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Promising herbicides for weed control in chickpea

(*Keywords* Weed density dry matter *Chenopodium album* L chickpea)

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Abstract Chickpea suffers severe competition due to *Chenopodium album* L infestation Two to three hoeings are generally given to check *C album* but increasing labour costs and scarcity of farm labour make the manual weeding difficult Usage of herbicides appears to be a logical solution Pre emergence applications of pendimethalin or ametryn alone at 1 5 kg ai ha or one hand weeding at 35–40 days after seeding following either 1 kg ai ha of pendimethalin ametryn or fluchloralin or metribuzin at 0 3 kg ai ha applied pre emergence gave effective control of *C album* and seed yields similar to clean weeded chickpeas There was an 84 % reduction in seed yield of chickpea without weeding

1. Introduction

Chickpea (*Cicer arietinum* L) is an important postrainy season pulse crop in India Due to its initial slow growth and wide row spacing which provides ample scope for weed infestation it often suffers severe weed competition Presence of weeds is one of the major constraints of low seed yield of chickpea (Faris and Gowda 1990) The magnitude of losses depends on the composition and density of weed flora Unchecked weed growth can reduce seed yield by 40–50% (Ahlawat *et al* 1981) *C album* is a major weed of this crop in northern India at latitudes of 25–30 N (Kolar *et al* 1979) It is tolerated by farmers because of its use as a green leafy vegetable It germinates in two to three flushes and requires two to three hoeings to control it manually (Dhingra *et al* 1982) Timely control of *C album* is vital since it is a relatively fast-growing weed with an enormous capacity to produce dry matter and to smother the understorey chickpea completely resulting in drastic yield reduction With the increasing migration of villagers to urban areas farm labour is becoming expensive and scarce for conventional manual weeding The use of herbicides to control weeds in chickpea seems to be a logical solution It was therefore considered worthwhile to screen potential herbicides since there has been no systematic effort to identify herbicides to control *C album* However pre-emergence herbicides may not provide the desired control of *C album* because of its germination at later stages of crop growth If this late weed growth coincides with a critical period of crop growth it can result in serious reduction in chickpea yields Thus an integration of chemical and manual methods may be more appropriate

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2. Materials and methods

Chickpea cv Annigeri was grown at the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) Co operative Research Station at the Jawahar Lal Nehru Krishi Vishwa Vidyalaya (JNKVV) Gwalior India (26 N 78 E 899 mm rainfall) during the 1987 1988 postrainy season The soil of the experimental plot was an Inceptisol with medium fertility The field was fertilized with 18 kg N and 36 kg P O_5 ha^{-1} at the time of seedbed preparation and irrigated with tube well water before seeding The crop was sown on 18 November 1987 at 30 cm row spacing using 90 kg seed ha^{-1} and was harvested on 24 March 1988 Four herbicides applied as 14 treatments including some handweedings (Table 1) were applied in a randomized block design with three replications All the herbicides were applied one day after sowing with a knapsack sprayer fitted with a flat fan-type nozzle using water as a carrier at a volume of 700 l ha^{-1} The clean weeded check was maintained by repeated handweedings done by hoes every 10 days until harvest The weeds present were collected at 60 days after sowing (DAS) from a randomly placed quadrant of 1 m^2 counted washed and then oven-dried to estimate weed density and dry matter The data on weed density and dry matter was transformed into $\sqrt{X + 0.5}$ for statistical analysis *C album* constituted more than 60% of the total weed numbers Other weeds present included *Asphodelus fistulosis* L *Fumaria parviflora* L *Convolvulus arvensis* L *Anagalis arvensis* and *Melilotus indica*

3. Results

Weed density recorded at 60 DAS indicated that the integration of herbicides at a lower dosage with manual weeding around 35–40 DAS greatly reduced *C album* and other weeds (Table 1) Applications of herbicides alone required higher doses for good weed control and improved yields Fluchloralin was the least effective herbicide and at 1 5 kg ai ha^{-1} checked the growth of chickpea plants

Owing to severe *C album* competition chickpea growth and development was drastically reduced by 84% in the unweeded control followed by fluchloralin-treated plots

Increase in grain yield was associated with fewer weeds and lower dry mass of weeds Pendimethalin, metribuzin, ametryn and fluchloralin at lower concentration in combination with manual weeding around 35–40 DAS most effectively controlled *C, album* resulting in yields of chickpea which were similar to the clean-weeded check Pre-emergence application of pendimethalin at 1 5 kg ai ha^{-1} and ametryn

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Table 1 Effect of various treatments on weed population, density (60 days after sowing) and yield of chickpea

Treatments and dosage (kg ai ha $^{-1}$)	Weed density (m $^{-2}$)		Weed dry matter (g m $^{-2}$)		Chickpea seed yield (kg ha $^{-1}$)
	C. album	Total	*C. album*	Total	
Pendimethalin (Pre-em) 1·0	13·0 (3·7)*	40·3 (6·4)	84·9 (9·2)	147·8 (12·2)	1438
Pendimethalin (Pre-em) 1·5	2·7 (1·8)	15·3 (3·8)	11·8 (3·5)	67·0 (8·2)	1785
Metribuzin (Pre-em) 0·3	6·3 (2·6)	27·3 (4·6)	53·7 (7·4)	129·6 (11·4)	1424
Metribuzin (Pre-em) 0·6	4·3 (2·2)	56·7 (7·4)	43·9 (6·6)	61·3 (7·9)	1674
Ametryn (Pre-em) 1·5	9·3 (3·1)	28·3 (4·9)	74·3 (8·6)	111·6 (10·6)	1772
Ametryn (Pre-em) 2·0	4·7 (2·2)	17·7 (3·7)	23·9 (4·9)	66·1 (8·2)	1928
Fluchloralin (ppi) 1·0	21·3 (4·6)	34·0 (6·1)	152·8 (12·4)	244·1 (15·6)	1065
Fluchloralin (ppi) 1·5	12·7 (3·6)	17·0 (4·2)	78·3 (8·9)	116·1 (10·8)	1332
Pendimethalin (1·0) + HW	0·0 (0·7)	13·3 (3·5)	0·0 (0·7)	13·5 (3·7)	1980
Metribuzin (0·3) + HW	0·0 (0·7)	12·7 (3·4)	0·0 (0·7)	13·7 (3·8)	2038
Ametryn 1·0 + HW	0·0 (0·7)	6·7 (2·5)	0·0 (0·7)	12·2 (3·5)	2131
Fluchloralin (1·0) + HW	4·0 (2·1)	15·7 (2·9)	0·9 (1·2)	16·3 (4·1)	2045
Clean weeded check	0·0 (0·7)	0·0 (0·7)	0·0 (0·7)	0·0 (0·7)	1941
Unweeded control	121·3 (11·0)	153·3 (12·4)	349·8 (18·7)	459·5 (21·5)	311
SEM ±	0·2	0·3	0·3	0·3	91·3
CD (0·05)	0·58	0·87	0·87	0·87	264·7

Pre-em, pre-emergence; ppi, pre-plant incorporation; HW, hand weeding at 35–40 DAS

Data in parenthesis are $\sqrt{X + 0.5}$, where X is weed density or dry matter

Table 2. Relative profitability (US$) of different treatments over unweeded control and clean weeded check

	Seed yield (kg ha $^{-1}$)	Net returns (US$)	APUC	APCC
Pendimethalin 1·0	1438	383	294	106
Pendimethalin 1·5	1785	471	382	18
Metribuzin 0·3	1424			
Metribuzin 0·6	1674	—	—	—
Ametryn 1·5	1772	480	391	9
Ametryn 2·0	1928	518	429	29
Fluchloralin 1·0	1065	283	194	206
Fluchloralin 1·5	1332	351	262	139
Pendimethalin (1·0) + HW	1980	524	435	35
Metribuzin (0·3) + HW	2038	—		
Ametryn (1·0) + HW	2131	575	486	86
Fluchloralin (1·0) + HW	2045	547	458	58
Clean weeded check	1941	489	400	—
Unweeded coantrol	311	89	—	311

APUC, additional profit over unweeded control; APCC, additional profit over clean-weeded check. Costs: Chickpea grain US$ 280 t $^{-1}$, pendimethalin US$ 6, ametryn US$ 9·0 fluchloralin US$ 6·5, metribuzin price not available.

Female/male wage US$ 0·60 day $^{-1}$ (Clean-weeded and herbicide + handweeded treatments consumed 100 and 20 women days respectively. Herbicide spraying required 5 man days.)

at 1·5 or 2·0 kg ai ha^{-1} produced grain yields identical to the clean-weeded check and were the best herbicide treatments.

The relative profitability of different treatments in terms of additional profit over unweeded control (APUC) and additional profit over clean weeded check (APCC) was worked out depending on the prevailing prices of input/output costs (Table 2). All the weed management treatments were remunerative over unweeded control and resulted in substantial economic gains. On the other hand, the additional profit over clean-weeded check (APCC) was obtained only with ametryn at 2·0 kg ai ha^{-} and with the treatments having integration of chemical and manual weeding. Thus integration of chemical and manual methods appear to be more remunerative and effective in *C. album* control.

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