Journal of Food Legumes
36(1): 43-46, 2023
DOI: 10.59797/jfl.v36.i1.128

Research paper

Bio-efficacy of different POE herbicides for broad spectrum weeds management in chickpea (*Cicer arietinum* L.)

Md. Hedayetullah[1*] and Narendra Kumar[2]

[1*]*AICRP on Chickpea, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia -741252 (West Bengal), India*
[2] *Head, Division of Crop Production, ICAR-Indian Institute of Pulses Research, Kanpur -208024 (Uttar Pradesh), India*

[*]***E-mail**:* md.hedayetullah@bckv.edu.in

Handling Editor:
Dr. C.P. Nath, ICAR-Indian Institute of Pulses Research, Kanpur, India

***Received**: 11 July 2023*
***Accepted**: 3 August 2023*

ABSTRACT

A field experiment was conducted during 2020-21 and 2021-22 to study the effect of different post-emergence (POE) herbicides for broad spectrum weed management in chickpea. The experiment was laid out in a randomized block design with eight treatments and replicated thrice. Treatments comprises topramezone 20.6 g a.i. ha^{-1} at 14 DAS, topramezone 20.6 g a.i. ha^{-1} at 21 DAS, topramezone 25.7 g a.i. ha^{-1} at 14 DAS, topramezone 25.7 g a.i. ha^{-1} at 21 DAS, quizalofop-p-ethyl 100 g a.i. ha^{-1} at 21 DAS, unweeded control, weed free check (manual) and imazethapyr + manual weed control (MWC). Among the different herbicidal treatments, topramezone 20.6 g a.i. ha^{-1} at 21 DAS significantly higher seed yield (1377 kg ha^{-1}) followed by topramezone 20.6 g a.i. ha^{-1} at 21 DAS (1265 kg ha^{-1}), highest weed control efficiency and also recorded higher return (₹ 45,659 ha^{-1}) and B: C ratio (2.73) during 2020-21.

***Key words*:** Bio-efficacy, Post-emergence, Weed species, WCE, Yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important food legume crops of India and occupy a special position in Indian agriculture. India is the largest producer of chickpea contributing about 65% of the world's chickpea production. In India, it is grown in an area of 8.4 m ha with production of 10.13 mt and productivity of 1.07 t ha^{-1} (2019-20). The crop weed competition is more prevalent in early stage of crop growth and therefore, initial 50-60 days after sowing is very critical. Poor weed management is detrimental in chickpea yield. The chickpea crop is short statured plant resulting highly susceptible to weed competition which causes yield loss of up to 75% (Chaudhary *et al*., 2005). Tremendous weed competition may adversely affect the flowering and fruiting that resulted in small seed size, an important quality parameter in chickpea. Manual or mechanical weed control is costly and therefore limits the production area (Dubey, 2014). Thus, suitable herbicide(s) for effective control of broad spectrum weeds in chickpea is essential. The use of post-emergence herbicides for season-long weed control is thus, preferred over pre-plant incorporation (fluchloralin and trifluralin) and pre-mergence (pendimethalin) herbicides. Keeping in view above facts, the present study was undertaken to evaluate the performance of post-emergence herbicides in chickpea for timely and economic weed control. Therefore, present study conducted with the objective to find out suitable and economically viable weed management practice for chickpea.

MATERIALS AND METHODS

The experiment was conducted during the *rabi* season of 2020-21 and 2021-22 at the AB block farm of BCKV, Kalyani. The study site comes under the New alluvial zone of West Bengal with average rainfall of 1650 mm and evaporation of 1502 mm. Soil properties of the study site had low organic carbon with clay loam texture having pH of 6.6 and bulk density of 1.28 g cm^{-3}. The experiment was conducted in randomized block design and replicated thrice. The chickpea (variety 'GNG 2299') crop was cultivated with the eight different weed management practices. The weed management practices involved the application of T_1 : topramezone 20.6 g a.i. ha^{-1} at 14 DAS, T_2 : topramezone 20.6 g a.i. ha^{-1} at 21 DAS , T_3 : topramezone 25.7 g a.i. ha^{-1} at 14 DAS, T_4 : topramezone 25.7 g a.i. ha^{-1} at 21 DAS, T5 : quizalofop-p-ethyl 100 g a.i. ha^{-1} at 21 DAS, T_6 : unweeded control, T_7 : weed free check (manual) and T_8 : imazethapyr 100 g a.i. ha^{-1} + manual weed control (MWC).

The recommended dose of chemical fertilizer was N:P_2O_5:K_2O of 20:40:40 kg ha^{-1} of applied as basal and thoroughly mixed with the soil during

final land preparation. The seeds were inoculated with chickpea *Rhizobium* culture and sown in planting geometry of 30 x 10 cm at a depth of 5 cm. Post-emergence application of herbicide was done with knap-sack sprayer using flat-fan nozzle in 500 l of water ha^{-1}. Weed density and weed dry weight were recorded species wise at 45 days after sowing (DAS) during both the years by using a quadrate of 0.5 x 0.5 m (0.25 m^2) size. After counting of species wise, weeds were dried in sun followed by in oven at 70°C for three days to estimate the weed dry weight.

RESULTS AND DISCUSSION

Weed density and dry weight

The weed flora during crop period consisted of grasses, broad leaf and sedges. The major weeds identified were *Cynodan dactylon*, *Cyperus rotundus*, *Physalis minima*, *Vicia sp.*, *Chenopodium album, Cirsium arvense, Saccharum spontaneum, Cucumis melo wild, Melilotus albus, Chenopodium murale, Solanum nigram,* . Among all the weed control treatments, significantly lower number of weeds (21 m^{-2}) was recorded in imazethapyr + MWC during 2020-21, whereas during 2021-22, lowest weed density (20 m^{-2}) was recoded in topramezone 20.6 g a.i. ha^{-1} at 21 DAS (Table 1). Among all the weed control treatments, significantly higher number of weeds 96, 87 and 93 m^{-2}, respectively during 2020-21, 2021-22 and pooled was recorded in unweeded check. Among the weedicide treatments, imazethapyr 100 g a.i. ha^{-1} + MWC recorded significantly lowest weed dry weight (0.82 g m^{-2}) during 2020-21, whereas topramezone 20.6 g a.i. ha^{-1} treatment at 21 DAS during 2021-22 (1.98 g m^{-2}) followed by imazethapyr 100 g a.i. ha^{-1} + MWC (Table 1). Maximum weed dry weight was observed in quizalofop-p-ethyl 100 g a.i. ha^{-1} at 21 DAS in both the year except unweeded control plot. The similar results were observed by Khope *et al.* (2011).

Weed control efficiency

Higher weed control efficiency (89.5%) was recorded in imazethapyr 100 g a.i. ha^{-1} + MWC followed topramezone 20.6 g a.i. ha^{-1} at 14 DAS (76.0%) during 2020-21. In the year of 2021-22, maximum weed control efficiency (72.3%) was recorded in topramezone 20.6 g a.i. ha^{-1} at 14 DAS which was at par with topramezone 25.7 g a.i. ha^{-1} at 14 DAS (72.3%) (Table 1). Minimum weed control efficiency was observed in quizalofop-p-ethyl 100 g a.i. ha^{-1} at 21 DAS. Correlation with seed yield and weed control efficiency was perfectly positive (r= 892), this may be due to the weed control efficiency was higher with herbicide effects on broad spectrum weeds. The effect of herbicide treatments on weed index is presented in Fig. 3. Among all the herbicides treatments, significantly minimum weed index (23.9) and (12.8) was recorded in topramezone 20.6 g a.i. ha^{-1} at 21 DAS during 2020-21 and 2021-22, respectively and maximum weed index was

Table 1. Effect of different herbicides on weed density, weed dry weight, weed control efficiency and weed index in chickpea

Treatments	Weed density (No. m^{-2})			Weed dry weight (g m^{-2})			Weed control efficiency (%)		Weed index	
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	2020-21	2021-22
Topramezone 20.6 g a.i. ha^{-1} at 14 DAS	6.28 (39)	5.19 (27)	5.73 (33.0)	1.52 (1.84)	1.74 (2.53)	1.63 (2.19)	76.00	64.4	33.6	19.9
Topramezone 20.6 g a.i. ha^{-1} at 21 DAS	5.44 (31)	4.48 (20)	4.96 (25.5)	1.69 (2.37)	1.57 (1.98)	1.63 (2.18)	69.27	72.3	23.9	12.8
Topramezone 25.7 g a.i. ha^{-1} at 14 DAS	4.74 (23)	5.94 (35)	5.34 (29.0)	1.95 (3.42)	1.91 (3.20)	1.93 (3.3)	69.27	72.3	30.7	20.2
Topramezone 25.7 g a.i. ha^{-1} at 21 DAS	5.3 (29)	5.97 (36)	5.67 (32.5)	1.73 (2.49)	1.73 (2.48)	1.73 (2.4)	67.49	65.0	30.6	23.9
Quizalof-p-ethyl 100 g a.i. ha^{-1} at 21 DAS	9.51 (90)	9.51 (90)	9.51 (90.0)	2.48 (5.73)	2.39 (5.25)	2.44 (5.4)	25.09	26.3	28.0	44.1
Unweeded control	9.74 (96)	9.94 (87)	9.84 (93.0)	2.86 (7.71)	2.76 (7.15)	2.81 (7.4)	0.00	0.0	40.7	64.1
Weed free check (Manual)	0.71 (0)	0.71 (0)	0.71 (0.0)	0.71 (0.00)	0.71 (0.0)	0.71 (0.0)	100.00	100.0	0.0	0.0
Imazethapyr + manual weed control (MWC)	4.59 (21)	6.19 (39)	5.39 (30.0)	1.14 (0.82)	1.63 (2.17)	1.38 (1.5)	89.53	69.8	9.0	33.2
SEm+	0.48	0.37	0.43	0.10	0.07	0.09				
CD (p=0.05)	1.40	1.10	1.22	0.30	0.20	0.25				

Note: values are square-root transformed. numbers in parenthese are actual values; DAS= Days after sowing; Nos= Numbers' MWC= Manual weed control

Table 2. Effect of different herbicides on plant height, pod per plant, seed yield and harvest index at harvest of chickpea crop

Treatments	Plant height (cm)			Pod plant^{-1}			Seed yield (kg ha^{-1})			Harvest index (%)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Topramezone 20.6 g a.i. ha^{-1} at 14 DAS	60.8	64.8	62.8	81.0	60.9	71.0	912	1265	1089	29.5	35.8	32.7
Topramezone 20.6 g a.i. ha^{-1} at 21 DAS	62.3	66.6	64.5	70.5	68.8	69.7	1045	1377	1211	30.4	37.8	34.1
Topramezone 25.7 g a.i. ha^{-1} at 14 DAS	59.9	64.8	62.4	78.5	54.7	66.6	952	1260	1106	29.7	34.4	32.1
Topramezone 25.7 g a.i. ha^{-1} at 21 DAS	60.2	69.2	64.7	85.3	63.2	74.3	953	1201	1077	30.5	33.9	32.2
Quizalof-p-ethyl 100 g a.i. ha^{-1} at 21 DAS	53.0	67.5	60.3	71.5	44.7	58.1	989	883	936	30.8	28.5	29.7
Unweeded control	53.8	58.8	56.3	64.5	35.5	50.0	814	567	691	26.6	26.2	26.4
Weed free check (Manual)	65.1	68.1	66.6	85.8	70.8	78.3	1373	1579	1476	33.7	38.9	36.3
Imazethapyr + manual weed control (MWC)	64.2	64.8	64.5	83.0	60.0	71.5	1250	1054	1152	32.0	31.2	31.6
SEm+	2.7	1.8	2.3	4.8	4.6	4.7	72	56	63	0.9	1.2	1.1
CD (p=0.05)	7.6	5.1	6.4	13.8	13.2	13.5	205	156	181	2.5	3.5	3.0

DAS= Days after sowing; Nos= Numbers' MWC= Manual weed control

Table 3. Effect of different herbicides on economics of chickpea crop

Treatments	Gross Returns (₹ ha^{-1})			Net returns (₹ ha^{-1})			B:C		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Topramezone 20.6 g a.i. ha^{-1} at 14 DAS	44,467	61,654	53,060	14,631	39,779	27,205	1.69	2.51	2.2
Topramezone 20.6 g a.i. ha^{-1} at 21 DAS	50,941	67,134	59,038	21,105	45,658	33,381	1.93	2.73	2.3
Topramezone 25.7 g a.i. ha^{-1} at 14 DAS	46,434	61,437	53,935	16,298	39,247	27,772	1.74	2.47	2.2
Topramezone 25.7 g a.i. ha^{-1} at 21 DAS	46,465	58,571	52,518	16,329	36,172	26,250	1.74	2.36	2.0
Quizalof-p-ethyl 100 g a.i. ha^{-1} at 21 DAS	48,200	43,031	45,615	18,364	19,800	19,082	1.81	1.73	1.8
Unweeded control	39,665	27,618	33,642	11,029	4,465	7,747	1.58	1.18	1.4
Weed free check (Manual)	66,940	76,959	71,949	29,120	53,899	41,509	2.05	2.88	2.5
Imazethapyr + manual weed control (MWC)	60,915	51,378	56,146	23,095	26,455	24,775	1.86	1.92	1.9
SEm+	3,506	2,660	3,083	3,002	2,853	2,928	0.13	0.11	0.12
CD (p=0.05)	10,015	7,597	8,806	8,575	8,150	8,362	0.36	0.30	0.33

DAS= Days after sowing; Nos= Numbers' MWC= Manual weed control

recorded by quizalofop-p-ethyl 100 g a.i. ha^{-1} at 21 DAS (Table 1).

Growth, yield and yield attributes

Growth and yield attributing characters such as plant height, number of pods plant^{-1}, seed yield and harvest index are presented in Table 3. At harvest, the maximum plant height (65.1 cm) was recorded in weed free check plot. Minimum plant height (58.8 cm) was recorded under unweeded control during 2021-22. These findings were in agreement with those Poonia *et al.* (2013) and Rupareliya *et al.* (2017). Imazethapyr 100 g a.i. ha^{-1} + MWC observed maximum number of pods per plant which were significantly higher than other weed management practices during 2020-21 (Table 2). Among herbicide treatments, significantly highest chickpea seed yields of 1045 kg ha^{-1} in 2020-21 and 1377 kg ha^{-1} in 2021-22 were recorded in Topramezone 20.6 g a.i. ha^{-1} applied at 21 DAS over unweeded control (Table 2). Similar trend was also recorded under pooled analysis. Significantly the highest (37.8%) harvest index was recorded with Topramezone 20.6 g a.i. ha^{-1} at 21 DAS (1045 kg ha^{-1}) during 2021-22 and followed by weed free treatment (38.9%) during 2021-22. Negative relationship of seed yield and weed density (Fig. 1) were depicted perfectly. It might be due higher infestation of weeds that lesser translocation of photosynthesis from source to sink. The results support from the other report by Dubey *et al.* (2018) and Sethi *et al.* (2021).

Economics

Among treatments, weed free treatment recorded maximum gross return of ₹ 66,940 ha^{-1} and ₹ 76,959 ha^{-1} during 2020-21 and 2021-22,

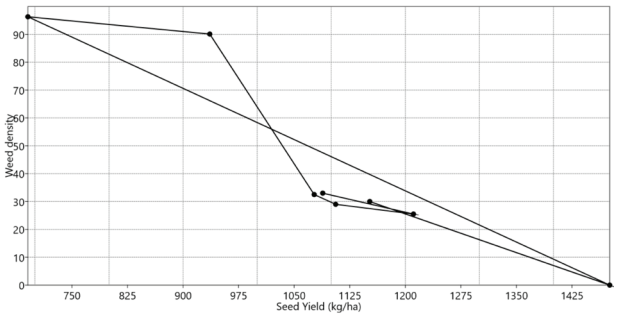

Fig. 1. Relationship with weed density with seed yield of chickpea

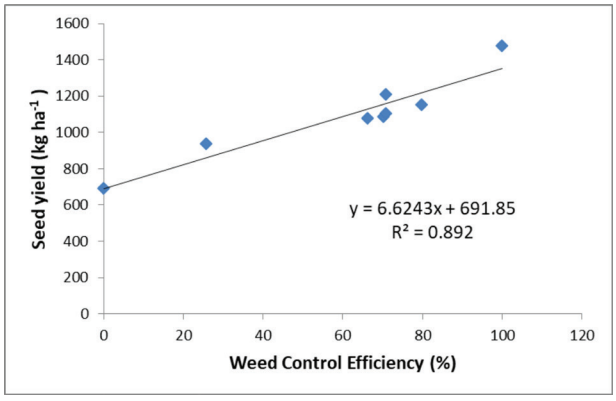

Fig. 2. Correlation with seed yield and weed control efficiency

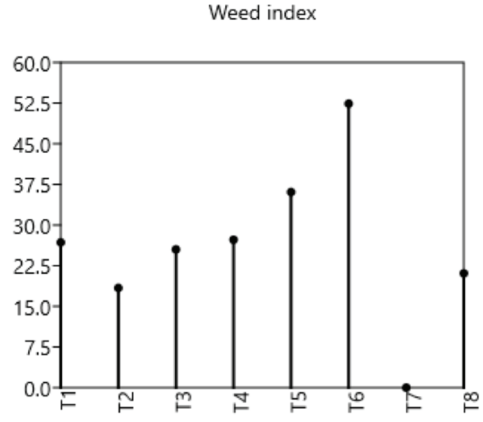

Fig. 3. Effect of herbicide treatments on weed index

respectively. Among herbicides, topramezone 20.6 g a.i. ha^{-1} at 21 DAS recorded higher gross return (₹ 67,134 ha^{-1}) during 2021-22 and similar trend was observed also in pooled values. The similar trend was also recorded in net return. The maximum net return was recorded in topramezone 20.6 g a.i. ha^{-1} at 21 DAS during both the year and in pooled value (₹ 27,772 ha^{-1}). The highest B:C ratios of 1.93 and 2.73 were recorded during 2020-21 and 2021-22, respectively as well as also in pooled value (Table 3). Therefore, from the study it was found that the application topramezone 20.6 g a.i. ha^{-1} at 21 DAS proved superior in chickpea crop. The similar results confirmed by Yadav *et al.* (2019) and Nath *et al.* (2022). Therefore, based on economics, application of topramezone 20.6 g a.i. ha^{-1} at 21 DAS was found best treatment.

CONCLUSION

It is concluded that application of topramezone 20.6 g a.i. ha^{-1} at 21 DAS was the best treatment in terms of lower weed density, higher weed control efficiency, yield and economics of chickpea.

REFERENCES

Chaudhary BM, Patel JJ and Delvadia DR. 2005. Effect of weed management practices and seed rates on weeds and yield of chickpea. Indian Journal of Weed Science **37:** 271–272.

Khope D, Kumar S and Pannu RK. 2011. Evaluation of Post-emergence Herbicides in Chickpea (*Cicer arietinum*). Indian Journal of Weed Science **43**(1&2): 92-93.

Dubey RP. 2014. Integrated weed management- an approach. pp. 19-21. In: Training Manual Advance Training in Weed Management, held at DWSR, Jabalpur, India on 14-23 January.

Dubey SK, Kumar A, Singh D, Pratap T and Chaurasiya A. 2018. Effect of different weed control measures on performance of chickpea under irrigated condition. International Journal of Current Microbiology and Applied Science **7:** 3103–3111.

Sethi IB, Singh H, Kumar Suresh, Jajoria Mahesh, Jat LK, Braod NK, Muralia S and Mali HR. 2021. Effect of post-emergence herbicides in chickpea Indian. Journal of Weed Science **53**(1): 49–53.

Nath CP, Kumar N, Hazra KK, Praharaj CS, Singh SS, Dubey RP, and Sharma AR. 2021. Topramezone: a selective post-emergence herbicide in chickpea for higher weed control efficiency and crop productivity. Crop Protection **150**: 1-10.

Poonia TC and Pithia MS. 2013. Pre- and post-emergence herbicides for weed management in chickpea. Indian Journal of Weed Science **45**(3): 223–225.

Rupareliya VV, Chovatia PK, Vekariya SJ and Javiya PP. 2017. Effects of different pre- and post-emergences herbicide on growth, yield attributes, yield and quality of chickpea (*Cicer arietinum* L.). International Journal of Science, Environment and Technology **6**(4): 2587–2593.

Yadav LV, Shukla UN, Raiger PR and Mandiwal M. 2019. Efficacy of pre and post-emergence herbicides on weed control in chickpea (*Cicer arietinum* L.). Indian Journal of Agricultural Research **53**(1): 112-115.