CONTROL OF CREEPING KNAPWEED ON CEREAL FALLOWS

G.H. PRITCHARD

Keith Turnbull Research Institute
Department of Conservation, Forests and Lands
P.O. Box 48
Frankston, Victoria. 3199

Summary. The results of 14 herbicide trials which commenced between 1978 and 1982 are summarised. Application was made during spring and summer to creeping knapweed *(Acroptilon repens* syn. *Centaurea repens)* growing on cultivated fallow on predominately sandy loam soils in north-western Victoria.

Mean control one year after application with 3,6-dichloropicolinic acid ranged from 96% at 0.6 kg ha^{-1} to 100% at 1.4 kg ha^{-1}. Picloram/2,4-D amine[1] gave means from 80% at 0.28/1.1 kg ha^{-1} to 99.7% at 1.1/4.4 kg ha^{-1}, and mean control with dicamba ranged from 95% at 2.2 kg ha^{-1} to 99% at 8.8 kg ha^{-1}. Glyphosate at 3.6 kg ha^{-1} and two applications at 3.6 kg ha^{-1} gave means of 52% and 56% control respectively. The high levels of control exercised by the better treatments were maintained in the second year. Time of application, spray volume, seasonal conditions, or splitting treatments into two equal applications a few months apart did not affect control. However, there was an indication that control was reduced on heavier soils.

Yields of wheat or barley, sown 2½ to 7 months after application, were measured in five trials. Mean yield increases over untreated controls were 23% for picloram/2,4-D at 0.55/2.2 kg ha^{-1}, 33% for 3,6-dichloropicolinic acid at 1.2 to 1.4 kg ha^{-1} and 36% for dicamba at 4.4 kg ha^{-1}.

INTRODUCTION

Creeping knapweed, or hardheads as it is known in Victoria, is an introduced herbaceous perennial composite. A native of the area around the Caspian Sea in southern USSR, and Iran, Asia Minor and Mongolia (Moore and Frankton, 1974), it was considered naturalized in Victoria by 1907 (Parsons, 1973). It is a weed of irrigated horticulture along the Murray River in north-western Victoria and of dryland areas mainly in the Eastern Mallee, where it competes severely with cereal crops.

The root system of deep vertical and creeping horizontal roots produces new shoots each spring. After flowering and seeding in summer, the topgrowth dies off in late summer or autumn. Cultivation at any time, except in the winter months, stimulates new shoot growth from the root system, and by dragging root pieces, may extend the infestation.

This paper summarises the results of 14 herbicide trials set up between 1978 and 1982, in which application was made, mostly in summer, to the weed on the fallow. In many of the trials wheat or barley was then sown in the following autumn.

MATERIALS AND METHODS

The trials were laid down on cereal farms in the Swan Hill area of north-west Victoria. All trials were arranged as randomized blocks with at least four replications. Plot size ranged from 4 m by 5 m (1 trial) to 4 m by 10 to 13 m (13 trials). When treated, the weed was regrowing on cultivated fallow, and was

---
[1] As 'Tordon 50-D'

mostly at the rosette to pre-budding stage. Applications were made between October and May, although most were between November and January. In nine of the trials there were comparisons of two or more application times. The mean density of creeping knapweed shoots at application in the various trials ranged from 11.4 to 65.3 m^{-2}, with most trials having a density between 20 and 40 shoots m^{-2}. Applications were made with a hand-held boom connected to an LP gas-operated precision sprayer. Nozzles used were flat fan jets (most trials) or hollow cones, and application volumes ranged from 120 to 290 L ha^{-1}, most being between 200 and 250 L ha^{-1}. Soil types were sandy loams except in two trials which had clay loams.

Weed control assessments were made about one year after application (at harvest in the cropping trials) and five trials were assessed again after a further year. Assessments were made by counting shoot numbers usually in three or four quadrats of 1 m^2 per plot. Crop yield (wheat or barley) was measured in three trials in 1981, and two in 1983. An area of 8.0 to 14.3 m^2 was harvested in the central part of each plot with a small-plot harvester. The crops in these trials were sown 2½ to 7 months after application.

RESULTS

The control results from the 14 trials are summarised in Table 1. Neither time of application, nor spray volume significantly affected the control obtained, so all results from each application rate have been grouped. In a few instances a treatment was applied as a split application, half being applied initially and half a few months later. Since the resulting control was not significantly different from that given by a single dose at the total rate, these treatments have been included in the table at the total rate.

With 3,6-dichloropicolinic acid, mean control one year after application was 97% at 0.6 kg ha^{-1} (12 tests in seven trials) 99.6% at 1.2 kg ha^{-1} (16 tests in eight trials) and 100% at 1.4 kg ha^{-1} (three tests in three trials). Picloram/2,4-D amine one year after application gave mean controls of 80% at 0.28/1.1 kg ha^{-1} (five tests in four trials), 98% at 0.55/2.2 kg ha^{-1} (18 tests in nine trials) and 99.7% at 1.1/4/4 kg ha^{-1} (two tests in two trials). With dicamba control ranged from a mean of 93% at 2.2 kg ha^{-1} (four tests in three trials) to 99% at 8.8 kg ha^{-1} (one test). Glyphosate gave means of 0%, 53% and 56% control one year after application of 1.8, 3.6 and 3.6 plus 3.6 kg ha^{-1} respectively.

The better treatments showed very little decline in control in the second year. For example, two years after application 3,6-dichloropicolinic acid at 1.2 kg ha^{-1} gave a mean of 99.9% control from 10 tests in six trials, and picloram/2,4-D amine at 0.55/2.2 kg ha^{-1} gave a mean of 94% control from 11 tests in four trials.

The crop yield from seven tests in three trials with picloram/2,4-D amine at 0.55/2.2 kg ha^{-1} was a mean of 123% (range 91 to 170%) of the yield from untreated plots. The mean yield from nine tests in five trials with 3,6-dichloropicolinic acid at 1.2 or 1.4 kg ha^{-1} was 133% (range 98 to 209%) of the control yield, while with dicamba at 4.4 kg ha^{-1} the mean yield from five tests in three trials was 136% (range 83 to 177%). Crop yield following glyphosate application at 3.6 kg ha^{-1} was measured in only one trial, and was 137% of the yield from untreated plots.

The larger yield increases occurred with denser infestations of creeping knapweed and in the 1981 harvest which had relatively less favourable seasonal conditions than in 1983. Earliness of application (October/November compared with February/March) was of lesser importance.

Table 1. Control of creeping knapweed one and two years after application.

Herbicide	Rate (kg ha^{-1})	Year 1 No. of Tests[2]	Year 1 Control[1] (%) Mean	Year 1 Control[1] (%) Range	Year 2 No. of Tests	Year 2 Control (%) Mean	Year 2 Control (%) Range
Picloram/2,4-D amine[3]	0.28/1.1	5[4]	80	24-100	1	86	-
Picloram/2,4-D amine	0.55/2.2	18[5]	98	75-100	11	94	74-100
Picloram/2,4-D amine	1.1/4.4	2	99.7	99-100	1	100	-
3,6-dichloropicolinic acid	0.6	12	97	81-100	3	99.8	99.5-100
3,6-dichloropicolinic acid	0.9	8[6]	98	92-100	4	100	-
3,6-dichloropicolinic acid	1.2	16	99.6	98-100	10	99.9	99.9-100
3,6-dichloropicolinic acid	1.4	3	100	-	3	99.8	99.5-100
Dicamba	2.0-2.2	4	95	89-99.7			
Dicamba	4.0-4.4	15	96	70-100	9	88	43-100
Dicamba	8.8	1	99	-			
Glyphosate	1.8	1	0	-			
Glyphosate	3.6	4	53	29-86	1	38	-
Glyphosate	3.6+3.6	2	56	53-58	1	57	-

1 Percent reduction in shoot density relative to untreated plots.
2 Where the same rate is compared at different application times in the one trial, each application is included in the Table as a separate test.
3 As 'Tordon 50-D'.
4 Includes 2 tests at 0.25/1.0 kg ha^{-1}.
5 Includes 2 tests at 0.5/2.0 kg ha^{-1}.
6 Includes 1 test at 1.0 kg ha^{-1}.

DISCUSSION

The current recommendation in Victoria for creeping knapweed control in dryland cereal areas are 3,6-dichloropicolinic acid at 1.2 kg ha^{-1}, picloram/2,4-D amine at 0.55/2.2 kg ha^{-1} and dicamba at 4.4 kg ha^{-1} (Anon., 1983). Over a wide range of seasonal conditions, the only poor results with these rates of picloram/2,4-D amine or dicamba was in one of the two trials which were on clay loam soils. Picloram/2,4-D amine at two application times and as a split application gave control after one year which was equivalent to that on lighter soils, but control deteriorated in the second year to a mean of 80%. With dicamba, control was only 75% (mean of two application times) after one year, and 48% after two years. In the same trial, 3,6-dichloropicolinic acid at 1.4 kg ha^{-1} gave excellent control equivalent to that on lighter soils. These results alone would not be sufficient to conclude that control is adversely affected by heavier soil types. However, similarly indifferent control from 3,6-dichloropicolinic acid, as well as picloram/2,4-D amine and dicamba has sometimes been obtained in other trials, not reported here, on clay loam soils.

The present results indicate that high levels of control for at least one year can be obtained with lower rates of all three herbicides, although there was some increase in the variability of the control obtained. The most reliable of the three herbicides at lower rates was 3,6-dichloropicolinic acid. At 0.6 kg ha^{-1} only one out of 12 tests in seven trials (all on sandy loam soils) gave less than

94% control after one year. The poor result, 81% control, was from an application made after sheep had completely eaten all the topgrowth of the weed. The three tests at 0.6 kg ha^{-1} which were assessed after two years (comparisons of time at application in the one trial), gave 99 to 100% control.

Direct comparisons were made of times of application (two to four per trial) of picloram/2,4-D amine and 3,6-dichloropicolinic acid in six trials, and of dicamba in five trials. Application times ranged from late October to mid-May. Because applications were to regrowth on cultivated fallows, the weed was mostly at the rosette to early bolting growth stage. However, budding and flowering shoots were present at some applications. On four occasions in three trials in the 1981-82 summer, 3,6-dichloropicolinic acid was applied in the absence of any topgrowth. Although at 1.2 kg ha^{-1} there was no reduction in the control obtained, at 0.6 kg ha^{-1} in one trial control was less than when application was to growing shoots. With this one exception, to which the drought conditions may also have contributed, the time of application of all three herbicides between late October and mid-May did not significantly effect the level of control as measured in the summer following application.

Yields lower than the untreated controls in these trials were associated with the later applications of picloram/2,4-D amine and dicamba. Results to be reported elsewhere indicate that at the times and rates used, 3,6-dichloropicolinic acid does not cause yield reductions. However, it would be expected that the earlier on the fallow that the weed is removed, the greater will be the yield benefit. With 3,6-dichloropicolinic acid the greatest yield benefit from earlier over later application was in a trial in which application in October of 0.9 or 1.2 kg ha^{-1} yielded 9% higher (not significant at 5% level) than a February application. This result was with only a moderate density of creeping knapweed and with the excellent growing conditions which preceded the 1983 harvest. Both factors would tend to reduce any potential benefit of earlier application. However, even with high shoot densities in a 1981 trial, a November application at 1.4 kg ha^{-1} did not out-yield a January application. Thus, when herbicide toxicity is not a factor, earliness of application, at least in years of above average rainfall, appears to be less important for subsequent yield than the density of the creeping knapweed infestation.

In previous work (Pritchard and Shaw, 1981) a cultivation 16½ months after application resulted in a greater deterioration of control from several treatments, including picloram/2,4-D amine, than in an adjacent trial which was not cultivated. In the present series of trials, cultivation was carried out both before and after application. Following application there was usually a cultivation within four to eight weeks. Although no treatments in these trials were left uncultivated, the high level of control obtained suggests that cultivation did not impair the results. For example, with picloram/2,4-D amine, out of 18 tests at 0.55/2.2 kg ha^{-1} nine were giving complete control after one year and five out of 11 tests were giving complete control after two years.

ACKNOWLEDGEMENTS

This work was supported by a grant from the Wheat Industry Research Council. Mr. P. Luke assisted with the field work.

LITERATURE CITED

Anon. 1983. Recommendations for the Control of Noxious Weeds in Victoria. Bulletin No. 3F, Department of Crown Lands and Survey.

Moore, R.J. and C. Frankton. 1974. The Thistles of Canada. Research Branch, Canada Department of Agriculture, Monograph No. 10.

Parsons, W.T. 1973. Noxious Weeds of Victoria. Inkata Press, Melbourne.

Pritchard, G.H. and K.A. Shaw. 1981. Proc. 6th Aust. Weeds Conf. Vol. 1, p.15-19.