YELLOW GROMWELL CONTROL WITH HERBICIDES IN WHEAT

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SUMMARY

The efficacy of several herbicides for the control of yellow gromwell *(Amsinckia calycina)* in wheat *(Triticum aestivum)* was assessed in five experiments conducted in Canterbury during 1979 and 1980. Yield losses as a result of competition from yellow gromwell, as high as 63% and 44% occurred in 1979 and 1980 respectively. Higher yields were obtained with herbicides containing bromoxynil and with chlorsulfuron than with prometryn, methabenzthiazuron and linuron. Early application of the herbicides, when the yellow gromwell was in the cotyledon to early rosette stage, resulted in wheat yields 27% higher than late applications, when plants were beginning to form flower stems.

INTRODUCTION

Yellow gromwell is a troublesome arable weed in many parts of the world including Australia (Meadly 1968; Welsh 1968; Wells 1979), U.S.A. (Schafer and Chilcote 1970), and England (Chancellor 1975). It has been present in New Zealand since 1831 but restricted for much of this time to the Hawea Flats area. It has been present in Canterbury for 30 or 40 years and until recently, apparently on only a few properties. Unreliable control by herbicides, and an'explosion' on to numerous other arable farms has led to concern about the plant's potential as a weed of cropping land. Experiments to find suitable herbicidal control were conducted in 1979 and 1980. Treatments were based on Australian recommendations (Anon 1977) and the results are reported in this paper.

METHOD

Five experiments (three in 1979 and two in 1980) were conducted in Canterbury wheat crops in which yellow gromwell was the major weed species. Trial details are given in Table 1 and herbicides used listed in Tables 2 and 3.

All experiments except at Southbridge were split-plot designs with time of application as main plots and herbicide treatments as sub-plots. The Southbridge experiment was a randomised complete block design and all experiments had two replicates. The plot size was 2 x 15 m and herbicide treatments were applied at each of two dates, 'early' and 'late' (Table 1), in 200 litres/ha with a modified Oxford Precision sprayer with Teejet 8002 nozzles at 200 kPa.

The density of yellow gromwell was recorded from five randomly placed 0.1 m^2 quadrat/plot c. 4 weeks after spraying. Machine dressed wheat yields, corrected to 15% moisture, were obtained from a 1.5 m wide swath/plot harvested by a Wintersteiger Seedmaster.

Two combined analyses using the means from the three 1979 experiments and the two 1980 experiments were carried out. For the 1979 data, each treatment factor (application time, herbicide) was tested against the interaction between that treatment factor and experiments while the interaction between time of application and herbicide was tested against the experiment x time of application x herbicide interaction. Yellow gromwell counts were transformed to square roots before analysis.

Linear regressions of wheat yield against yellow gromwell density in the treatments, excluding yields from untreated plots, were calculated for both years. The square root transformation was not used for this analysis.

TABLE 1: Localities, application dates, sowing times, crop growth stages and yellow gromwell growth stages and densities for the five wheat trials.

Locality	Date of application		Growth stage of wheat		Growth stage of yellow gromwell†		No. yellow gromwell /m²
	early	late	early	late	early	late	(untreated)
Southbridge	12.9.79	17.10.79	2½ leaf	1st node	c-15 leaf	stems elongating	564
Maronan	20.7.79	5.10.79	5 leaf	1st node	c	5 cm to flowering	222
Dorie*	5.10.79	12.11.79	2½ leaf	3rd node	c-10 leaf	c-20 cm	163
Blackbridge	11.9.80	11.10.80	3½ leaf	1st node	c-12 leaf	stems elongating	67
Highbank	11.9.80	11.10.80	2½ leaf	6½ leaf	c-10 leaf	c-30 leaf	325

* Sown spring, all other sites sown autumn
† c = cotyledons

RESULTS

1979 Experiments

Wheat yield

The wheat yield was increased markedly by all treatments and overall, 'early' applications gave yields 27% higher than 'late' applications (Table 2). Since there was no interaction between time of spraying and herbicide, means of both times of application are given for herbicide comparisons. Averaged over both times of spraying chlorsulfuron gave the highest yield but all other treatments except prometryn (0.4 kg/ha), methabenzthiazuron (1.4 kg/ha) and linuron (0.8 kg/ha) returned yields which

TABLE 2: The effect of herbicides on wheat yield and density of yellow gromwell (combined analysis of three experiments in 1979).

Treatment	Rate (kg/ha)	Wheat yield (t/ha)	Yellow gromwell denisty† (plants/m²)
MCPA + bromoxynil	0.4 + 0.4	3.79	10.3 (106)
MCPA + bromoxynil	0.6 + 0.6	3.67	8.2 (67)
prometryn	0.4	3.30	9.5 (90)
prometryn	0.8	3.43	4.0 (16)
mecoprop + ioxynil + bromoxynil	1.125 + 0.225 + 0.225	3.68	8.5 (72)
MCPA + bromoxynil + 3,6-DCPA	0.9 + 0.3 + 0.09	3.71	9.8 (96)
methabenzthiazuron	1.4	3.23	8.6 (74)
linuron	0.8	2.77	9.2 (85)
chlorsulfuron	0.08	3.86	12.4 (154)
LSD (5%) herbicide main effect		0.46	3.8
early application		3.91	9.1 (83)
late application		3.08	8.8 (77)
LSD (5%) application time main effect		0.46	11.4
untreated		1.70	16.7 (280)

† Analysis on square roots; back-transformed means in brackets
3,6-DCPA = 3,6-dichloropicolinic acid

were not significantly lower. Increaseing the rates of MCPA + bromoxynil and prometryn did not significantly alter the yield. The highest yield of all of 4.56 t/ha was obtained from the 'early' application of chlorsulfuron. Since the untreated wheat yielded 1.70 t/ha, a loss of 2.86 t/ha (63%) was prevented by this treatment.

Yellow gromwell density

Yellow gromwell density was reduced substatially by the treatments but overall, time of application did not have a significant effect and did not interact with herbicide (Table 2). Prometryn (0.8 hg/ha) gave best control of yellow gromwell while chlorsulfuron was least effective. The linear regression analysis of wheat yield against yellow gromwell density, (excluding untreated) showed there was no relationship between these variables.

TABLE 3: The effect of herbicides on wheat yield and density of yellow gromwell (combined analysis of two trials in 1980).

Treatment	Rate (kg/ha)	Wheat yield (t/ha)	Yellow gromwell denisty† (plants/m^2)
MCPA + bromoxynil	0.4 + 0.4	4.30	3.1 (10)
MCPA + bromoxynil	0.6 + 0.6	4.10	2.4 (6)
prometryn	0.4	3.48	6.1 (37)
prometryn	0.8	3.58	5.6 (31)
chlorsulfuron (+ citowett 0.02 v/v)	0.025	4.07	5.9 (35)
chlorsulfuron (+ citowett 0.02 v/v)	0.05	3.89	4.6 (21)
LSD (5%) herbicide main effect		0.56	3.1
early application		4.35	3.7 (14)
late application		3.46	5.5 (30)
LSD (5%) application time main effect		2.35	16.9
untreated		2.64	12.8 (164)

† Analysis on square roots; back-transformed means in brackets

1980 Experiments

Wheat yield

The yield of wheat was increased by all treatments and overall, the 'early' applications resulted in yields 26% higher than 'late' applications (Table 3). This difference however was not statistically significant. As in 1979, there was no interaction between time of spraying and herbicide; means for both times are therefore given. MCPA + bromoxynil and the low rate of chlorsulfuron gave the highest wheat yields. Prometryn was inferior to MCPA + bromoxynil at the lower rate. There was no difference between rates for any herbicide. The highest yield of 4.7 t/ha resulted from MCPA + bromoxynil at low rate applied early. This treatment prevented a yield loss of 2.06 t/ha (44%) relative to untreated.

Yellow gromwell density

Yellow gromwell density was reduced by herbicide treatment but overall, time of application had no effect (Table 3). However there was a significant time x herbicide interaction caused by MCPA + bromoxynil giving lower densities when applied 'late' (both rates $<$ 1 plant/m^2) than when applied 'early' (30 and 15 plants/m^2 low and high rate respectively), while prometryn and chlorsulfuron tended to result in lower densities when applied 'early'. The most effective treatment was MCPA + bromoxynil at the high rate which was significantly better than prometryn and the low rate of chlorsulfuron. There was no relationship between wheat yield and yellow gromwell density, with the range of densities induced by the treatments.

DISCUSSION

Yellow gromwell was highly competitive with wheat in these experiments since its control resulted in yield increases of up to 63%. In north western Victoria, where *Amsinckia* species are also a significant weed problem, losses in wheat yields of > 20% (Lumb 1968) and 30-35% (Welsh 1965) have been reported.

Chlorsulfuron and herbicides containing bromoxynil were better than prometryn, methabenzthiazuron and linuron for preventing wheat yield loss. However the herbicides giving the highest wheat yields did not necessarily result in the lowest densities of yellow gromwell and no correlation between weed density and crop yield could be demonstrated. Assuming that within the herbicide treatments, the higher the wheat yield the greater the reduction in the competitiveness of yellow gromwell, it is apparent that the density of yellow gromwell following herbicide treatment, was not a suitable measure of the effect of the treatments on the weeds competitiveness. This may be related to differing vigour of the plants surviving the various treatments. A better measure of yellow gromwell 'control' than population density following treatment is needed. For the purposes of relating 'control' to crop yield, a visual score of the vigour of the weed may be sufficient. However if the objective is to determine the best treatment for reducing the weed population over time, then seed production per unit area would be a more suitable measure of 'control'.

The need for 'early application of herbicides for maximum yield response in wheat infested with yellow gromwell has been commented on by Mears and Boersma (1969) and Lumb (1968). *Amsinckia* species appear to be most susceptible to bromoxynil and prometryn when in the early rosette stage (Foy and Gibson 1964; Lumb 1968). Wheat yields in the 1979 experiments were 27% higher with 'early' applications to yellow gromwell at the cotyledonary and young rosette stage than with 'late' application to plants forming flower stems. This effect was probably due to both the greater susceptibility of the younger plants and the earlier removal of competition, and clearly demonstrates the importance of early herbicide application.

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