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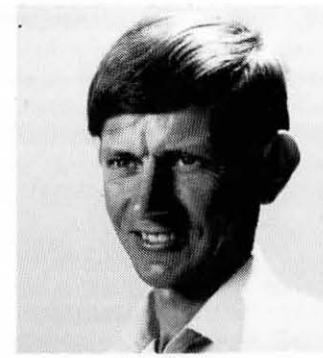

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Herbicide evaluation studies in sesame

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Summary

Pre-emergence and post-emergence herbicides were evaluated for their effects on sesame (*Sesamum indicum* L.) grown under weed free and weedy conditions in a series of experiments conducted in the Lockyer Valley, Queensland. Alachlor at 2.25 kg ha^{-1} was the most selective treatment, while trifluralin, chlorthal-dimethyl, linuron, pendimethalin, bifenox and prometryn all caused some degree of crop damage. Diphenamid did not significantly reduce yields. Bentazone, bromoxynil and methabenzthiazuron affected crop vigour, but only bentazone reduced grain yield significantly.

Introduction

Sesame (*Sesamum indicum* L.) is mainly grown in countries where abundant and inexpensive labour is available. There is at present no commercial production of sesame in Australia, but investigations are being carried out in Queensland to determine whether the crop can be adapted to mechanized production.

Recent studies have shown that a row spacing of 33 cm should result in a higher grain yield than spacings of 66 cm or wider (Schrodter, unpublished report). Inter-row cultivation for weed control is impracticable at this narrow spacing, and since the young sesame plants grow slowly and compete poorly with weeds, successful production will require development of effective herbicide treatments.

Chemical weed control in sesame crops has been studied in several countries. In experiments under irrigated conditions in Ethiopia (Anon., 1973) prometryn at 1 kg ha^{-1} and alachlor at 1.6 to 2.75 kg ha^{-1} applied pre-emergence were safe to use on the crop. Prometryn at 1.85 kg ha^{-1} resulted in some crop damage. In a similar trial under natural rainfall prometryn at 2.2 kg ha^{-1} completely eliminated the crop. Highest yields of sesame were obtained with trifluralin at 0.75 to 1.4 kg ha^{-1} incorporated prior to planting and by alachlor at 2.9 kg ha^{-1} applied pre-emergence. In other studies in Ethiopia (Moore, 1974), pre-emergence application of prometryn gave excellent weed control with negligible crop damage at 3.2 kg ha^{-1} under irrigated conditions, but in a rain-grown crop caused 100% mortality at 0.8 kg ha^{-1}. Alachlor applied pre-emergence was the most selective treatment.

In the U.S.A. Santelmann *et al.* (1963) observed that diphenamid at 3.3 to 6.7 kg ha^{-1} and EPTC at 2.2 to 4.4 kg ha^{-1} were safe when applied one day after planting. Slight phytotoxicity was evident with chlorthal-dimethyl at 4.5 to 9.0 kg ha^{-1} and linuron at 1.1 to 2.2 kg ha^{-1}. Yields were reduced by chlorthal-dimethyl at 13.5 kg ha^{-1} and by linuron at 4.4 kg ha^{-1}.

In an experiment in India diphenamid at 4.5 kg ha^{-1} or alachlor at 2.2 kg ha^{-1} applied to previously hand weeded plots gave the highest yield (Guar and Tomar, 1978).

The purpose of the experiments reported here was to investigate the performance of a range of herbicide treatments in sesame crops grown under the normal production system for oilseed crops in Australia. The selection of herbicides was based on their performance in the studies reviewed above, their known effectiveness in controlling weeds under local conditions and their availability or potential availability as registered products for use in other crops in Queensland.

Materials and methods

Four experiments were conducted during 1978–79 and 1979–80 at Gatton Research Station in southern Queensland (27°33′S, 152°20′E; altitude 104 m). The soil was a black earth classified as Ug 5.15–Ug 5.16 (Powell, 1982) under the Northcote system (Northcote, 1979). The sesame crops in which the experiments were carried out were planted into dry soil and irrigated later the same day with an overhead sprinkler system. Further irrigations by sprinkler were made during the season to maintain active growth. Cultivar 60/1B was planted in Experiments 1 and 2 and cultivar Palmetto in Experiments 3 and 4.

The herbicides used in the experiments are listed in Table 1.

Experiment 1 was planted on 24 October 1978. The herbicides applied were trifluralin (incorporated before planting) and alachlor, chlorthal-dimethyl and linuron (all post-planting pre-emergence); there were two rates for each herbicide (Table 2). Trifluralin and chlorthal-dimethyl caused severe visible damage. Therefore Experiment 2 (planted on 11 January 1979) was based on alachlor, linuron and pendimethalin, all post-planting pre-emergence and applied at two rates (Table 2).

Experiments 3 and 4 were both planted on 12 December 1979. Experiment 3 was intended to provide more information on alachlor and linuron, which had given promising results in Experiments 1 and 2, and on benta-

Table 1 Common names and commercial products of herbicides used in evaluation studies on sesame

Common name	Commercial product	Percentage active ingredient in product
alachlor	Lasso	500 g L^{-1}
bentazone	BASF Basagran post-emergence herbicide	480 g L^{-1}
bifenox	Modown	400 g L^{-1}
bromoxynil	Brominil emulsifiable concentrate selective herbicide	200 g L^{-1}
chlorthal-dimethyl	Dacthal W75 pre-emergence herbicide	750 g kg^{-1}
diphenamid	Enide 50 W	500 g kg^{-1}
diquat	ICI Reglone	200 g L^{-1}
linuron	Du Pont Linuron 50	500 g kg^{-1}
methabenzthiazuron	Tribunil herbicide spray	700 g kg^{-1}
pendimethalin	Stomp 330 E herbicide	330 g L^{-1}
prometryn	Gesagard 50 wettable powder selective herbicide	500 g kg^{-1}
trifluralin	Elanco Treflan selective herbicide	400 g L^{-1}

Table 2 Effect of herbicides on sesame in Experiments 1 and 2

Treatment	Rate (kg ha^{-1} a.i.)	Experiment 1 Number of plants (1000's ha^{-1})	Experiment 1 Yield of grain (kg ha^{-1})	Experiment 2 Number of plants (1000's ha^{-1})	Experiment 2 Yield of grain (kg ha^{-1})	Height of plants (cm)
trifluralin	0.84	24 d[1]	221 bc			
	1.68	13 d	113 cd			
alachlor	2.25	38 ad	133 bd	289 ab	403 b	19 ab
	4.5	56 ab	295 ab	307 ab	460 a	17 bc
chlorthal-dimethyl	7.5	34 ad	147 bd			
	15.0	29 bcd	102 cd			
linuron	1.1	62 a	144 bd	293 ab	414 ab	19 ab
	2.25			278 ab	425 ab	16 c
pendimethalin	1.5			172 c	118 c	6 d
	3.0			102 d	22 d	4 d
weed free control	–	59 a	431 a	251 b	385 b	18 abc
weedy control	–	52 ac	55 d	322 a	431 ab	20 a

[1] Means not followed by a common letter differ significantly ($P < 0.05$)

Table 3 Effect of herbicides on sesame in Experiment 3

Treatment	Rate (kg ha^{-1} a.i.)	Number of plants Transformed means[1]	Number of plants Equivalent means (thousands ha^{-1})	Yield of grain (kg ha^{-1})	Plant vigour rating[2]
alachlor (weedy)	2.25	11.0 a[3]	230	1051 a	4.8 a
alachlor (weed free)	2.25	11.1 a	233	953 a	4.8 a
linuron (weedy)	2.25	5.9 bc	65	634 bc	2.8 c
linuron (weed free)	2.25	8.1 b	122	875 ab	3.5 b
bentazone (weedy)	0.96	6.8 bc	85	210 e	1.5 d
bentazone (weed free)	0.96	6.0 bc	66	545 cd	1.5 d
bentazone (weed free)	1.92	2.0 d	7	174 e	0.3 e
alachlor + bentazone (weedy)	2.25 + 0.96	5.1 c	49	327 de	1.5 d
linuron + bentazone (weedy)	2.25 + 0.96	2.0 d	7	83 e	0.8 e
weed free control	–	12.9 a	314	1075 a	5.0 a
weedy control	–	11.7 a	259	579 c	4.9 a

[1] Square root (x + 0.5) transformation used
[2] Plant vigour rating (scale 0-5)
5 = all plants healthy, uniform growth
4 = all plants healthy, some small plants
3 = light to moderate stunting and leaf scorching
2 = some plants dead, others with moderate to severe stunting and leaf scorching
1 = many plants dead, surviving plants showing severe stunting and leaf scorching
0½ majority of plants dead, surviving plants showing severe stunting and complete loss of leaf
[3] Means not followed by a common letter differ significantly ($P < 0.05$)

zone (post-emergence) which had appeared safe to use on sesame in an observation plot grown the previous year. The three herbicides were studied both under weed free conditions and in the presence of surviving weeds; the treatments included applications of bentazone following alachlor or linuron (Table 3). Bifenox, diphenamid and prometryn (post-planting pre-emergence) and two rates each of bromoxynil and methabenzthiazuron (post-emergence) were applied in Experiment 4 (Table 4).

All experiments included weedy control and weed free control treatments; the latter were hand weeded throughout the growing period of the crop.

Herbicides were applied by means of an Oxford Precision Sprayer delivering a liquid volume of 440 L ha^{-1} at a pressure of 206 kPa. The pre-planting incorporated trifluralin treatments in Experiment 1 and the post-planting pre-emergence treatments in all experiments were applied on the day of planting before the first irrigation. The applications of bentazone in Experiment 3 and methabenzthiazuron in Experiment 4 were made on 2 January 1980, 21 days after planting when the third pair of true leaves had developed on the sesame plants.

The plots in Experiment 1 were each four rows 71 cm apart and 10 m long with datum area of 8 m in the two middle rows. In the other experiments plots were three rows 66 cm apart and 10 m long with measurements made on the middle row. The experimental designs were randomized blocks with four replicates in Experiments 1, 2 and 3 and three replicates in Experiment 4.

Plant population was recorded 38 days after planting in Experiment 1, 20 days after planting in Experiment 2 and 35 days after planting in Experiments 3 and 4. Grain yield was determined by cutting off the plants at ground level and placing them on trays to air dry for a few weeks before separating the grain in a stationary threshing machine. The height of plants in Experiment 2 was measured 29 days after planting on a sample of five plants selected at random within each plot. Ratings of plant vigour were estimated 29 days after planting in Experiments 3 and 4.

Results and discussion

Experiment 1 Plant populations (Table 2) were reduced by trifluralin at 0.84 kg ha^{-1} and 1.68 kg ha^{-1} and by chlorthal-dimethyl at 15.0 kg ha^{-1} when compared with the weed free

Table 4 Effect of herbicides on sesame in Experiment 4

Treatment	Rate (kg ha^{-1})	Number of plants: Transformed means[1]	Number of plants: Equivalent means (thousands ha^{-1})	Yield of grain (kg ha^{-1})	Plant vigour rating[2]
bifenox	2.0	1.4 b[3]	3	57 d	0 d
diphenamid	6.0	12.0 a	272	783 b	4.7 a
prometryn[4]	2.0	0	0	0	0
bromoxynil	0.28	11.5 a	249	1077 a	3.7 b
	0.42	10.5 a	209	802 ab	2.3 c
methabenzthiazuron	0.7	11.7 a	259	928 ab	2.7 c
	1.4	11.2 a	236	940 ab	2.7 c
weed free control	—	12.9 a	312	937 ab	5.0 a
weedy control	—	12.4 a	290	492 c	5.0 a

[1] Square root (x + 0.5) transformation used
[2] Refer Table 2
[3] Means not followed by a common letter differ significantly ($P < 0.05$)
[4] Treatment omitted from statistical analysis due to loss of plants

control. Plant population was not significantly reduced by chlorthal-dimethyl at 7.5 kg ha^{-1} although stunted plants were observed. Alachlor and linuron had no significant effect on plant population.

Grain yield in the weedy control was reduced by 87% when compared with the weed free control, which significantly outyielded all treatments except alachlor at 4.5 kg ha^{-1}. The yield reduction resulted from lower plant population and/or competition from weeds not controlled by the herbicide treatments.

Experiment 2 Pendimethalin at 1.5 kg ha^{-1} and 3.0 kg ha^{-1} reduced plant population, grain yield and plant height when compared with the weed free control (Table 2). Plant maturity was delayed and the pendimethalin treatments were harvested 5 days after the other treatments. Alachlor and linuron had no effect on the crop. Grain yield in the weedy control was not significantly different from the weed free control. There was a reduction in number of plants in the weed free control, probably as a result of losses during the hand weeding operation.

Experiment 3 Weed competition in the weedy control (Table 3) reduced grain yield by 46% when compared with the weed free control. Alachlor was the safest herbicide in this experiment with yield, population and vigour similar to the weed free control. The yield following treatment with linuron (weed free) was not significantly less than the weed free control but linuron (weedy) reduced yield, possibly because of incomplete weed control, and both linuron treatments reduced plant population and vigour. All treatments using bentazone reduced yield, population and vigour.

Experiment 4 Diphenamid had no effect on yield, population or vigour (Table 3). Bromoxynil and methabenzthiazuron also produced yields and populations similar to the control treatments despite an observed effect on crop vigour. Bifenox and prometryn both caused serious crop damage.

Results from the four experiments showed that alachlor at 2.25 kg ha^{-1} applied post-planting and pre-emergence was the most acceptable herbicide treatment. Diphenamid gave good results in one experiment and should be evaluated further.

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