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WEED DYNAMICS PRODUCTIVITY AND ECONOMICS OF DIFFERENT VARIETIES OF CHICKPEA (*CICER ARIETINUM* L.) WITH DIFFERENT DOSES OF HERBICIDES UNDER POST-EMERGENCE CONDITION

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ABSTRACT

Field experiment was conducted to find out the evaluation of herbicide doses and application time of topramezone on different chickpea varieties during rabi season of 2020-21 at research farm of Bihar Agricultural University, Sabour, Bhagalpur (Bihar) tested in sub sub-plot design (SSPD) revealed that the GCP 105 varieties of chickpea at the 25 DAS *i.e.* post-emergence with the doses of 25 g/ha topramezone herbicide were effectively controlled all the weed effectively in chickpea recorded significantly highest plant height (cm), dry matter accumulation g/m² at 60 DAS, number of pods/plant, 100 seed weight (g), grain yield (1.62, 1.66, 1.81 t/ha), net return (96933, 98521, 106956 Rs ha⁻¹) and B:C ratio (2.64, 2.71, 2.47) respectively.

Key words: Chickpea, Topramezone, GCP 105, Herbicide, Yield, Economics

Introduction

Chickpea is a leading pulse crop, grown in an area of 9.86 million ha with annual production of 10.44 million tonnes, registering an average productivity of 1059 kg/ha (Ministry of Agriculture, 2021-22). The productivity of chickpea has fallen due to various constraints such as biotic and abiotic factors. Among the biotic constraints wilt, dry root rot and blight are the major constraints in Bihar. Chickpea is short stature crop with slow initial growth and Poor weed management is one of the most important yield limiting factors in chickpea therefore, heavily infested with wide spectrum of weeds. The initial 60 days' period considered to critical for weed crop competition in chickpea (Singh and Singh 2000), but continuously facing of the scarcity of labour and increase in labour cost, manual weed control has become a difficult task. The early emergence and fast growth of the weeds lead to severe crop-weed competition for light, moisture, nutrients and space, which culminates in heavy reduction in growth and yield of chickpea and lessens the

profitability (Chopra *et al.*, 2003). Being slow in its early growth and short statured plant, chickpea is highly susceptible to weed competition and weeds causes up to 75% yield loss (Chaudhary *et al.*, 2005) and (Balyan and Bhan, 1984). Most weed species can grow faster and taller than chickpea and inhibit its growth, absorbs sunlight, and affect photosynthesis and plant productivity adversely (Rao 2000). Solh and Pala (1990) reported 40-87 % yield loss in chickpea due to weeds. The poor productivity of chickpea is mainly due to competition from diverse weed population (Sharma, 2009). Although weed-management practices through manual weeding is effective in weed control, it is uneconomical due to higher costs (Kumar *et al.*, 2010). So far, pendimethalin was identified as a suitable pre-emergence (PE) herbicide effective against emerging broad-leaf weeds (especially *Chenopodium album*). However, it is not found effective against many other weeds including *Cyperus rotundus* (Kumar and Hazra, 2012). Therefore, pendimethalin along with a manual weeding at 35–40 days after sowing was

Table 1: Effect of herbicide doses and application time of topramezone on total weed population (No./ m²) and total dry weight of weeds (g/m²) in different chickpea varieties at 60 DAS and at harvest.

Treatments	Total weeds population (No./ m ²)		Total dry weight of weeds (g/m ²)	
	60 DAS	At harvest	60 DAS	At harvest
Varieties				
GCP 105	4.14(16.68)	3.66(12.92)	3.74(13.52)	4.00(15.57)
PG 186	4.6(20.66)	4.15(16.74)	3.78(13.79)	4.26(17.66)
SEm±	0.04	0.02	0.01	0.02
CD(P=0.05)	0.16	0.08	0.03	0.06
Application times of herbicide				
25 DAS	4.24(17.49)	3.72(13.36)	3.69(13.18)	4.04(15.88)
30 DAS	4.40(18.94)	3.90(14.73)	3.72(13.41)	4.12(16.54)
35 DAS	4.64(21.08)	4.11(16.40)	3.85(14.38)	4.23(17.41)
SEm±	0.05	0.05	0.05	0.02
CD(P=0.05)	0.13	0.13	0.14	0.07
Herbicide doses				
0	7.57(56.81)	6.69(44.32)	6.49(41.68)	6.22(38.22)
25	2.77(7.22)	2.40(5.30)	2.41(5.34)	2.87(7.75)
30	2.63(6.44)	2.32(4.92)	2.20(4.37)	2.78(7.27)
35	2.59(6.21)	2.29(4.77)	2.17(4.23)	2.77(7.21)
SEm±	0.06	0.07	0.07	0.08
CD(P=0.05)	0.17	0.13	0.14	0.16

*Figures in the parentheses indicate transformed data to $\sqrt{x+1}$ DAS-days after sowing

recommended (Chaudhary *et al.*, 2011). Use of post-emergence herbicides in combination with pre-emergence may be one of the tools for broad-spectrum weed control. Quisqualofop ethyl is recommended in soybean and other leguminous crops to control grassy weeds (Kumar *et al.*, 2013). Introduction of new herbicides has made it possible to control a wide spectrum of weeds in pulses effectively at a remunerative cost. Many research workers from the various parts of the country has been reported that the application of pendimethalin as pre-emergence at 1.0 kg ha⁻¹ (Singh and Jain, 2017) and oxyfluorfen (80 g ha⁻¹) as weed control treatment (Patel *et al.*, 2006) provided effective control of annual broad leaved and grassy weeds in chickpea field at an early stage. However, later flushes of weeds can only be control by application of imazethapyr as post-emergence (Rathod *et al.*, 2017). Topramezone is a hydroxylphenyl pyruvate dioxygenase enzyme inhibitors of biosynthesis of plastoquinone and plant growth. There is an urgent need to identify and evaluate an effective post-emergence herbicide and its appropriate doses 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 these facts, the present investigation was undertaken to test the performance of different varieties of chickpea (*Cicer arietinum* L.) with different doses of

topramezone under post-emergence condition for providing effective weed control in chickpea.

Materials and Methods

The experiment was carried and laid out during rabi season of 2020-21 of the research farm of Bihar Agricultural University, Sabour, Bhagalpur (Bihar). The experimental plot was provided and has sufficient basic infrastructure facilities, with assured irrigation as well as proper drainage facility with uniform slope. Geologically, the geographical location of Bhagalpur comes under the Middle Gangetic plain region of Agro-climatic Zone III A. It is situated between 25°50' N latitude and 87°19' E longitude at an altitude of 52.73 meters above mean sea level. This region receives an average rainfall of 130 mm and the average monthly temperature during the growing period in the experimental year was 33.0 °C the soil was clay loam in texture with pH (7.51), organic carbon (0.52 %), low in available nitrogen (219.88 kg ha⁻¹), medium in available phosphorous (35.46 kg P₂O₅ha⁻¹), and medium in available potassium (162.90 kg K₂Oha⁻¹). The experiment was tasted in Split-Split Plot Design with twenty-four treatments combination having three replications during Rabi season of 2020-21. The treatments comprised varieties in main plot viz., GCP105 and PG 186, Sub-plot treatments consisted of three time of herbicide applications i.e. 25 DAS, 30 DAS and 35 DAS whereas in Sub-sub plot treatments comprised of different herbicide doses i.e. no herbicide, 25 g, 30 g and 35 g topramezone. The following the recommended seed rate i.e. 75 kg ha⁻¹. The size of each plot was 5.0 m x 3.0 m with the spacing of crop 30 cm x 10 cm having ten rows of five-meter row length. The recommended dose of fertilizer in chickpea are 20 and 40 N, P₂O₅ kg ha⁻¹ respectively through urea, and DAP were applied uniformly to all the plots, all fertilizer was applied in a single dose i.e. basal application. Intercultural operations were done as and when required. No any irrigation was given i.e. crop was grown in rainfed condition. Herbicides were applied with the help of Knapsack sprayer fitted with flat fan nozzle. Data were recorded on weeds, crop growth parameters and yield of chickpea. The mature crop were harvested when crop colour change from green to brown.

Result and Discussion

The dominant weed flora of the experiment field comprised of Grasses: *Cynodon dactylon*, *Phalaris minor*, *Fumaria parviflora*. Sedges: *Cyperus rotundus*.

Table 2: Effect of herbicide doses and application time of topramezone on plant height (cm), dry matter accumulation (g/ m²) at 60 DAS, number of pods/plant and 100 seed weight (g) in different chickpea varieties.

Treatments	PH	DMA	NPP	100SW
Varieties				
GCP 105	19.68	52.13	28.18	17.48
PG 186	18.72	40.55	25.92	16.70
SEm±	0.33	0.89	0.58	0.16
CD(P=0.05)	NS	3.14	2.07	0.62
Application times of herbicide				
25 DAS	19.62	49.08	26.53	17.36
30 DAS	19.20	47.31	25.57	17.13
35 DAS	18.78	44.64	23.05	16.78
SEm±	0.30	1.35	0.73	0.10
CD(P=0.05)	NS	3.74	2.22	0.28
Herbicide doses				
0	18.34	42.61	23.03	16.62
25	19.94	50.01	27.03	17.63
30	19.55	46.94	25.37	17.16
35	18.99	45.81	24.76	16.95
SEm±	0.41	1.03	0.56	0.20
CD(P=0.05)	NS	3.29	1.73	0.49
PH: Plant height (cm) at 60 DAS; DMA: Dry matter accumulation g/ m ² at 60 DAS; NPP: Number of pods/plant; 100SW: 100 seed weight (g)				

Broad leaved weeds: *Argemone mexicana*, *Solanum nigrum*, *Anagallis arvensis*, *Chenopodium album*, *Rumex dentatus*, *Melilotus indica*, *Vicia sativa* were found dominated weeds.

Effect on weed

The experimental findings revealed that the significantly lowest weed population and weed dry weight (g/m²) were recorded under variety GCP105 over chickpea variety PG 186 at 60 DAS and at harvest this is might be due to the variety of chickpea GCP105 was more vegetative growth than PG 186 variety of chickpea however in sub-plot the efficiency of topramezone herbicide is statistically maximum at 25 DAS over the 30 DAS and 35 DAS this is due to the efficiency of topramezone herbicide is more at 25 DAS which reduce the weed population after 25 DAS as a result vegetative growth of chickpea increase and gradually efficiency of herbicide decreases as a result weed population increase and in sub-sub-plot the optimum doses of topramezone herbicide at which maximum efficiency occurs at 35g However, the effect of 25 g topramezone was at par with 30 and 35 g topramezone (Table 1).

Effect on crop

The statistically maximum plant height (19.68 cm),

Table 3: Effect of herbicide doses and application time of topramezone on yield (t/ha) and economics of two different chickpea varieties.

Treatments	Grain yield (t/ha)	Grossreturn (Rs. ha ⁻¹)	B:C ratio
Varieties			
GCP 105	1.62	96933	2.64
PG 186	1.51	87827	2.45
SEm±	0.04	2113	0.06
CD(P=0.05)	0.10	9094	0.13
Application times of herbicide			
25 DAS	1.66	98521	2.71
30 DAS	1.57	92452	2.58
35 DAS	1.47	86167	2.35
SEm±	0.02	1139	0.04
CD(P=0.05)	0.06	3162	0.13
Herbicide doses			
0	1.20	70994	1.97
25	1.81	106956	2.47
30	1.68	98838	2.19
35	1.57	92734	2.02
SEm±	0.05	2433	0.04
CD(P=0.05)	0.14	4918	0.12

dry matter accumulation (52.13 g/m²) at 60 DAS, No. of pods/plant (28.18) and 100 seed weight (17.48 g) were recorded under variety GCP105 this is might be due to the variety of chickpea GCP105 was more vegetative and vigorous growth than PG 186 variety of chickpea however in sub-plot the efficiency of topramezone herbicide is maximum at 25 DAS over the 30 DAS and 35 DAS this is due to the efficiency of topramezone herbicide is more at 25 DAS which reduce the weed population after 25 DAS the vegetative growth of chickpea increase and gradually efficiency of herbicide decreases as a result plant height (19.62 cm), dry matter accumulation (49.18g/m²) at 60 DAS, No. of pods/plant (26.53) and 100 seed weight (17.34 g) increase over at the 30 DAS and 35 DAS whereas under sub-sub-plot the optimum doses of topramezone herbicide at which maximum efficiency occurs at 25g as a result statistically maximum dry matter accumulation (50.01/m²), No. of pods/plant (27.03) and 100 seed weight (17.63 g) (Table 2) were maximum recorded over the other three doses of topramezone herbicide and plant height was found non-significant on different doses of herbicide at 60 DAS. However, the effect of 25 g topramezone was at par with 30 g topramezone.

Grain yield and economics

By sowing of variety GCP105 registered yield advantage of (6.79%) compared to variety PG 186 however in sub plot, at 25 DAS of chickpea was found

statistically maximum grain yield (1.81 t/ha) over other two days of application of herbicide whereas the application of different doses of topramezone herbicide found statistically maximum with 25 g doses which significantly stepped up grain yield as compared to control but remained statistically at par with 30 g topramezone. gross return (Rs. 96933) and B:C ratio (2.64) were found significantly higher under GCP105 variety of chickpea whereas in subplot the time of application of herbicide it was found statistically maximum at 25 days (Rs. 98521) and B:C ratio (2.71) (Table 3) after sowing of chickpea however in sub sub plot with different doses of herbicide it was found statistically maximum with 25 g doses of topramezone (Rs. 106956) and B:C ratio (2.47) similar result was found by Kumar *et al.*, (2015).

Conclusion

Topramezone herbicide 25 g/ha at 25 DAS *i.e.* post-emergence effectively controlled all the weed effectively in chickpea *viz.* *C. album*, *M. denticulata* and *Phalaris minor* etc whereas as increase the doses of topramezone *i.e.* 30 g/ha and 35 g/ha were slightly phytotoxic to chickpea plants, which recovered later on and less effective if we applied at 30 DAS and 35 DAS. The highest grain yield and gross return was obtained in GCP 105 varieties of chickpea with doses of 25 g/ha at 25 DAS.

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