. It is applied to pasture or fallow prior to sowing cereals at rates up to 1.2 kg/ha for the control of creeping knapweed, *Acroptilon repens*, and has the potential to be used in this manner on skeleton weed, *Chondrilla juncea*. The purpose of the three trials reported here was to assess the tolerance of wheat and barley to clopyralid applied on sandy soils at various times on the fallow, or soon after sowing.

METHODS

One trial in 1980 and two trials in 1982 were established in the Swan Hill district on areas of regularly cropped paddocks which were free of perennial weeds. At the first application in November or December the paddocks had been bare fallowed for three to four months. Each trial area was treated as part of the paddock for cultivation during summer and autumn, for pre-sowing applications of trifluralin or pendimethalin and for sowing of the crop in May or June. The trial areas were maintained essentially weed-free with no differences in weediness between plots.

Trial treatments were applied with a hand-held, LP gas-operated boom sprayer with flat fan nozzles. Clopyralid was formulated as the monoethanolamine salt. The three trials had a factorial design (herbicide x application time) with treatments arranged in randomized blocks with four replications. A small-plot harvester was used for yield determinations. Details of the soils at the three sites are given in Table 1.

Trial 1 Single applications of clopyralid at 2.5 kg/ha, along with picloram plus 2,4-D amine (as Tordon 50-D®) and dicamba (as methanolamine salt) were applied to cultivated, weed-free plots of 15x2.65 m on 7 November, and 8 December 1980, and 15 January 1981. Spray volumes were from 134 to 164 L/ha. Wheat, cv. Halberd, was sown on 14 June 1981, 31, 27 and 21 weeks respectively after the three treatment dates. A central area of 11 m by 3 crop rows in each plot was harvested on 1 December 1981.

Table 1. Properties of the soils in the three trials.

Trial No.	Soil type	pH	Organic matter(%)	Sand (%)	Silt (%)	Clay (%)
1	sandy clay loam	8.2	<2	67	8	25
2	sandy clay loam	8.3	<2	70	8	22
3	sandy clay loam	8.4	<2	64	7	29

Trial 2. Single applications of clopyralid at 1.2 and 2.4 kg/ha were made on 20 December 1982, 14 February 1983, and 29 March 1983 to cultivated, weed-free soil and on 14 June 1983 to barley, cv. Weeah, which had been sown on 21 May 1983 and was at the 3-leaf stage. Plot size was 15x4 m. Spray volumes ranged from 193 to 205 L/ha. Spraying was 22, 13.5 and 7.5 weeks before, and 3.5 weeks after sowing. Yield was determined from a central area of 12x1.6 m in each plot on 15 November 1983.

Trial 3. Single applications were made to a weed-free fallow on 31 December 1982, 15 February and 27 March 1983, and to wheat, cv. Condor, at the 2-leaf stage, on 14 June 1983. These applications were 20, 13.5 and 7.5 weeks before, and 3.5 weeks after, the 20 May 1983 sowing date. The plots were harvested on 5 December 1983. Other trial details were as for Trial 2.

RESULTS AND DISCUSSION

Trial 1. Clopyralid at 2.5 kg/ha applied 31 to 21 weeks before sowing did not significantly reduce (P=0.05) the yield of Halberd wheat, although the yield from the application at 21 weeks was 11.5% lower than the untreated control (Table 2). However, the sensitivity of the trial was low, with the l.s.d. (P=0.05) representing 21.8% of the untreated control. Clopyralid at 2.5 kg/ha was safer to wheat than picloram plus 2,4-D at 0.55 + 2.2 kg/ha or dicamba at 4.4 kg/ha.

Table 2. Grain yield of wheat cv. Halberd following herbicide applications on the fallow 31, 27 or 21 weeks before sowing in Trial 1.

Herbicide	Rate (kg/ha)	Application time(weeks before sowing) 31	27	21
		Grain Yield (t/ha)		
Untreated			1.56	
Clopyralid	2.5	1.56	1.71	1.38
Picloram + 2,4-D	0.55+2.2	0.97	1.04	0.96
Dicamba	2.2	1.79	-	1.84
Dicamba	4.4	1.60	1.38	1.19

l.s.d.(P=0.05): 0.34; (P=0.01): 0.45

Trial 2. The yield of Weeah barley was not affected by clopyralid at either 1.2 or 2.4 kg/ha applied on the fallow as close as 7.5 weeks before sowing, or at the 3-leaf stage of the crop 3.5 weeks after sowing (Table 3). However, the in-crop application at 2.4 kg/ha visibly affected the crop and decreased its height.

Trial 3. Condor wheat yield was not affected by clopyralid at 1.2 kg/ha applied 7.5 weeks before sowing (Table 3). Application 3.5 weeks after sowing when the crop was at the 2-leaf stage, resulted in a 7% reduction which was not significant (P=0.05). At 2.4 kg/ha, the in-crop application significantly (P=0.01) reduced yield by 39%. While the l.s.d. indicated that the pre-sowing applications at 2.4 kg/ha did not significantly reduce yield, the applications 13 and 7.5 weeks before sowing both resulted in yield reductions relative to the untreated of 15%, which approached significance (P=0.05). A reduction of at least 18% would have been needed before being detected as significant.

Table 3. Grain yield(t/ha) of barley cv. Weeah and wheat cv. Condor following application of clopyralid on the fallow 22 to 7.5 weeks before sowing and 3.5 weeks after sowing.

Application time (weeks from sowing)	Trial 2 (Barley) Clopyralid (kg/ha) 0	1.2	2.4	Trial 3 (wheat) Clopyralid(kg/ha) 0	1.2	2.4
	2.62			3.13		
20(22[a])		2.84	2.71		3.21	2.96
13.5		2.80	2.83		3.25	2.66
7.5		2.72	2.85		3.30	2.65
-3.5[b]		2.84	2.90		2.91	1.91
l.s.d.(P=0.05)		N.S.			0.56	
(P=0.01)					0.75	

[a] Trial 2 [b] (-) = after sowing

The results of Trial 3 show both a trend for lower yields as application of 2.4 kg/ha is made closer to sowing, and significant yield differences between the two rates at each of the last three application times. Linear or quadratic regressions of yield (or % yield reduction) against time between application and sowing indicate that this period significantly affects yield. For example, the linear regression for yield (in t/ha) is y= 2.236 + 0.043W (where W=weeks before sowing) (R^2=0.66, P <0.05). However yield does not continue to increase (linear regression), or increase and then decline (quatratic regression) as application time before sowing increases, so these regressions cannot predict yield responses to application times outside those used in the trial. A better regression is one which is a quadratic at application times nearer to sowing and then at some time more distant from sowing becomes a horizontal line as yield is unaffected by application time. Such a segmented model (1) gives the relationship yield (in t/ha) = 2.16 + 0.06W - $0.001W^2$ (R^2=0.58) with yield being constant (at 2.95 t/ha) at application times of 25 weeks or more before sowing. Thus this regression indicates that clopyralid at 2.4 kg/ha results in yield reductions if applied closer than 25 weeks to sowing This outcome appears similar to the result in Trial 1, where 2.5 kg/ha applied 21 weeks before sowing gave a yield reduction (which was not detected as being significant at P=0.05) of 11.5%.

The cultivars of wheat, and barley tested in these trials had a good level of tolerance to clopyralid. However differences between wheat cultivars in their tolerance has been shown in Canada (4), so these results may not apply to all cultivars. The greater tolerance of barley agrees with results obtained in Canada (2, 3, 4).

Apart from soil type and very low temperatures, the main factor affecting the persistence of clopyralid in the soil is rainfall. In Trial 1 rainfall (recorded 10 km from the trial site) in the 21-week period between the last application and sowing was 161mm, which was 120% of the long term mean. The possibility of damage was therefore less than in a normal year. In Trials 2 and 3, rainfall (recorded 12-15 km from the trial sites) between each of the applications and sowing was 169mm (20, 22 weeks), 158mm (13.5 weeks) and 41mm (7.5 weeks). These were 141%, 192% and 84% respectively of the long term means. Since clopyralid at 2.4kg/ha had no adverse effect on the yield of barley in these seasonal conditions when applied 7.5 weeks before sowing, it seems unlikely that 1.2kg/ha (the maximum rate recommended for use on fallows) applied with this interval would effect barley on similar soils to these, even in drier years. Wheat is less tolerant than barley, and while under `normal' rainfall an application of clopyralid at 1.2 kg/ha 7.5 weeks before sowing would appear to be safe, under drier conditions it is possible that this interval would be too short to prevent some yield reduction.

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