Chemical weed control in chickpeas (*Cicer arietinum* L.)

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Summary

Experiments to investigate the most effective herbicides for use in chickpeas (*Cicer arietinum* L.), were conducted from 1979-83. No post-emergence application gave effective weed control without also causing crop damage. The following herbicides applied pre-emergence gave satisfactory results — trifluralin + triallate, cyanazine, methabenzthiazuron, metribuzin ± methabenzthiazuron, terbutryne and prometryne. Oxyfluorfen, propazine and simazine applied pre-emergence, and acifluorfen, bentazon, diuron, MCPA, methabenzthiazuron, metribuzin, metoxuron and prometryne applied post-emergence were unsuitable for use in chickpeas.

Introduction

In 1978, work commenced at the Victorian Crops Research Institute, Horsham to assess the commercial potential of chickpeas. It soon became apparent that since chickpeas are autumn sown and grown slowly in winter, they require a high degree of weed control to maximize yields. Experiments were therefore undertaken to establish an effective and economic chemical weed control strategy.

The main weeds of dryland crops in the Wimmera are: wild oats (*Avena fatua* L.), annual or Wimmera ryegrass (*Lolium rigidum* Gaudin), capeweed (*Arctotheca calendula* Levyns), corn gromwell (*Buglossoides arvensis* L.), fumitories (*Fumaria* spp.), deadnettle (*Lamium amplexicaule* L.), poppies (*Papaver* spp.), hogweeds (*Polygonum* spp.) and mustards (*Sisymbrium* spp.) (Wells and Lyons, 1979). Of these, the mustards have proved the most difficult to control selectively in chickpeas.

This paper describes the results of research on chemical weed control in chickpeas carried out at the Cereal Experimental Centre, Dooen, Victoria, between 1979 and 1983. The experiments initially included herbicides registered for use in other crops in Victoria at their recommended rates and times of application and herbicides tested in chickpeas overseas by Ahlawat *et al.*, 1979; Eshel *et al.*, 1979 and Kolar *et al.*, 1982. Herbicides were tested at different rates and application times in later years. Initial observations were restricted to crop tolerance, but as the number of herbicides was reduced, weed control was also assessed.

Methods

All experiments were located on an alkaline grey self mulching clay (Ug 5.24) (Northcote, 1979). The plots were 15 m × 2 m with the treatments arranged in randomized blocks in four replications.

Herbicides were applied through six Spraying Systems flat fan 'Teejet' nozzles on a hand held boom in 110 L ha^{-1} of water at 210 Kpa and any necessary incorporation was carried out with harrows. The first experiment (Experiment 1) was sown in 1979, Experiment 2 in 1980, Experiment 3 in 1981, and Experiments 4 and 5 in 1983. The 1982 experiment was very badly affected by drought and so is not included in this report.

The herbicides, their rate of active ingredient and time of application for Experiments 1-3 are shown below.

Experiment 1 (1979)

trifluralin (0.6)[a]
triallate (0.8)[a]
simazine (1, 1.5, 2)[a]
simazine + trifluralin (1 + 0.6)[a]
simazine + triallate (1 + 0.8)[a]

Experiment 2 (1980)

trifluralin + triallate (0.4 + 0.4)[a]
oxyfluorfen (0.36)[a]
acifluorfen (0.72)[a]
propham (4.1)[a]
propazine (1.75)[b]
diuron (0.30)[b]
prometryne (0.50)[c]
metribuzin + methabenzthiazuron (0.12 + 0.47)[c]
methabenzthiazuron (0.59)[c]
MCPA (0.33)[c]
acifluorfen (0.36)[c]
bentazon (0.96)[c]

Experiment 3 (1981)

trifluralin + triallate (0.4 + 0.4)[a]
oxyfluorfen (0.24, 0.36, 0.48)[a]
oxyfluorfen + trifluralin (0.48 + 0.4)[a]
oxyfluorfen + triallate (0.48 + 0.4)[a]
trifluralin + metribuzin + methabenzthiazuron (0.4 + 0.056 + 0.22)[a].
cyanazine (0.5)[b]
prometryne (1.0)[b]
metribuzin + methabenzthiazuron (0.14 + 0.56)[b]
barban (0.156)[c]
metribuzin (0.21)[c]
terbutryne (0.275)[c]
MCPA (0.33)[c]

Key: [a]Pre-sowing
[b]Post sowing pre-emergence
[c]Post-emergence (6 weeks after sowing)

Chickpeas (cv. CPI56296B) were inoculated and sown at 110 kg ha^{-1} with 100 kg ha^{-1} superphosphate. The plots were harvested using a Massey Ferguson plot harvester. In 1983 a weed seed mixture obtained from grain cleaning using a Federal seed cleaner at the previous harvest was sown to ensure a dense weed population.

In the first three experiments crop establishment was determined using five 0.2 m^2 quadrats 6 weeks after sowing for pre-emergence applications or 6 weeks after spraying for post-emergence applications. In 1983 the weed densities were measured at the same time as crop establishment using ten 0.25 m^2 quadrats per plot.

In Experiments 1-3 the control plots were unsprayed but in Experiments 4 and 5 there were also plots which were kept weed-free by hoeing and hand-pulling.

Results

Experiment 1 (1979)

The grain yields of the plots sprayed with trifluralin or triallate were similar to that of the unsprayed control, whereas all rates of simazine caused a reduction in yield. The two highest rates of simazine reduced crop density by 78% and 73%, which resulted in there being no harvestable crop. The low rate reduced crop density by 36% and yield by 46%.

Experiment 2 (1980)

A combination of trifluralin and triallate was the only treatment to yield significantly (P = 0.05) more than the unsprayed control.

Table 1 Effect of pre-emergent herbicides on chickpea establishment and yield in Experiment 4 (1983)

Herbicide	Rate (kg ha^{-1})	Plants m^{-2} 6 weeks after sowing	Grain yield (t ha^{-1})
trifluralin + triallate	0.4 + 0.4	68	2.38
oxyfluorfen	0.36	32	2.51
	0.24	43	2.60
	0.12	66	2.57
oxyfluorfen + trifluralin	0.24 + 0.4	28	2.35
oxyfluorfen + triallate	0.24 + 0.4	25	1.76
terbutryne	1.0	77	2.84
cyanazine	2.0	66	2.87
methabenzthiazuron	1.75	70	2.72
terbutryne + trifluralin	1.0 + 0.4	74	2.81
cyanazine + trifluralin	2.0 + 0.4	64	3.13
methabenzthiazuron + trifluralin	1.75 + 0.4	61	2.85
Bayer SSH 086	0.7	73	3.55
unsprayed		68	2.09
handweeded		75	3.23
LSD 0.5%		11	0.44

Propazine applied pre-emergence, post-emergence applications of prometryne, methabenzthiazuron alone or with metribuzin, acifluorfen and bentazon all caused yields to be significantly ($P = 0.05$) less than the control. Both bentazon and propazine caused significant ($P = 0.05$) reductions in plant stand.

Experiment 3 (1981)

None of the herbicides used in this trial either increased or decreased crop yield significantly, whilst a post-emergence application of metribuzin at the 4- to 6-leaf stage totally eliminated the crop. Oxyfluorfen alone and in combinations, trifluralin + metribuzin + methabenzthiazuron, cyanazine, barban, terbutryne and MCPA all significantly reduced crop plant stand but not yield.

Experiment 4

The application of trifluralin + triallate and of oxyfluorfen either alone or in mixtures resulted in crop yields similar to the unsprayed treatment (Table 1), but there was visible evidence of crop toxicity at the high rate of oxyfluorfen. The poor yield after using trifluralin + triallate compared to the previous experiments was probably due to the large population of mustard in the plots (Table 2). Yields after the pre-emergence application of terbutryne ± trifluralin, cyanazine ± trifluralin, methabenzthiazuron + trifluralin and Bayer SSH 086 were comparable to those of the weeded plots indicating a satisfactory combination of adequate weed control and insignificant crop toxicity.

Experiment 5

There were unusually large variations between the replicates in this trial, and as a consequence none of the differences in yield were significant (Table 3). Nonetheless, the yields of plots treated by a pre-emergence application of herbicides were close to those of the weeded plots, especially for methabenzthiazuron/metribuzin. These treatments also gave acceptable weed control in most cases (Table 4). None of the post-emergence applications of herbicide were satisfactory as all caused unacceptable crop damage and also failed to give effective weed control.

Discussion

The use of a mixture of trifluralin + triallate did not consistently lead to a significant yield increase. This reflects both the low weed densities in earlier trials and the presence of resistant weeds, particularly mustard, in the later trials. However, trifluralin + triallate successfully controlled deadnettle, hogweed, ryegrass and wild oats and the mixture is now registered for use in chickpeas in Victoria.

Bayer SSH 086 was the most effective herbicide tested in terms of both yield and weed control, but has been withdrawn and is unlikely to be available in the future.

Good control of mustard, deadnettle and hogweed was obtained by a post-sowing pre-emergence application of metribuzin alone or in combination with methabenzthiazuron, which resulted in at least 0.5 t ha^{-1} yield improvement over the unsprayed plots.

Mustard and deadnettle were also effectively controlled by cyanazine, methabenzthiazuron, terbutryne and prometryne, and since hogweed can be

Table 2 Effect of pre-emergence herbicides on weed density/m^2 (Experiment 4, 1983)

Herbicide	Ryegrass	Mustard	Deadnettle	Hogweed	Prickly lettuce	Ox-tongue	Wild cabbage	Fumitory
trifluralin + triallate		117.6	1 (97)	3.4 (94)	1.2	0.2	1	3.4
oxyfluorfen (0.36)		5.2 (95)	0.6 (98)	6.6 (88)				
(0.24)		12.2 (87)	0 (100)	10.8 (80)	0.2		0.2	2.4
(0.12)	0.2	41 (58)	2 (94)	23.6 (56)	0.4	0.4	0.2	0.8
oxyfluorfen + trifluralin		4.6 (95)	0 (100)	1 (98)				0.4
oxyfluorfen + triallate	0.2	3.6 (96)	0 (100)	4.4 (92)	0.8	0.4		0.4
terbutryne	1.2	16.4 (83)	9.8 (74)	62.4	0.8	1		0.2
cyanazine	0.2	17.8 (82)	7.2 (79)	27.2 (49)	0.6		0.2	1
methabenzthiazuron	1	19.2 (80)	10.8 (69)	38 (29)	2	0.2	0.2	3
terbutryne + trifluralin	0.4	52.4 (46)	4.6 (87)	7 (87)	2	0.2	0.4	0.8
cyanazine + trifluralin		27 (72)	1 (97)	10.2 (81)	1	0.2		0.6
methabenzthiazuron + trifluralin		17 (82)	6.7 (81)	1.6 (97)	6.4	0.8	0.4	0.6
Bayer SSH 086		0.4 (99.5)	0 (100)	1.2 (98)	0.2	0.2		
unsprayed	2.6	97.4	34.8	53.6	0.2	0.2	1	3.8

Figures in parentheses are percentage reduction – only calculated for the larger populations.

controlled using trifluralin, significant yield increases were obtained when these herbicides (excepting prometryne) were tested in combination with trifluralin.

These trials have shown that there are several herbicides available for use alone or in mixtures which have potential for effective weed control in chickpeas. These are methabenzthiazuron and metribuzin alone or in combination, and cyanazine, prometryne and terbutryne, all applied pre-emergence either pre- or post-sowing. The presowing applications allow a greater flexibility of operation and may be preferred by the growers. As the rates used in the experiments testing these herbicides were high, it is necessary to carry our further experiments to determine the most economic strategies and the effective dosage rates for future registration. The following herbicides have been shown to be unsuitable for use in chickpeas: pre-emergence use of oxyfluorfen, propazine and simazine, and post-emergence use of acifluorfen, bentazon, linuron, MCPA, methabenzthiazuron and metribuzin alone or mixed, metozuron and prometryne.

Table 3 Effect of herbicides applied post-sowing on chickpeas in Experiment 5 (1983)

Herbicide	Rate (kg ha^{-1})	Plants m^{-2} 6 weeks after sowing/spraying	Grain yield (t ha^{-1})
Pre-emergent			
metribuzin	0.28	63	2.81
methabenzthiazuron + metribuzin	0.42 + 0.105	66	3.05
prometryne	0.5	67	2.66
terbutryne	0.275	68	2.78
Post-emergent			
methabenzthiazuron	0.385	54	1.18
MCPA	0.121	75	2.40
	0.217	74	1.60
	0.338	66	1.38
metoxuron	2.24	Crop killed	–
linuron	2.24	Crop killed	–
handweeded		68	2.95
unsprayed		63	2.35
LSD 5%		13	0.80

Table 4 Effect of post-sowing herbicides on weed density/m^2 (Experiment 4, 1983)

Herbicide	Mustard	Deadnettle	Hogweed	Prickly lettuce	Ox-tongue	Wild cabbage	Fumitory
Pre-emergence							
metribuzin	0 (100)	1.6 (95)	3.8 (91)	0.8			0.2
methabenzthiazuron + metribuzin	1.6 (97)	2.8 (91)	8.2 (80)	1.4			0.8
prometryne	11.2 (80)	8.2 (74)	22.6 (46)	3.4	4.5		0.6
terbutryne	14 (75)	9.6 (70)	42.4	2.4	0.4	0.2	0.8
Post-emergence							
methabenzthiazuron	1.8 (97)	3.4 (89)	25 (40)	2.2	0.4	0.2	2.8
MCPA 0.121	12.2 (78)	32.2	32.6 (22)	1.8	1.8	1	4.4
0.217	8.6 (85)	24.2 (23)	22.4 (46)	0.4	0.6	0.4	2.2
0.338	1.8 (97)	20.8 (34)	20.6 (51)	1.4	0.2		0.6
unsprayed	56	31.6	41.8	4.6	1.4	0.6	4.6

Figures in parentheses are percentage reduction – only calculated for the larger populations.

Acknowledgements

The financial support for this work by the Victorian Wheat Industry Research Committee is gratefully acknowledged, as is the technical assistance of Mr D. Pye and the staff of the Cereal Experimental Centre, Mr R. Argall and Mrs J. Reading.

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