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RESEARCH ARTICLE

Weed management in chickpea through broad spectrum herbicides

A.S. Rao* and G. Santhosh Kumar

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ABSTRACT

A field experiment was laid out in a randomized block design with three replications, during *Rabi* 2022-23 and 2023-24 at J Farm, Agricultural Research Institute, Rajendranagar, Hyderabad, India to evaluate the efficacy of different broad spectrum post emergence herbicides on weed control, yield and economics of chickpea. Results indicated that all the post emergence herbicides applied at 25 days after sowing (DAS) significantly reduced the weed growth and increased crop growth, yield over weedy check. Among the post emergence herbicides, the highest weed control efficiency (WCE) of 61.5% and 60% was obtained at 60 DAS and harvest with the application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha, respectively. However, all the post emergence herbicides applied at 25 DAS caused crop injury ranging from 10 to 16% at 14 days after herbicide application, though crop gradually recovered later. Among the post emergence herbicides tested, though higher yield of 1012 kg/ha was obtained with the application of sodium salt of acifluorfen 16.5% + clodinafop propargyl 8% at 200 g/ha but was on par with all other post emergence herbicides. There is an increased yield of 89% obtained with this treatment compared to weedy check. Higher net monetary returns (Rs. 33,485/-) and benefit cost ratio (BCR) of 1.22 were also obtained with this treatment. Thus, it was concluded that post emergence application of sodium salt of acifluorfen 16.5% + clodinafop propargyl 8% at 200 g/ha was found to be effective and economical compared to other post emergence herbicides under study.

Key words: Chickpea, Weed management, Broad-spectrum, Post-emergence herbicides, Phytotoxicity, Weed control efficiency

INTRODUCTION

Chickpea (*Cicer arietinum* L.), the world's third most important food legume is also an important major pulse crop of India. One of the reasons for its low productivity is weed infestation. Being a short statured crop with initial slow growth, severely infested with weeds and causes yield reduction varying from 40-75% (Ratnam *et al.* 2011, Shrikant *et al.* 2024). Farmers usually apply pre-emergence herbicides and/ or manual weeding (Kashyap *et al.* 2022) but due to scarcity of labour and increased cost of labour wages manual weeding is difficult and not economical. Further, the pre-emergence herbicide does not control the late emerged and many weeds. For control of grasses several post-emergence herbicides like quizalofop-ethyl, propaquizafop *etc*. recommended but for the control of broad -leaf weeds which are very problematic, suitable selective post emergence herbicide without any phytotoxicity to chickpea is not available. Farmers are repeatedly asking for a suitable post-emergence broad-spectrum herbicide for the effective and economical weed management in chickpea. Keeping all this in view, the present experiment was conducted to evaluate the efficacy of different broad spectrum post emergence herbicides on weed control, crop growth, yield and economics of chickpea.

MATERIALS AND METHODS

A field experiment was conducted consecutively for two years during *Rabi* seasons of 2022-23 and 2023-24 at J Farm, Agricultural Research Institute, Rajendranagar, Hyderabad, Telangana, India. The soil of the experimental plot was sandy clay loam in texture with medium in available nitrogen, phosphorus and high in available potassium and with pH of 7.7. The experiment consists of seven treatments, *viz.* weedy check, hand weeding at 15 and 30DAS, imazethapyr 50 g/ha, sodium salt of acifluorfen + clodinafop propargyl 200 g/ha, topramezone 15 g/ha, fomesafen + fluazifop-butyl 250 g/ha and imazethapyr + propaquizafop 125 g/ha was laid out in a randomized block design with three replications. The seeds of chickpea (cv. *Gold 75*) during the third week of December 2022 during first year and first week of December 2023 in second

J Farm and PTC (TAFE unit), ARI, PJTAU, Rajendranagar, Hyderabad, Telangana 500030, India

* Corresponding author email: atlurisrao@gmail.com

year. All the recommended packages of practices except weed control were followed in raising the crop. The crop was fertilized with 20-50-20 kg/ha of N-P-K as basal. The post-emergence herbicides were applied at 25 DAS using a spray volume of 500 L/ha of water through a knapsack sprayer fitted with a flat fan nozzle. There were no major pests and diseases during the both years of experimentation but during the initial stage of crop, Spodoptera was noticed and it was controlled by spraying chlorpyriphos and novaluron. The weed density and dry matter were recorded at various stages with the help of 0.5 x 0.5 m quadrate and then converted to per square meter. The weed species were identified and separated as grasses, sedges and broad leaves. The data on the weed density and dry weight were subjected to square root transformation $\sqrt{x+0.5}$ before statistical analysis to normalize their distribution (Panse and Sukhatame 1978). The herbicide phytotoxicity on crop (like yellowing, stunting, scorching etc.) was done on a scale of 0 to 10 (0 meant no phytotoxicity and 10 meant complete death of plant) equal to 0-100 % (Rao 2000) at 7 and 14 DAA (Days After Application). The economics of various treatments was calculated taking the prevailing market prices of inputs and outputs into consideration.

RESULTS AND DISCUSSION

Weed flora

The major weed flora of the weedy check plots were *Echinochloa colona, E. crus-galli, Dinebra retroflexa, Dactyloctenium aegyptium, Panicum repens, Leptochloa chinensis, Leersia hexandra* (grasses), *Cyperus rotundus, Fimbristylis miliacea* (sedges), *Trianthema portulacastrum, Chrozophora rottleri, Celosia argentea, Cleome viscosa, Cyanotis axillaris, Parthenium hysterophorus, Alternanthera sessilis, Nicotiana plumbagin folia, Ageratum conyzoides, Abutilon indicum* (broad-leaf weeds), Similar weeds in chickpea were also reported earlier (Ratnam *et al.* 2011, Sanketh *et al.* 2021).

Weed growth

All the herbicidal treatments significantly influenced grasses, sedges and broad leaf weed population and also the total weed dry weight at 60 DAS and at harvest **(Table 1** and **2**). Among the herbicide treatments, post-emergence application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha applied at 25 DAS was found effective in minimizing the total weed density and dry weight at both stages of observation but was on par with imazethapyr at 50 g/ha at 60 DAS and was on par with all post emergence herbicides at harvest.

The highest WCE of 61.5% and 60% was also obtained with this treatment. This may be attributed to broad spectrum weed control properties exhibited by this ready-mix herbicide treatment. The highest weed growth was observed in weedy check and the lowest weed index of 23.7% was obtained with post-emergence application of sodium salt of acifluorfen 16.5%+ clodinafop-propargyl 8% at 200 g/ha followed by topramezone at 15 g/ha. The highest weed index of 59.6% was observed in weedy check. The results are corroborating with those reported by Nath *et al.* 2021.

Table 1. Effect of different treatments on weed density of different weed groups at 60 DAS and at harvest in chickpea (pooled data of two years)

Treatment	At 60 DAS				At harvest			
	Grasses (no./m^2)	Sedges (no./m^2)	Broad-leaf weeds (no./m^2)	Total weed density (no./m^2)	Grasses (no./m^2)	Sedges (no./m^2)	Broad-leaf weeds (no./m^2)	Total weed density (no./m^2)
Imazethapyr 50 g/ha	8.35 (71.0)	6.35 (40.9)	7.75 (61.7)	13.05 (173.7)	7.05 (49.3)	6.15 (39.2)	6.10 (39.7)	11.20 (128.2)
Sodium salt of acifluorfen + clodinafop-propargyl 200 g/ha	7.15 (53.0)	7.10 (50.0)	6.90 (45.8)	12.1 (152.3)	5.75 (34.0)	6.50 (41.7)	5.85 (34.2)	10.50 (111.5)
Topramezone 15 g/ha	8.55 (76.2)	7.05 (50.1)	7.10 (50.8)	13.2 (177.2)	7.25 (52.8)	7.05 (50.0)	6.80 (45.5)	12.15 (148.3)
Fomesafen + fluazifop-p-butyl 250 g/ha	7.55 (57.2)	7.95 (63.8)	7.05 (50.0)	13.05 (171.3)	6.60 (40.0)	6.95 (50.5)	5.80 (35.0)	11.20 (132.5)
Imazethapyr + propaquizafop 125 g/ha	7.70 (59.2)	7.75 (61.5)	7.35 (58.0)	13.20 (178.1)	7.35 (54.2)	8.00 (64.0)	6.80 (46.0)	12.75 (164.5)
Hand weeding at 15 and 30 DAS	6.10 (37.7)	4.90 (28.3)	5.15 (27.0)	9.45 (86.3)	6.00 (29.3)	5.15 (26.3)	4.95 (24.7)	9.35 (87.0)
Weedy check	10.40 (112.0)	7.68 (60.3)	8.90 (82.0)	15.80 (254.3)	8.55 (73.3)	7.00 (49.0)	9.00 (88.3)	14.30 (207.7)
LSD (p=0.05)	2.80	1.75	2.75	3.45	2.55	1.8	2.7	3.0

*Figures in parentheses are original values, data transformed to $\sqrt{x+0.5}$ transformations

Effect on crop

Herbicide phytotoxicity: Herbicide phytotoxicity observations were recorded at 7 and 14 DAA All the post emergence herbicides applied 25 DAS caused crop injury symptoms like yellowing scorching ranging from 10 to 16% at 14 DAA (**Table 3)**. However, the crop gradually recovered later. Similar line of observations on herbicide injury in chickpea were also reported earlier (Gajanand *et al.* 2023, Shrikant *et al.* 2024)

Growth attributes: All the weed control treatments had significantly higher plant height, no. of branches/ plant over weedy check **(Table 4**). All the herbicidal treatments were on par among themselves but significantly lower than hand weeding which had higher crop dry weight. Among the herbicide treatments, sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200g/ha had higher crop dry weight and more number of branches per plant at harvest, This treatment was closely followed by topramezone 15g/ha. This might be due to the effective weed control under these treatments created more space to crop and reduced the competition for space, light and moisture and nutrients eventually resulted in more number of branches and crop dry weight. The results are in concurrence with those of Shrikant *et al.* (2024)

Yield and yield attributes: Number of pods/plant, hundred seed weight and seed yield were significantly influenced by the weed control treatments **(Table 4**). Among the post-emergence herbicides, though the highest seed yield of 1012 kg/ha was obtained with the application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha but it was on par with all other post- emergence herbicides. There was an increased yield of 89% in this treatment compared to weedy check. The next best treatment was post- emergence application of topramezone at 15 g/ha with seed yield of 1000 kg/ha. The increased yield in these treatments might be due to proper utilization of moisture, nutrients, light and space by chickpea crop in the absence of weed competition resulting in more photosynthates translocated from source to sink. None of the herbicidal treatments could reach the level of hand weeding at 15 and 30 DAS, which had the highest seed yield of 1326 kg/ha, this indicates the influence of crop injury and failure of herbicides to provide crop weed free situation. Weed competition during the crop growth period due to uncontrolled weed growth caused 60% yield loss in chickpea compared to hand weeding at 15 and 30 DAS. The results are akin to those reported by Sethi *et al.* (2021) and Kashyap *et al.* (2022),

Table 3. Effect of herbicide application on phytotoxicity in chickpea (pooled data of two years)

Treatment	Phytotoxicity rating (%) at	
	7 DAA*	14 DAA*
Imazethapyr 50 g/ha	10	10
Sodium salt of acifluorfen + clodinafop-propargyl 200 g/ha	17	10
Topramezone 15 g/ha	13	10
Fomesafen + fluazifop-p-butyl 250 g/ha	20	16
Imazethapyr + propaquizafop 125 g/ha	27	15
Hand weeding at 15 and 30 DAS	-	-
Weedy check	-	-

Economics

The highest net monetary return of Rs. 33,485/- and BCR of 1.22 was obtained with the post-emergence application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha which may be due to higher WCE and increased crop yield **(Table 4)**. This was closely followed by the post-emergence application of topramezone at 15 g/ha with net monetary return of Rs. 32,785/- and BCR of 1.20. Though hand weeding at 15 and 30 DAS had the highest seed yield, it resulted in lower BCR of 0.87 mainly because of higher cost of labour involved in this treatment.

Table 2. Effect of different treatments on weed dry weight of different weed groups at 60 DAS and harvest in chickpea (pooled data of two years)

Treatment	Dosage (g/ha)	Weed dry weight at 60 DAS (g/m^2)	WCE (%)	Weed dry weight at Harvest (g/m^2)	WCE (%)	WI (%)
Imazethapyr 50 g/ha	50	6.35(45.4)	53.0	5.30(34.2)	52.5	26.6
Sodium salt of acifluorfen + clodinafop-propargyl 200 g/ha	200	5.20(35.5)	61.5	4.45(23.2)	60.0	23.7
Topramezone 15 g/ha	15	7.00(57.7)	48.0	5.80(40.1)	48.0	24.5
Fomesafen + fluazifop-p-butyl 250 g/ha	250	7.35(63.1)	43.7	5.80(36.8)	48.0	39.3
Imazethapyr + propaquizafop 125 g/ha	125	7.60(68.5)	45.6	5.9(44.3)	47.0	40.0
Hand weeding at 15 and 30 DAS	-	3.90(15.4)	74.1	3.05(9.2)	72.6	-
Weedy check	-	13.15(177.3)	-	11.15(125.3)	-	59.6
LSD (p=0.05)		1.60		1.78		

*Figures in parentheses are original values, data transformed to $\sqrt{x+0.5}$ transformations

Table 4. Effect of weed control treatments on crop growth, yield parameters, yield and economics in chickpea (pooled data of two years)

Treatment	Plant height (cm) at harvest	No. of branches / plant at harvest	Crop dry weight (g/plant) at harvest	No. of pods/ plant	100 seed weight (g)	Seed yield(kg/ha) 2022-23	Seed yield(kg/ha) 2023-24	Pooled yield (kg/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	Benefit: cost ratio
Imazethapyr 50 g/ha	24.4	3.4	9.4	18.2	16.3	1025	900	963	57,780	31,480	1.19
Sodium salt of acifluorfen + clodinafop-propargyl 200 g/ha	27.8	4.2	10.8	22.2	17.3	1075	949	1012	60,720	33,485	1.22
Topramezone 15 g/ha	25.8	4.1	10.4	19.1	16.7	1100	900	1000	60,000	32,750	1.20
Fomesafen + fluazifop-p-butyl 250 g/ha	27.3	3.9	9.7	15.0	16.6	890	720	805	48,300	20,393	0.73
Imazethapyr + propaquizafop 125 g/ha	26.8	3.7	10.1	15.8	16.3	900	687	794	47,640	17,640	0.53
Hand weeding at 15 and 30 DAS	31.7	4.8	16.8	30.5	17.2	1451	1200	1326	79,560	36,960	0.87
Weedy check	17.3	2.8	6.3	10.8	15.3	518	554	536	32,160	7,160	0.29
LSD (p=0.05)	4.5	1.3	4.4	7.8	1.4	260.2	252.4	256.3			

From the results, it was concluded that post-emergence application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha was found to be effective and economical compared to other treatments under the study. In view of the initial crop injury, in all the post- emergence herbicides understudy, the future research emphasis on identification of safe and selective broad spectrum post-emergence herbicide in chickpea should be continued.

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