

RESPONSE OF PRE AND POST EMERGENCE HERBICIDES ON GROWTH, YIELD ATTRIBUTES AND YIELD OF CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

The current study was carried out on sandy loam soil at TCA's research farm, Dholi, Muzaffarpur, during the *rabi* season of 2020-21. The experiment was carried out in an RBD design with three replications and ten treatments *i.e.* topramezone 20.6 and 25.7 g ha⁻¹ applied at 14, 21 and 28 DAS and quizalofop-p-ethyl (100 g ha⁻¹) applied at 25 DAS as post emergence (PoE), pre emergence (PE) application of valor 1000 g ha⁻¹ + one hand weeding (HW) at 30 DAS, weed-free control (WFC) and weedy check. The two hand weeded treatment at 30 and 50 DAS recorded significantly maximum plant growth parameters, yield attributes and yield followed by PE application of valor (1000 g ha⁻¹), while the lowest was in the weedy check. Among all PoE treatments, a spray of topramezone 25.7 g ha⁻¹ after 21 days of sowing (DAS) recorded significantly maximum plant height and dry matter at 60 and 90 DAS, respectively. It was significantly increased the chickpea dry matter production by 1.1-13.2% at 60 DAS and 5.7-29.0% at 90 DAS compared with other doses and application times of topramezone. It was also recorded 21.6-49.6% higher plant dry weight than quizalofop-p-ethyl 100 g ha⁻¹ (25 DAS). Same treatment also increased number of branches and pods plant⁻¹, test weight and seed yield, but significantly lowest in the quizalofop-p-ethyl (100 g ha⁻¹ at 25 DAS) treated plot. However, PE spray of valor 1000 g ha⁻¹ + one weeded treatment was recorded significantly highest B:C ratio (2.17) followed by topramezone 25.7 g ha⁻¹ at 21 DAS (2.01). Hence, these two treatments can be considered as the most effective treatments.

(Key words: Topramezone, valor, post-emergence, pre-emergence and quizalofop-p-ethyl, weed)

INTRODUCTION

Chickpea is a major winter pulse crop, it is known as gram, bengal gram, hommos, pios and garbanzo. It is a very good source of protein, minerals and vitamins. Chickpea is mainly consumed after the processing of whole seed, dal or dal floor (Besan). Gram is excellent animal feed, and its haulm also has good forage value. Semi-tropical countries accounted for approximately 92% of area and 89% of chickpea production worldwide (Rathod *et al.*, 2017). In India, it was cultivated in 99 lakh ha areas and produced a 107 lakh tonne yield with 1086 kg ha⁻¹ productivity (Anonymous, 2022).

Chickpeas have higher yield potential, but it has remained stagnant for several decades. Higher weed infestation is the major cause of yield reduction compared to other factors (pest and disease). It is a poor weed competitor due to its slow early growth and yield reduction of approximately 80% observed during a long crop-weed competition period (Nath *et al.*, 2021). The losses included direct yield reductions caused by cropweed competition, as well as indirect losses due to decreased crop quality, increased cost of cultivation, and higher incidence of insect

pests and diseases (Deshkari *et al.*, 2019). For weed management in chickpea, pre-emergence (PE) application of pendimethalin at 1000 g ha⁻¹ with single hand weeding is recommended practice. Weed control through manual weeding is a difficult task due to increasing cost and scarcity of labour (Rathod *et al.*, 2017).

In PoE (post-emergence), an herbicide like quizalofop-p-ethyl 100 g ha⁻¹ is recommended for grassy weeds without crop phytotoxicity (Kumar *et al.*, 2015), but broad-leaved weeds cause more yield reduction in chickpea. Herbicide is the most effective weed control technique because its use provides an opportunity to decrease risk (Singh *et al.*, 2020). Farmers need a broad spectrum PoE herbicide for controlling all broad and narrow-leaved weeds flora. Use of herbicides plays an essential role in control of weeds at early stages of crop growth. Hence, the search of new herbicides is very important (Vanisree *et al.*, 2019). Topramezone is a PoE herbicide that is recommended for maize, but its selectivity for chickpea is unknown.

So, the present experiment was conducted to find out the selectivity of herbicides in chickpea by the application of differential doses and time intervals for optimum weed management.

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MATERIALS AND METHODS

The current research was conducted at the Trihut College of Agriculture's agronomical research farm at Dholi, Muzaffarpur (Bihar) during *rabi* season of 2020-21. It is located in the Indo-Gangetic region at 250° 49' N latitude, 850° 60' E longitude, and 52.18 meters above mean sea level. The experimental soil was low in available N and medium in P₂O₅ and K₂O (239, 17.6 and 128 kg ha⁻¹, respectively). The experiment was conducted with three replications in a randomized block design. The experiment consisted of ten treatments, *viz.*, topramezone 20.6 g ha⁻¹ at 14 days after sowing (DAS) (as early-PoE), 21 DAS (PoE) and 28 DAS (late-PoE), topramezone 25.7 g ha⁻¹ at 14 DAS (early-PoE), 21 DAS (PoE) and 28 DAS (late-PoE), and quizalofop-p-ethyl 100 g ha⁻¹ at 25 DAS applied as post-emergence (PoE). Valor (pendimethalin 30% + imazethapyr 2%) 1000 g ha⁻¹ pre-emergence (PE) followed by one manual weeding at 30 DAS, weed free check (twice hand weeding at 30 and 50 DAS) and weedy check (WC). The existing crop variety of chickpea (*Cicer arietinum* L.) was GNG-2299 (Awadh) and suitable for late sown irrigated condition of NEPZ. This variety has good tolerance against important diseases like *Fusarium* wilt and root rot. Land was prepared by cross-ploughing with a cultivator and planking was done after each plough to level the field. Fertilizers applied as basal applications *viz.*, N, P₂O₅, K₂O and ZnSO₄ with a doses of 20, 40, 20 and 25 kg ha⁻¹, respectively and these were provided by urea, DAP, MOP and ZnSO₄ as recommended in the Bihar state diary. Sowing of the crop was done at 30 cm x 10 cm spacing, the seed rate was 80 kg ha⁻¹. Before sowing the crop, seed was treated with carbendazim (2.5 g kg⁻¹ of seed) then treated with rhizobium culture and PSB culture. Sowing was done in, open furrows with liners at 30 cm spacing. Using the kera technique, chickpea seeds were sown in the 30 cm x 10 cm gap. For controlling weeds, manual weeding was done with the help of labour power. After calculating the above recommended doses of herbicide as per treatment, they were mixed with 630 ml of water and sprayed over each plot (14.6 m²) by knapsack sprayer. Crop growth observations recorded from five plants were randomly picked and categorized from every plot to review pre and post-harvest observations. For measuring the dry matter of plants, five plants were randomly uprooted from every plot and dried in sunlight for 2-3 days. After sun drying, plant samples were oven dried for 72 hours at 70 °C and dry weights were taken after complete drying by measuring balance. Plant dry matter production was measured at 60 and 90 DAS. The number of effective nodules plant⁻¹ was counted carefully after washing the uprooted roots with fresh water. The plant height was measured from base to tip of main shoot at 60 and 90 DAS using a measuring scale, while the number of branches plant⁻¹ was counted manually at 60 DAS. The total number of pods plant⁻¹ was recorded after crop maturity and the average number of seeds pod⁻¹ was calculated from ten randomly selected pods. Test weight was obtained by weighing 1000 randomly selected seeds using an electronic weighing

balance and expressed in grams. Seed yield plot⁻¹ was recorded after cleaning and drying of seeds and then converted to yield kg ha⁻¹. Similarly, haulm yield was determined by weighing the dried plant matter (excluding seeds) and expressed in kg ha⁻¹. The recorded crop data for various parameters were analyzed using ANOVA in the OPSTAT program.

RESULTS AND DISCUSSION

Crop-weed competition:

Meaning of competition is struggle for existence for their continuous growth and development. In crop-weed competition, there is competition for nutrients, water, sunlight and their deficiency affects crop growth. PE application of valor (1000 g ha⁻¹) kept the crop weed-free during the early growth stage and manual weeding at 30 DAS controls later flushes of weed and ultimately, reduced crop-weed competition. The PoE application of topramezone at 21 DAS (25.7 g ha⁻¹) had the lowest crop-weed competition as compared to other PoE applications. Early PoE applications (14 DAS) did not control later flushes of weeds, whereas with late PoE applications (28 DAS), weeds were more resistant to herbicide.

Effect of herbicides applications on crop growth parameters

Plant height

All weed management treatments had greater plant height than the weedy control plot. The two hand weeded treatment at 30 and 50 DAS recorded significantly maximum plant height followed by pre-emergence application of valor 1000 g ha⁻¹ one HW (T₈) and topramezone 25.7 g ha⁻¹ at 21 DAS (T₅), while the lowest was in the weedy check (Table 1). Among the post-emergence (PoE) herbicides application of topramezone 25.7 g ha⁻¹ at 21 DAS was the most effective PoE application, resulting in the 1518% greater plant height (60 and 90 DAS) than the weedy check. Reddy *et al.* (2025) observed that among all the herbicides, post-emergence application of topramezone 25 g ha⁻¹ at 25 DAS gave significantly highest plant height.

Branches plant⁻¹

The significantly maximum number of branches plant⁻¹ at 60 DAS were recorded in two hand weeding treatment (30 and 50 DAS), which was at par with valor 1000 g ha⁻¹ (PE) + HW at 30 DAS, topramezone 25.7 g ha⁻¹ at 21 DAS (T₅) followed by topramezone 20.6 g ha⁻¹ at 21 DAS (T₂). Among the PoE herbicidal treatments, topramezone 25.7 g ha⁻¹ at 21 DAS (T₅) produced significantly higher number of branches plant⁻¹.

Root nodules formation (Number m⁻²)

The significantly maximum number of root nodules plant⁻¹ at 60 DAS were recorded in two hand weeding treatment (30 and 50 DAS), which was at par with valor 1000 g ha⁻¹ (PE) + HW at 30 DAS. Among the PoE herbicidal treatments, topramezone 25.7 g ha⁻¹ at 21 DAS (T₅) produced significantly higher root nodules plant⁻¹.

Dry matter production

During the crop growth phase, a significant effect of weed management practices on plant dry matter accumulation was found between treatments. The two-hand weeded treatment produced the significantly maximum plant dry matter at all growth stages (60 and 90 DAS) followed by PE application of valor (1000 g ha⁻¹) with one HW at 30 DAS treatment and topramezone 25.7 g ha⁻¹ at 21 DAS (T₅). These treatments provided effective weed suppression throughout the crop growth period, leading to enhanced dry matter accumulation.

Among the PoE herbicidal treatments, treatment T₅ (topramezone 25.7 g ha⁻¹ at 21 DAS) was recorded 28.1 to 30.0% higher plant dry matter compared to early-PoE (T₁ and T₄) and 6.3 to 13.2% higher than the late-PoE spray of topramezone (T₃ and T₆), respectively at 90 DAS. This treatment also recorded 49.6% higher plant dry weight (90 DAS) than quizalofop-p-ethyl 100 g ha⁻¹. This clearly indicates that application of topramezone (25.7 g ha⁻¹) at 21 DAS was the most effective post-emergence strategy for enhancing biomass accumulation through improved weed suppression during critical crop growth stages. Patel *et al.* (2024) found that significantly highest dry matter accumulation of chickpea was obtained with PE applied herbicide (oxyfluorefen 150 g ha⁻¹) followed by topramezone 20.6 g ha⁻¹ (PoE).

Yield attributes

The highest number of seeds pod⁻¹ and test weight were observed in the twice HW treatment followed by PE application of valor + one HW and the lowest in the weedy control plots, but significant difference was not found across treatments. It might be due to those characters being more dependent on genetic factors. Two hand weeded treatment produced the significantly highest number of pods plant⁻¹ followed by PE application of valor (1000 g ha⁻¹) + one manual weeding. Among the PoE applications, topramezone spray 25.7 g ha⁻¹ at 21 DAS recorded significantly maximum number of pods plant⁻¹, which was statistically at par with topramezone 20.6 g ha⁻¹ at 21 DAS. Reddy *et al.* (2025) found that among all the herbicides, post-emergence application of topramezone 25 g ha⁻¹ at 25 DAS gave maximum values of

yield attributes (number of pods plant⁻¹ and number of seeds pod⁻¹).

Seed and haulm yield

The two manually weeding treatment (T₉) yielded significantly more seed yield followed by PE application of valor (1000 g ha⁻¹) with one weeding (T₈) and PoE application of topramezone 25.7 g ha⁻¹ (T₅) but lowest seed and haulm yield recorded under weedy check. Pre-emergence application of valor (1000 g ha⁻¹) + one hand weeding was shown to be superior in improving seed production.

Among PoE herbicide applications, topramezone 25.7 g ha⁻¹ applied after 21 days of sowing (T₅) produced significantly higher yield than other PoE applications followed by topramezone 20.6 g ha⁻¹ 21 DAS (T₂). It was yielded 82.4% more seed yield than the weedy check treatment, as well as 47.6-57.2% more than early-PoE at 14 DAS (T₁ and T₄) and 29.2-39.4% higher than late-PoE spray of topramezone at 28 DAS (T₃ and T₆). This treatment also increased 64.4% higher seed yield as compared to PoE application of quizalofop-p-ethyl 100 g ha⁻¹. Patel *et al.* (2024) reported that PoE application of topramezone increased 59.9% seed yield than quizalofop-p-ethyl (PoE) and 197.2% higher than weedy check. Tiwari *et al.* (2018) studied on maize by using a 25.5 g ha⁻¹ dose of topramezone on maize, and observed the highest values of yield and all yield attributes compared to other herbicides. Varshini *et al.* (2023) found that topramezone spray (PoE) increased chickpea yield by 30-39% as compared to other PoE applied herbicides. Swetha *et al.* (2015) reported PoE application of topramezone 25.2 g ha⁻¹ decreased weed growth and enhanced crop yield.

B:C ratio

Among all treatments PE spray of valor 1000 g ha⁻¹ + one HW treatment was recorded significantly highest B:C ratio (2.17) and it was followed by PoE application of topramezone 25.7 g ha⁻¹ at 21 DAS (2.01).

In conclusion, based on the economic analysis, the pre-emergence application of valor (pendimethalin + imazethapyr) with a single manual weeding proved to be the most effective treatment, followed by the post-emergence application of topramezone 25.7 g ha⁻¹ at 21 DAS.

Table 1. Effect of herbicide application on plant growth parameters

Treatments	Plant height		Branches plant ⁻¹	Root nodules plant ⁻¹	Plant dry weight (g m ⁻²)	
	(cm)				60 DAS	90 DAS
	60 DAS	90 DAS	60 DAS	60 DAS	60 DAS	90 DAS
T ₁	22.94	39.70	8.30	22.40	34.40	113.17
T ₂	25.13	42.49	9.52	22.13	38.54	137.12
T ₃	24.62	39.81	8.47	21.43	38.11	127.98
T ₄	22.70	39.57	8.07	21.55	34.68	111.52
T ₅	25.33	43.78	9.71	22.19	38.95	144.95
T ₆	24.42	40.02	9.01	21.20	39.82	136.35
T ₇	23.13	37.85	7.00	19.73	32.03	96.90
T ₈	27.78	47.42	10.88	29.45	43.69	163.47
T ₉	28.01	47.69	10.94	32.78	44.18	165.19
T ₁₀	21.90	37.07	5.81	17.96	31.50	94.50
SE(m)±	1.05	1.52	0.64	1.80	2.19	8.52
CD at 5%	3.13	4.50	1.90	5.34	6.52	25.32

Table 2. Effect of herbicides applications on yield attributes and yield

Treatments	Pods plant ⁻¹	Seeds pod ⁻¹	Test weight (g)	Yield (kg ha ⁻¹)		B:C ratio
				Seed	Haulm	
				T ₁	15.03	
T ₂	19.71	1.56	133.50	1222	1857	1.93
T ₃	16.43	1.54	132.83	938	1452	1.48
T ₄	13.77	1.53	132.39	832	1303	1.28
T ₅	21.11	1.57	133.73	1308	1964	2.01
T ₆	16.43	1.55	133.33	1012	1591	1.56
T ₇	14.22	1.47	131.83	794	1274	1.35
T ₈	22.74	1.61	134.10	1504	2208	2.17
T ₉	24.23	1.62	134.31	1582	2289	1.98
T ₁₀	13.75	1.48	131.07	717	1163	1.29
SE(m)±	1.20	0.04	2.80	96.7	144.3	0.15
CD at 5%	3.58	-	-	287.2	428.6	0.43

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