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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 614-616

www.thepharmajournal.com
Received: 05-08-2022
Accepted: 12-09-2022

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Effect of different PoE broad spectrum herbicides on yield attributes, seed and stover yield of chickpea crop (*Cicer arietinum* L.) in Chhattisgarh plains

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Abstract
A field study was conducted at Instructional Cum Research Farm of IGKV, Raipur (Chhattisgarh) during winter season of 2020-21 and 2021-22 to study the "Effect of different PoE broad spectrum herbicides on yield attributes, seed and stover yield of chickpea crop (*Cicer arietinum* L.) in Chhattisgarh plains". The soil was clayey (*Vertisols*) in texture, locally known as "*Kanhar*" which was low, medium and high in available N, P_2O_5 and K_2O, respectively. The experiment was laid out in Randomized block Design with four replications with Chickpea (*Cicer arietinum* L.) variety Indira chana-1. Treatment comprised two different doses of topramezone at 14 DAS & 21 DAS along with Quizalofop-p-ethyl and another treatment with recommended practice (with pre + post emergence/manual control herbicide). The significantly highest pods per plant, seeds per pod, 100 seeds weight, seed yield and harvest index were recorded under treatment weed free check and lowest was recorded under unweeded control but among the herbicidal treatment topramezone 20.6 g a.i./ha at 14 DAS found superior over all the other treatment during both the years and on mean basis. Highest stover yield was obtained under weed free check while lowest under Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS.

Keywords: Chickpea, yield attributes, seed and stover yield, harvest index, Post emergence herbicides

Introduction
Chickpea (*Cicer arietinum* L.) is one of the important grain legumes of the world which is grown in 44 countries across five continents. India is the largest producer of chickpea accounting to 75% of the world production. The major chickpea growing states in India are Maharashtra, Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Rajasthan, Uttar Pradesh and Gujarat. It grows on a very light sandy loam to heavy textured clay soils. Among the potential pulse crops in the country, chickpea occupies the second place after pigeonpea, with an area of 8.3 m ha. In chickpea production, one of the major constraints is weed infestations. Weeds create a serious problem in cultivation of chickpea and reduce the yield up to 90%. Bhalla *et al*. (1998) [3] reported that herbicide treatment gave 50 - 64% weed control with an increase in yield. Weed growth was significantly reduced by the use of herbicides and resulted in 50% increase in yield over untreated fields (Hosseini *et al.* 1997) [7]. Presently, pre-emergence herbicide (pendimethalin) and manual weeding at 30–35 days after sowing (DAS) is recommended in chickpea. However, manual weeding is proving difficult because of labour scarcity at critical time of weeding and increasing cost. Therefore, to control of the later flush of weeds, use of post-emergence herbicides becomes important. But, no post-emergence herbicide is available for controlling broad leaved weeds like Medicago denticulala, Vicia sativa, Convolvulus arvensis, Chenopodium album and others. Quizalofop-ethyl, imazethapyr, topramezone, are new generation post-emergence herbicides used in many crops. Quizalofop ethyl are used in many leguminous crops. It is a phenoxy compound used to control grassy weeds. Topramezone is a hydroxylphenyl pyruvate dioxygenase enzyme inhibitors of biosynthesis of plastoquinone and plant growth. Acifluorfen is protoporphyrinogen oxidase inhibitors of biosynthesis of chlorophyll. There is an urgent need to identify and evaluate an effective post-emergence herbicide to control broad-spectrum weeds. However, no systematic study was conducted to see the efficacy of these post-emergence herbicides in chickpea. Keeping in view above facts, the present study was undertaken to evaluate the effect of post-emergence herbicides in chickpea.

Material and Methods

A field experiment was carried out at Instructional Cum Research Farm of IGKV, Raipur (Chhattisgarh) (21˚4′ N latitude and 81˚39′ E longitude), India, during Rabi season in 2020-21 and 2021-22. Soil of the experimental field belongs to the order Clayey (*Vertisols*) having Coarse Sand 5.33%, Fine Sand 14.93%, Silt 35.37%, Clay 44.41% texture. The chemical analysis of soil showed its pH 7.1, organic Carbon (0.68%), low in available N (235 kg ha^{-1}), medium in available P (12.26 kg ha^{-1}) and high exchangeable K (389.5 kg ha^{-1}).

Treatment comprised of two different doses of topramezone at 14 DAS & 21 DAS along with Quizalofop-p-ethyl, unweeded control, weed free check (manual weed control/Recom. Practice) and another treatment with recommended practice (with pre + post emergence/manual control herbicide). The experiment was laid out in randomized block design (RBD) with 4 replications. Chickpea variety Indira chana-1 were used for the study and was sown on 29 November 2020-21 and 03 December 2021-22 with same treatments in both years. Seed was sown with a rate of 80 kg ha^{-1}. Plant to plant distance was maintained 10 cm in a row spacing of 30 cm for chickpea. The fertilizers were applied as basal with 20:50:20 kg N:P:K/ha. Herbicides applied as post-emergence in treatment T1, T2, T3, T4 and T_5 respectively. Herbicide dissolved thoroughly in water @ 500 liter as ha^{-1}.

Results and Discussion

Yield attributing characters

The data of pods per plant and 100 seed weight during both the years and on mean basis found significant difference among all weed management treatments presented in Table 1 revealed that maximum pods per plant recorded under treatment weed free check (manual weed control/Recom. Practice) and it was at par with another treatment with recommended practice (with pre + post emergence/manual control herbicide) but among the herbicidal treatment topramezone 20.6 g a.i./ha at 14 DAS found superior over all the other treatment. It might be due to better germination and less mortality of plant. The minimum pods per plant and 100 seeds weight found under unweeded control during both the years and on the mean basis. In the year 2021-22 seeds per pod found non significant difference among all weed management treatments while in the year 2020-21 and on mean basis seeds per pod found significant, presented in Table 1.

The variation among treatments might be due to the less competition at critical period of crop growth and better suppression of weeds which allowed the crop to grow at their potential by absorbing sufficient nutrients, light and moisture which facilitate more translocation of photosynthates towards the reproductive parts as well as presence of favorable agro-climatic conditions led to more number of pods plant.

Table 1: Yield attributing characters of chickpea as influenced by different weed control measures

Treatments	Pods / Plant (No.)			Seeds /Pod (No.)			100 Seed Weight (g)		
	2020-21	2021-22	Mean	2020-21	2021-22	Mean	2020-21	2021-22	Mean
Topramezone 20.6 g a.i./ha at 14 DAS	41.00	40.90	40.95	1.35	1.35	1.35	27.60	27.64	27.62
Topramezone 20.6 g a.i./ha at 21 DAS	33.10	33.25	33.18	1.10	1.20	1.15	26.32	26.25	26.29
Topramezone 25.7 g a.i./ha at 14 DAS	38.55	38.55	38.55	1.30	1.25	1.28	26.91	26.77	26.84
Topramezone 25.7 g a.i./ha at 21 DAS	38.45	38.25	38.35	1.25	1.25	1.25	26.77	26.70	26.73
Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS	35.10	34.95	35.03	1.25	1.20	1.23	26.54	26.49	26.51
Unweeded control	20.55	20.40	20.48	1.15	1.15	1.15	26.28	26.15	26.22
Weed free check (manual weed control/Recom. Practice	44.20	43.95	44.08	1.50	1.45	1.48	28.92	29.04	28.98
Another treatment with recommended practice (with pre + post emergence/manual control herbicide)	43.00	42.70	42.85	1.40	1.40	1.40	28.68	28.59	28.63
SEm±	1.51	1.53	1.52	0.08	0.09	0.06	0.82	0.80	0.71
CD at 5%	4.45	4.51	4.47	0.23	NS	0.19	NS	NS	NS

Seed and stover yield (kg/ha)

Data based on two years and on the mean basis revealed that seed yield and stover yield significantly affected by all weed management practices on chickpea are presented in Table 2. Weed free check (manual weed control/Recom. Practice) recorded significantly higher seed yield (1824.96 kg/ha and 1822.07 kg/ha) and stover yield (2765.75 and 2798.61 kg/ha) during both the years and on mean basis which was at par with the treatment of another treatment with recommended practice (with pre + post emergence/manual control herbicide) and Topramezone 20.6 g a.i./ha at 14 DAS but among herbicidal treatment same trend follows as pods per plant. The minimum seed yield was recorded under unweeded control while stover yield was lowest under Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS. Higher seed yield under above treatments might be due to the proper utilization of moisture, nutrients light and space by the chickpea crop in the absence of weed competition. And the higher stover yield might be due to lesser weeds during early crop growth period, higher yield attributes and pod yield which leads to higher stover yield.

Harvest Index

The data based on two years and on mean basis harvest index (HI) presented in Table 2 was found significantly influenced by various weed management practices. Higher harvest index (39.79) recorded under treatment weed free check (manual weed control/Recom. Practice) during 2020-21 which was at par with the treatment Another treatment with recommended practice (with pre + post emergence/manual control herbicide), Topramezone 20.6 g a.i./ha at 14 DAS, Topramezone 20.6 g a.i./ha at 21 DAS, Topramezone 25.7 g a.i./ha at 14 DAS and Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS while in year 2021-22 the highest harvest index (39.65) recorded under the treatment Another treatment with recommended practice (with pre + post emergence/manual control herbicide) and it was at par with the treatment of weed free check (manual weed control/Recom. Practice), Topramezone 20.6 g a.i./ha at 14 DAS, Topramezone 20.6 g a.i./ha at 21 DAS, Topramezone 25.7 g a.i./ha at 14 DAS and Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS. Among the herbicidal treatment topramezone 20.6 g a.i./ha at 14 DAS

found superior over all the other treatment on both the years and mean basis. The minimum harvest index (18.14 and 18.04) was obtained under unweeded control due to low seed yield and more crop-weed competition. Maximum harvest index under these treatments might be due to proper reproductive growth due to timely translocation of photosynthesis from source to sink thus increase the seed production ratio in total produce.

Table 2: Seed yield, stover yield and harvest index of chickpea as influenced by different weed control measures

Treatment	Seed yield (kg/ha)			Stover yield (kg/ha)			Harvest index (%)		
	2020-21	2021-22	Mean	2020-21	2021-22	Mean	2020-21	2021-22	Mean
Topramezone 20.6 g a.i./ha at 14 DAS	1741.51	1739.47	1740.49	2704.36	2723.20	2717.52	39.17	38.98	39.08
Topramezone 20.6 g a.i./ha at 21 DAS	1536.45	1533.91	1535.18	2357.79	2352.97	2351.93	39.44	39.46	39.45
Topramezone 25.7 g a.i./ha at 14 DAS	1663.10	1656.52	1659.81	2574.98	2591.70	2586.70	39.25	39.00	39.12
Topramezone 25.7 g a.i./ha at 21 DAS	1389.23	1393.63	1391.43	2302.76	2314.07	2313.20	37.68	37.64	37.66
Quizalofop-p-ethyl 100 g a.i./ha at 25 DAS	1236.30	1234.35	1235.33	1923.58	1937.54	1933.97	39.13	38.92	39.03
Unweeded control	486.68	485.72	486.20	2197.27	2206.21	2206.92	18.14	18.04	18.09
Weed free check (manual weed control/Recom. Practice	1824.96	1822.07	1823.51	2765.75	2798.61	2784.75	39.79	39.45	39.62
Another treatment with recommended practice (with pre + post emergence/manual control herbicide)	1805.39	1804.16	1804.78	2763.22	2744.96	2764.09	39.54	39.65	39.59
SEm±	58.55	57.80	58.14	99.84	95.50	95.30	0.83	0.73	0.76
CD at 5%	172.20	169.99	170.98	293.62	280.88	280.29	2.45	2.15	2.25

Conclusion

The relevant study based on both the years and on mean basis it concluded that significantly maximum pods per plant, seeds per pod, 100 seeds weight and seed yield recorded under weed free check (manual weed control/Recom. Practice) but among the herbicidal treatment topramezone 20.6 g a.i./ha at 14 DAS found superior over all the other treatment and minimum in unweeded control.

The data on stover yield and harvest index showed significant difference under all the treatments. Maximum stover yield and harvest index were recorded under treatment weed free check (manual weed control/Recom. Practice) but among the herbicidal treatment topramezone 20.6 g a.i./ha at 14 DAS found superior in stover yield and topramezone 20.6 g a.i./ha at 21 DAS found superior in harvest index over all the other treatment.

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