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WEED DYNAMICS AND YIELD OF CHICKPEA (*CICER ARIETINUM* L.) AS INFLUENCED BY HERBICIDES

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ABSTRACT

A field experiment was conducted during rabi season of 2021-22 under limited irrigation at Rice Research farm, BAU, Kanke, Ranchi to study the "Efficacy of herbicides on chickpea (Cicer arietinum L.) Production". The experiment was laid out in randomized block design (RBD) replicated thrice with the variety Birsa Chana-3 under limited irrigation condition. The treatments consists of oxyfluorfen (150g/ha), oxyfluorfen (250g/ha), quizalofop-p-ethyl (100g/ha) at 21 DAS, propaquizafop (100g/ha) at 21 DAS, topramezone 20.6g/ha at 21 DAS ,oxyfluorfen 150g/ha (PE) fb quizalofop-p-ethyl 100g/ha at 15-20 DAS (PoE), oxyfluorfen 150g/ha(PE) fb propaquizafop 100g/ha at 15-20 DAS (PoE), oxyfluorfen 150g/ha (PE) fb topramezone 20.6g/ha at 14-21 DAS (PoE), imazethapyr 60 g/ha (PoE) at 21 DAS, Manual Weeding (Weed free) at 25 DAS and 45 DAS, Weedy Check. oxyfluorfen @150 g/ha as pre-emergence fb topramezone 20.6g/ha at 14-21 DAS as post-emergence recorded maximum yield attributes, viz. number of pods /plant (36.98), number of seeds/pod (1.78), 1000 seeds weight (290.5 g) and yield of chickpea (19.15 q/ha),harvest index (35.97%) and minimum weed index (8.28%) and higher weed control efficiency (59.19%) during initial crop growth stage and realized maximum net return (64131/ha) and B:C ratio (1.81) of chickpea under medium land situation in irrigated condition (3 irrigations) of Jharkhand.

Keywords **:** Productivity, Chickpea, oxyfluorfen fb topramezone, Weed control efficiency and Yield attributes.

Introduction

Chickpea (*Cicer arietinum* L.) is one of the world's most important legumes crops, with more than 44 countries growing it across five continents. Chickpea is India's most important rabi pulse crop, and it ranks top among pulses. India is the world's largest producer of chickpeas, India has a land area of 98.86 lakh hectares, produces 107.37 lakh tons, and has a productivity of 1086 kg/ha (GOI Ministry of agriculture & Farmers Welfare, Annual Report 2021-22) and in Jharkhand land area is 2.26 lakh hectares, produces 2.73 lakh tons, and has a productivity of 1208 kg/ha (GOI Ministry of agriculture & Farmers Welfare, Annual Report 2021-22).

Chickpea productivity has decreased because of several biotic and abiotic factors. One of the most major yield limiting factors in chickpea production is poor weed management. The dominant weed flora of chickpea is *Chenopodium album* (Bathua), *Chenopodium murale* (Khartia), *Cyperus rotundus* (Motha), *Cynadon dactylon* (Doob), *Melilotus alba* (Senji), *Anagalis arvensis* (Krishna neel) and *Tithonia*

diversitifolia L. (Gupta *et al.*, 2017). Weeds are more efficient than crops at removing plant nutrients from the soil. Chickpea is very susceptible to weed competition due to its slow early growth and petite statured plants, and weeds can result in yield losses of up to 75% (Chaudhary *et al.*, 2005). Although the first 60 days are considered crucial for weed crop competitiveness in chickpea (Singh and Singh, 2000). Many research workers from the various parts of the country have reported that the application of Oxyfluorfen as weed control treatment (Dubey and Kumar, 2018) provided effective control of annual broad leaved and grassy weeds in chick pea field at early stages. However, later flushes of weeds can only be control by application of imazethapyr as post-emergence (Rathod *et al.*, 2017).

Due to modest growth rates and minimal leaf formation during the early stages of crop growth and establishment, chickpea is a poor weed competitor. Under these situations, weed treatment is overlooked, resulting in yield losses of 40-87 percent (Ratnam, 2011). There are no effective post-emergence herbicides available after the emergence of weeds. In chickpea, a more effective herbicide with broad-spectrum weed control and flexibility is urgently needed (Singh and Sharma, 2010).

The aggressive use of herbicide to reduce weed population has gained appeal in recent years due to its low cost, ease of administration, and efficiency against weeds. We can determine the optimum herbicide for a certain crop by using novel molecular herbicides. There are only a few post-emergence herbicides that have been evaluated for weeds in chickpea. Herbicides are used as a pre-emergence treatment and can only control weeds to a certain extent.

Materials and Methods

The present study was carried out at Agronomical research farm of Birsa Agricultural University, Ranchi, Jharkhand is situated at 23°17' N latitude and longitude of 85°19' E with an altitude of 625 m above the mean sea level during the rabi seasons of 2021–22. A few showers are expected during winters and occasionally during summer months. May and June are the hottest months with average maximum temperature of 35.6°C and 36.2°C, respectively. January is the coldest month of the year when the temperature falls 8.1°C. It receives an average annual rainfall of 32.4 mm. Initial status of soil (0–15 cm) of experimental field was sandy loam (37.3 % sand, 30.2 % silt and 32.5 % clay) in nature, low in organic carbon (4.5) and available nitrogen (247.4 kg N/ha), medium in available phosphorus (20.6 kg P/ha), medium in available potassium (156.2 kg K/ ha) and low in soil reaction (pH 5.7). The experiment was laid out in randomized block design (RBD) replicated thrice with the variety Birsa Chana-3 under limited irrigation condition. The treatments consists of oxyfluorfen (150g/ha), oxyfluorfen (250g/ha), quizalofop-p-ethyl (100g/ha) at 21 DAS, propaquizafop (100g/ha) at 21 DAS, topramezone 20.6g/ha at 21 DAS, oxyfluorfen 150g/ha (PE) fb quizalofop-p-ethyl 100g/ha at 15-20 DAS (PoE), oxyfluorfen 150g/ha(PE) fb propaquizafop 100g/ha at 15-20 DAS (PoE), oxyfluorfen 150g/ha (PE) fb topramezone 20.6g/ha at 14-21 DAS (PoE) , imazethapyr 60 g/ha (PoE) at 21 DAS, Manual Weeding (Weed free) at 25 DAS and 45 DAS and Weedy check (Table-1). Herbicides were thoroughly dissolved in water at a rate of 500 litres per hectare as a carrier and sprayed with a knapsack sprayer using a flat fan nozzle. The observations on weeds were recorded at 30 and 60 DAS. Weeds were counted using a quadrat of (25 x 25 cm), and data obtained were expressed as density (no./m^2). Data on weeds were subjected to square root transformation $\left(\sqrt{X+0.5}\right)$ before its statistical analysis.

Results and Discussion

Effect of herbicides on weed dynamics

The dominant weeds, associated with chickpea crop in the experimental field, comprised of all category of weeds, viz. broad leaved and narrow leaved weeds, among narrow-leaf, *Cyanodon dactylon*, *Avena fatua* and *Echinocloa colonum* and in broad-leaf, *Digera arvensis*, *Portulaca oleraceae*, *Phyllanthus niruri*, *Melilotus alba*, *Chenopodium album* weeds were dominant. (Table 2). Chandrakar *et al*. (2015) reported that experimental field was infested by number of weed species. Weed free plot (2 Hand weeding at 25 and 45 DAS) significantly lowest total weed density of 7.10/m^2 and 9.04/m^2 at 30 and 60 DAS (Table 3). This might be due to timely eradication of weeds by intercultural tools. The weeds were uprooted and killed. Similar findings were observed by Patre *et al*. (2020). Among herbicides, application of Oxyfluorfen @150 g a.i./ha fb Topramezone 20.6g a.i/ ha at 14-21 DAS recorded lowest grassy weed dry matter at 30 DAS and 60 DAS (6.65 and 25.30 g/m^2).

However, the weed control efficiency (83.90% and 81.20%, respectively) at 30 and 60 DAS significantly reduced that weed free plot (2 Hand weeding at 25 and 45 DAS) followed by oxyfluorfen @150 g /ha fb topramezone 20.6g/ha at 14-21 DAS (Table 3). This might be due to decrease in weed dry matter as compared to rest of the weed management practices. Weed control efficiency may be improved as

a result of decreasing weed counts and dry weight. These results corroborated with the findings of Butter *et al*. (2008). Whereas lower weed control efficiency was largely due to higher weed counts and weed dry weight. These results are in conformity with the findings of Singh *et al*. (2008).

Effect on chickpea yield attributes and yield

Among different weed management practices, 2 hand weeding at 25 and 45 DAS observed significantly higher seeds per pod (1.90), pods per plant (37.68) and 1000 seed weight (291.2 g). However, among herbicides application of oxyfluorfen @150 g/ha fb topramezone 20.6g/ha at 14-21 DAS recorded significantly highest number of seeds per pod, pods per plant, 1000 seed weight (Table 3). The lowest yield attributes values were recorded in weedy check. This might be due to better growth of crop because of less crop weed competition under herbicidal treatment that subsequently increased nutrient and moisture availability to the chickpea crop. Similar results were also reported by Reddy *et al*. (2008) and Chavada *et al*. (2017).

Significantly, the lower weed index was recorded in all the weed management treatments than weedy check. Among different herbicides, oxyfluorfen @150 g/ha fb topramezone 20.6g/ha at 14-21 DAS proved to be best treatment in producing significantly higher seed (19.15 q/ha) and straw yield (34.08 q/ha) followed by oxyfluorfen @150 g/ha fb propaquizafop @ 100 g/ha at 21 DAS compared to weedy check (Table 3). Various weed control strategies significantly boosted seed yield as compared to the weedy control; this could be due to improved weed protection paired with reduced weed population and improved yield contributing features in these treatments. Higher seed output in the above treatments due to the chickpea crop's proper use of moisture, nutrients, light, and space in the absence of weed competition. These results are in accordance with the findings of Singh *et al*. (2008).

Among herbicidal treatments the lowest weed index (8.28%) was observed with oxyfluorfen @150 g/ha fb topramezone 20.6g a.i./ha at 14-21 DAS. Whereas, Weedy check had the significantly highest weed index (65.80 %). This could be attributed to the post-emergence herbicide's improved weed control efficacy and broad range weed control. Similar findings were reported by Kumar *et al*. (2020).

Economics

A critical analysis of data on economics revealed that the highest gross return (108336/ha) was obtained with two manual weeding at 25 and 45 DAS (weed free). But higher cost of cultivation in two manual weeding at 25 and 45 DAS due to engagement of more labourers for weeding. This confirms the findings of Pritam *et al*. (2015). oxyfluorfen @150 g/ha fb topramezone 20.6g/ha at 14-21 DAS had reduced the cost of cultivation compared to 2 manual weeding at 25 and 45 DAS. Maximum net return (64131/ha) were obtained with oxyfluorfen @150 g/ha fb topramezone 20.6g/ha at 14-21 DAS being at par to oxyfluorfen 250 g/ha) with higher benefit: cost ratio of (1.81) (Table 4) and (Figure 1). The higher net returns in this treatment oxyfluorfen @150 g/ha fb topramezone 20.6g/ha at 14-21 DAS when compared to oxyfluorfen 250g/ha was not because of higher yield because of lower cost involved in herbicide application than to oxyfluorfen 250g/ha). This confirms the findings of Kalyani (2011). The weedy check recorded significantly minimum net return (9002/ha) and propaquizafop @100 g/ha at 21 DAS recorded significantly minimum benefit: cost ratio (0.32) (Table 4) and (Figure 1). Similar findings were earlier observed by Pritam *et al*. (2015). Therefore, the highest cost involved in 2 manual weeding at 25 and 45 DAS was not compensated by net returns, resulting in lower return per rupee invested. The lowest gross returns, net returns and return per rupee investment were observed in weedy check. The results are corroborating with those reported by Pritam *et al*. (2015). Similar results were obtained by Patel and Patel (2006) and Muhammad *et al*. (2011).

Table 1: Treatment details of the chickpea experiment as influenced by weed control treatments (2021-22)

	Treatment details	**Dose (Kg a.i./ha)**
T_1:	Oxyfluorfen 150 g a.i./ha (PE)	0.15
T_2:	Oxyfluorfen 250 g a.i./ha (PE)	**0.25**
T_3:	Quizalofop-p-ethyl 100 g a.i./ha at 21 DAS(PoE)	**0.1**
T_4:	Propaquizafop 100 g a.i./ha at 21 DAS(PoE)	**0.1**
T_5:	Topramezone 20.6 g a.i./ha at 21 DAS(PoE)	**0.0206**

T_6:	Oxyfluorfen 150 g a.i./ha (PE) fb Quizalofop-p-ethyl 100 g a.i./ha at 15-20 DAS (PoE)	0.15+0.1
T_7:	Oxyfluorfen 150 g a.i./ha (PE) fb Propaquizafop 100 g a.i./ha at 15-20 DAS(PoE)	0.15+0.1
T_8:	Oxyfluorfen 150 g a.i./ha (PE) fb Topramezone 20.6 g a.i./ha at 14-21 DAS (PoE)	**0.15+0.0206**
T_9:	Imazethapyr 60 g a.i./ha (PoE) at 21 DAS	0.06
T_{10}:	Manual Weeding (Weed free) at 25 DAS and 45 DAS	-
T_{11}:	Weedy Check	-

Table 2 : Detail study on different types of weeds observed on the chickpea production during (2021-22)

Common Name	English Name	Botanical Name	Family	Number/m^2	Relative Weed Density (%)
Grassy leaved					
Doob	Bermuda grass	*Cyanodon dactylon*	Poaceae	93	12.65
Junglee jaee	Common wild oat	*Avena fatua*	Poaceae	42	5.71
Sawa	Barnyard grass	*Echinocloa colonum*	Poaceae	185	25.17
Broad leaved					
Chanchali	Cotton weed	*Digera arvensis*	Amaranthaceae	20	2.72
Nonia	Duckweed	*Portulaca oleraceae*	Portulacaceae	32	4.35
Niruri	Stonebreaker	*Phyllanthus niruri*	Phyllanthaceae	18	2.44
Senji	Sweet clover	*Melilotus alba*	Fabaceae	110	14.97
Bathua	Lamb's quarter	*Chenopodium album*	Chenopodiaceae	238	31.97
TOTAL				**738**	**100**

Table 3 : Weed Index (WI), weed control efficiency (WCE), yield components, Yield and harvest index (HI) of chickpea as influenced by weed control treatments (2021-22).

Treatments	WI (%)	WCE (%)		No. of pods/ plant	No. of seeds/ pod	1000 seed weight (g)	Seed yield (q/ha)	Straw yield (q/ha)	HI (%)
		30 DAS	60 DAS						
T_1: Oxyfluorfen @ 150 g a.i./ha (PE)	23.89	38.05	50.90	34.52	1.59	284.2	15.89	29.39	35.08
T_2: Oxyfluorfen @ 250 g a.i./ha (PE)	18.86	40.25	53.36	34.80	1.70	284.5	16.94	31.16	35.21
T_3: Quizalofop-p-ethyl @ 100 g a.i./ha at 21 DAS (PoE)	27.92	32.70	35.80	34.46	1.54	279.0	15.05	28.14	34.84
T_4: Propaquizafop @100 g a.i./ha at 21 DAS (PoE)	32.00	17.28	33.10	34.45	1.47	278.9	14.20	26.69	34.72
T_5: Topramezone @ 20.6 g a.i./ha at 21 DAS (PoE)	24.47	33.23	35.90	34.48	1.53	283.8	15.77	28.85	35.33
T_6: Oxyfluorfen @ 150 g a.i./ha (PE) fb Quizalofop-p-ethyl @100 g a.i./ha at 21 DAS(PoE)	18.39	45.48	56.60	34.81	1.72	284.8	17.04	31.01	35.46
T_7: Oxyfluorfen @ 150 g a.i /ha (PE) fb Propaquizafop @ 100 g a.i/ha at 21 DAS(PoE)	13.21	56.70	65.04	35.55	1.76	289.6	18.12	32.61	35.71
T_8: Oxyfluorfen 150g a.i/ha (PE) fb Topramezone 20.6g a.i/ha at 14-21 DAS (PoE)	8.28	59.19	66.11	36.98	1.78	290.5	19.15	34.08	35.97
T_9: Imazathapyr 60 g a.i/ha (PoE) at 21 DAS	19.10	35.52	50.74	34.50	1.55	284.0	16.89	31.41	34.96
T_{10}: Manual Weeding (Weed free) at 25 DAS and 45 DAS	-	83.90	81.20	37.68	1.90	291.2	20.88	36.95	36.10
T_{11}: Weedy Check	65.80	-	-	30.64	1.17	263.7	7.14	13.56	34.48
SE m ±	-	-	-	1.85	0.09	0.65	1.07	1.46	1.93
CD (P = 0.05)	-	-	-	2.65	0.15	NS	2.78	3.89	NS
CV (%)	-	-	-	8.34	8.43	6.04	10.02	11.00	8.38

NOTE- PE = pre-emergence application, PoE = post-emergence application

Table 4: Economics of chickpea as influenced by weed control treatments (2021-2022)

Treatments	CC	GR	NR	B:C ratio
T_1: Oxyfluorfen @ 150 g a.i./ha (PE)	30461	82509	52048	1.70
T_2: Oxyfluorfen @ 250 g a.i./ha (PE)	31562	87952	56390	1.78
T_3: Quizalofop-p-ethyl @ 100 g a.i./ha at 21 DAS (PoE)	33390	78162	44772	1.34
T_4: Propaquizafop @100 g a.i./ha at 21 DAS (PoE)	43040	73755	30715	0.71
T_5: Topramezone @ 20.6 g a.i./ha at 21 DAS (PoE)	32867	81870	49003	1.49
T_6: Oxyfluorfen @ 150 g a.i./ha (PE) fb Quizalofop-p-ethyl @100 g a.i./ha at 21 DAS(PoE)	35761	88454	52693	1.47
T_7: Oxyfluorfen @ 150 g a.i /ha (PE) fb Propaquizafop @ 100 g a.i/ha at 21 DAS(PoE)	45411	94043	48632	1.07
T_8: Oxyfluorfen 150g a.i/ha (PE) fb Topramezone 20.6g a.i/ha at 14-21 DAS (PoE)	35238	99369	64131	1.81
T_9 : Imazathapyr 60 g a.i/ha (PoE) at 21 DAS	29420	87709	58289	1.98
T_{10}: Manual Weeding (Weed free) at 25 DAS and 45 DAS	51190	108336	57146	1.11
T_{11}: Weedy Check	28090	37092	9002	0.32
SE m ±	-	3272	1271	0.55
CD (P = 0.05)	-	11586	8500	0.35

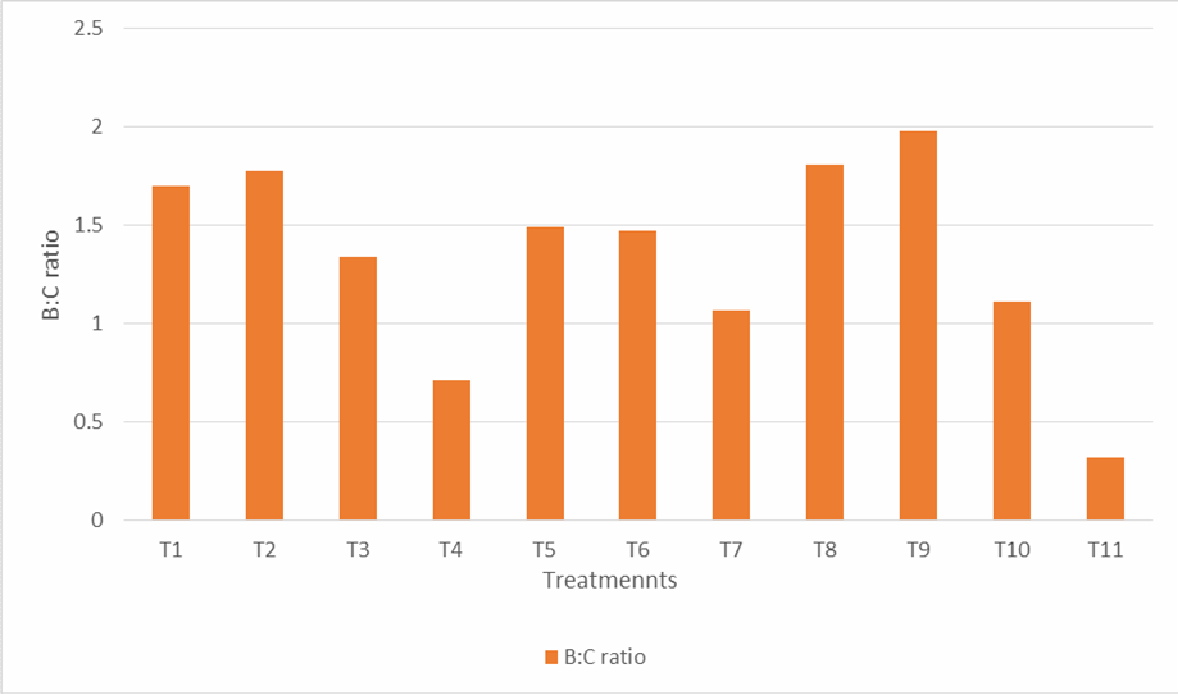

Fig. 1 : B:C ratio of chickpea as influenced by weed control treatments

Conclusion

On the basis of one-year experimentation it may be concluded that among herbicides, application of oxyfluorfen @150 g/ha as pre-emergence fb topramezone 20.6g/ha at 14-21 DAS as post-emergence proved to be effective in resulting higher weed control efficiency (59.19%) during initial crop growth stage, produced maximum chickpea yield (19.15 q/ha) and net return (64131 /ha) with B:C ratio (1.81) of chickpea under medium land situation in irrigated condition (3 irrigations) of Jharkhand.

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