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Weed management in chickpea through efficient pre and post herbicides

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Abstract
A field experiment was conducted during the *rabi* season, 2021-2 at Research Farm, Andro (Imphal), Central Agricultural University, Imphal (Manipur), India to evaluate most efficient pre and post herbicides on chickpea. The experiment was laid out in randomized block design comprising eight herbicides viz., oxyfluorfen 150 g ai.ha (pre-emergence),oxyfluorfen 250 g ai.ha (pre-emergence), quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (post-emergence), propaquizafop 100 g ai/ha at 15-20 DAS (post-emergence), topramezone 20.6 g ai/ha at 14-21 DAS (post-emergence), oxyfluorfen 150 g ai.ha - quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (pre+post), oxyfluorfen 150 g ai.ha - propaquizafop 100 g ai/ha at 15-20 DAS (pre+post) and oxyfluorfen 150 g ai.ha - topramezone 20.6 g ai/ha at 14-21 DAS (pre+post), besides unweeded (control) and weed free treatments. Results revealed that higher weed control efficiency of 60.4% was achieved under the combined pre and post emergence herbicidal treatment of oxyfluorfen 150 g ai.ha (pre-emergence) followed by topramezone 20.6 g ai/ha (post emergence herbicide at 14-21 DAS) compared to other weed control treatments. Also the treatment recorded 128 per cent higher grain yield over the unweeded control along with the highest benefit-cost ratio of 1.8.

Keywords: Crop, weed, pre emergence herbicide, post emergence herbicide, weed control efficiency, chickpea

Introduction
One of the most significant *Rabi* season pulse crops farmed in India is the chickpea (*Cicer arietinum* L.), also known as gram or Bengal gram. This is due to its economic significance as well as its role in preserving soil fertility. For our diet, it is a great source of protein (18–22% of the total), carbohydrates (62%), few minerals like calcium, iron, and vitamin C in the green stage. In addition, 100 g of the seed delivers 396 kcal of energy. Generally, Desi-type chickpeas are used to make split dal, flour (besan), and occasionally sprouted seeds. Chickpea seeds that are still green when ripe are also utilized as vegetables. In India, it is cultivated on an area of 10.56 million hectares, producing 11.23 million tonnes of grain year with a productive capacity of 1063 kg ha^{-1}. Weeds in pulse crops are not equally detrimental at all phases of growth. If weeds are not controlled or allowed to develop at these phases, catastrophic losses occur, and the crop suffers the most. Some growth stages are particularly sensitive to weed invasion. These weed-free times are referred to as the key phase of crop-weed competition because they promote superior crop plant growth and development. Crop-weed interaction in chickpea is crucial during the first 40 to 50 DAS (Chopra *et al*., 2003) [1]. Herbicides were particularly alluring for weed control because to the rising expense of hand weeding, its low effectiveness, and the lack of labor during busy times. Herbicides used prior to emergence provide weed control for the first 25 to 30 DAS. Herbicide applications made after weed flushes develop must be made in order to control them. Therefore, it is necessary to choose the most practical and cost-effective weed control method for chickpea. In order to evaluate the efficient herbicide, the current study was conducted.

Materials and Methods
A field experiment was conducted during the *rabi* season, 2021-2 at Research Farm, Andro (Imphal), Central Agricultural University, Imphal (Manipur), India. The soil at the test location site was a clay loam in texture, acidic in soil reaction (pH of 5.8), high in organic carbon, medium in available nitrogen, low in available phosphorus, and high in available potassium.

The experiment was laid out in randomized block design comprising eight herbicides viz., T_1-oxyfluorfen 150 g ai.ha (pre-emergence), T_2-oxyfluorfen 250 g ai.ha (pre-emergence), T_3-quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (post-emergence), propaquizafop 100 g ai/ha at 15-20 DAS (post-emergence), T_4-topramezone 20.6 g ai/ha at 14-21 DAS (post-emergence), T_5-oxyfluorfen 150 g ai.ha - quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (pre+post), T_6-oxyfluorfen 150 g ai.ha - propaquizafop 100 g ai/ha at 15-20 DAS (pre+post) and T_7-oxyfluorfen 150 g ai.ha - topramezone 20.6 g ai/ha at 14-21 DAS (pre+post), besides T_8-unweeded (control) and T_9-weed free treatments. Chickpea variety GNG-2207 was sown on November 13, 2021. A uniform dose of fertilizer 20:40:20 ($N:P_2O_5:K_20$ kg/ha) was applied during sowing. During the crop growth period, the maximum temperature of 18.9-32.2 °C and minimum temperature of 5.3-21.4 °C were recorded. Relative humidity readings of 86.34% in the morning and 50.48% in the evening were recorded. Total of 207 mm rainfall was received during the crop growth period. Application of the analysis of variance methodologies as described by Gomez and Gomez (1984) [2] was used to compute the data gathered on various experimentation-related elements. Anytime there were significant treatment differences, the crucial differences for comparison at the 5% level of probability were calculated. While NS stood in for non-significant.

Results and Discussion

Effect of weed control treatments on growth and yield components of chickpea

Data on growth and yield components viz., plant height (cm), No. of branches per plant, Dry matter production (g/plant), No. of pods /plant, No. of seeds/pod and 100 seed weight (g) are presented in Table 1. Highest plant height was found under weed control (50.80 cm) followed by T_2 and T_3 with the values 47.40 cm and 47.30 cm respectively and lowest in weed free check (44 cm) followed by T_8 and T_6. T_1 recorded the topmost no. of branches per plant fb T_6 and lowest in T10 (6.20). The highest dry matter production, no. of pods per plant, no. of seeds per pod and 100 seed weight were recorded under T_{10} with the values 17.73, 31.67, 1.34 and 20.31 g respectively. Increased competition between the chickpea and weeds, particularly in the early stages, for nutrients, light, and space is the primary cause of this. Similar findings were reported by Ratnam *et al*. (2011) [5].

Table 1: Effect of weed control treatments on growth and yield components of chickpea

Treatments	Plant height (cm)	No. of branches/plant	Dry matter production (g/plant)	No. of pods/plant	No. of Seeds/ pod	100 seed wt (g)
Oxyfluorfen 150 g ai.ha (pre-emergence)	46.97	10.20	7.39	15.67	1.33	18.35
Oxyfluorfen 250 g ai.ha (pre-emergence)	47.40	5.07	13.07	14.33	1.15	18.59
Quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (post-emergence)	47.30	6.70	16.49	17.00	1.26	17.00
Propaquizafop 100 g ai/ha at 15-20 DAS (post-emergence)	45.60	6.80	16.45	25.33	1.26	17.44
Topramezone 20.6 g ai/ha at 14-21 DAS (post-emergence) (already recommended)	45.67	6.27	14.57	26.00	1.25	19.17
Oxyfluorfen 150 g ai.ha - quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (pre+post)	43.60	9.07	13.49	24.00	1.18	17.39
Oxyfluorfen 150 g ai.ha - propaquizafop 100 g ai/ha at 15-20 DAS (pre+post)	45.97	7.53	13.86	27.33	1.19	17.61
Oxyfluorfen 150 g ai.ha - topramezone 20.6 g ai/ha at 14-21 DAS (pre+post)	44.50	7.73	15.13	27.33	1.19	19.85
Weed control	50.80	7.50	17.04	11.67	1.24	17.01
Weed free check	44.00	6.20	17.73	31.67	1.34	20.31
S. Em±	1.56	0.48	1.14	2.08	0.04	0.55
CD at 5%	4.63	1.41	3.39	6.16	NS	1.64

Table 2: Effect of weed control treatment on yield, weed control efficiency and economics of chickpea

Treatments	Seed yield (kg/ha)	Biological yield (kg/ha)	HI (%)	Cost of cultivation (Rs/ha)	Weed Index	Weed Control Efficiency (%)	Gross Returns (Rs/ha)	Net returns (Rs/ha)	B:C
Oxyfluorfen 150 g ai.ha (pre-emergence)	771.4	2439.3	36.0	35603.5	48.90	31.88	53996.7	18393.2	0.5
Oxyfluorfen 250 g ai.ha (pre-emergence)	697.7	4314.2	18.9	36378.0	54.78	32.45	48838.3	12460.3	0.3
Quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (post-emergence)	822.1	5440.5	17.8	35666.8	46.97	28.64	57545.3	21878.5	0.6
Propaquizafop 100 g ai/ha at 15-20 DAS (post-emergence)	1219.7	5427.6	25.5	36701.8	21.55	20.13	85378.1	48676.2	1.3
Topramezone 20.6 g ai/ha at 14-21 DAS (post-emergence) (already recommended)	1260.8	4807.9	30.8	37905.8	17.44	34.31	88257.7	50351.8	1.3
Oxyfluorfen 150 g ai.ha - quizalofop-p-ethyl 100 g ai/ha at 15-20 DAS (pre+post)	1197.5	4450.4	32.2	40489.8	20.70	55.82	83827.0	43337.2	1.1
Oxyfluorfen 150 g ai.ha - propaquizafop 100 g ai/ha at 15-20 DAS (pre+post)	1329.3	4575.4	33.5	33769.8	13.72	55.70	93050.0	59280.1	1.8
Oxyfluorfen 150 g ai.ha - topramezone 20.6 g ai/ha at 14-21 DAS (pre+post)	1319.0	4994.2	31.0	34959.6	14.00	60.40	92328.2	57368.6	1.6
Weed control	576.0	5622.7	12.2	33769.8	61.85	-	40322.2	6552.4	0.2
Weed free check	1536.1	5850.8	30.6	43849.8	-	-	107526.3	63676.5	1.5
S. Em±	80.4	376.9	1.6				5626.7	5626.7	0.2
CD at 5%	238.3	1117.2	4.6				16679.7	16679.7	0.5

Effect of weed control treatment on yield, weed control efficiency and economics of chickpea

For the seed yield, highest was recorded under T_{10} (1536.10 kg/ha) fb T_7 (1329.30 kg/ha) and lowest in T_9 (576 kg/ha) followed by T_2. T_{10} recorded the highest biological yield followed by T_9 and T_1 the lowest. The primary reason for the increased production in weed-free check was the total eradication of weeds during crop growth, which reduced competition and improved plant development. The results are similar with the findings of Khope *et al*. (2011) [3]. For HI T_1 (36%) recorded the highest and T_9 (12. 2%) the lowest. For weed index T_9 recorded the highest and T_7 recorded the lowest. T_8 was found to be the topmost treatment in terms of WCE and T_4 the lowest. T_{10} recorded the highest cost of cultivation, gross returns as well as net returns. Lowest cost of cultivation, gross income and net income was found in T_7, T_2 and T_9 respectively. T_7 recorded the highest B:C ratio and lowest in T_9. Higher seed yield obtained as a result of increased WCE was primarily responsible for the greater gross returns. Similar results are supported by Poonia and Pithia (2013) [4].

Conclusion

Based on the aforementioned outcomes, it can be conclude that under the combined pre and post emergence herbicidal treatment of Oxyfluorfen 150 g ai.ha (pre emergence) followed by topramezone 20.6 g ai/ha (post emergence herbicide at 14-21 DAS) was most effective in attaining higher weed control efficiency in chickpea under rainfed conditions of Manipur.

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