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EVALUATION OF IMAZETHAPYR FOR WEED MANAGEMENT IN CHICKPEA

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ABSTRACT

A field experiment was carried out at the Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, during the *rabi* season of 2020-21 to investigate the impact of imazethapyr in chickpea weed management. The experiment was carried out in a randomized block design, which contains nine treatments and three replications. The treatments include, pre and post emergence application of imazethapyr at varying doses viz., 30, 40, 50 g ha⁻¹, pre-emergence application of pendimethalin at 750 g ha⁻¹, weed free check and weedy check. The findings revealed that, the weed free check demonstrated superior weed control efficiency, crop growth parameters, yield attributes and overall yield compared to other weed management practices. However, considering labor constraints and economic feasibility, the pre emergence application of pendimethalin at 750 g ha⁻¹ showed better weed control, enhanced productivity and profitability of chickpea. This was promptly followed by the post emergence application of imazethapyr at 50 g ha⁻¹.

Key words : Chickpea, Weed management, Herbicide, Pendimethalin and Imazethapyr.

Introduction

Chickpea stands out as the primary winter pulse crop in India, commanding one-third of the pulse cultivation area and contributing about 50% of the total pulse production. Globally, it holds the position of the second most significant pulse crop after the common bean, *Phaseolus vulgaris*. In India, this premier pulse crop chickpea encompasses an expansive area of 10.56 million hectares, yielding 9.02 million tonnes with an average productivity of 1116 kg ha⁻¹ (Srabani Guha, 2020). Various factors contribute to the decline in chickpea productivity worldwide, with weeds emerging as a major biotic constraint. Unlike several other crops, pulses struggle to compete with weeds during their initial growth stages, often resulting in significant yield losses. According to Poonia and Pithia (2013), the estimated yield losses attributed to weeds in chickpea amount to 54.7%. The severity of yield reduction deviates considerably, ranging from 18% to 90%, in accordance with factors such as growing environment, plant species and farming methods (Prasad, 2014).

Weeds pose a significant challenge in agriculture and

can be effectively controlled through various methods, such as cultural, physical, chemical and biological approaches. Each of these techniques has its own set of advantages and disadvantages. Among them, hand weeding stands out as an efficient approach, ensuring the removal of all types of weeds, including those that closely resemble the crop (mimicry weed). However, the increasing labor costs and scarcity of proficient agricultural workers during peak farming seasons have driven the exploration of alternative approaches.

In this background, chemical weed management emerges as one of the most effective and economical solutions (Sureshkumar and Durairaj, 2016). The herbicide imazethapyr has been increasingly utilized in various cropping systems. Studies have also explored different dosages of imazethapyr in chickpea cultivation under various conditions. With this in mind, the study was conducted to assess the effectiveness of imazethapyr for weed management in chickpea.

Materials and Methods

The experimentation took place at the Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, located in

Sriniketan village, Birbhum District, West Bengal, during *rabi* season of 2020-21. The site's geographical coordinates are 23° 40' 9" north latitude, 87° 39' 27" east longitude with an average altitude of 58.90 meters above mean sea level (MSL). This area falls within the sub humid semi-arid region of West Bengal.

Soil at the trial site exhibited a slightly acidic nature with a pH of 6.07 and had a sandy loam texture. In terms of nutrient content, the soil had low levels of available nitrogen (157.8 kg ha⁻¹), medium levels of available phosphorus (13.67 kg ha⁻¹) and low levels of available potassium (167.85 kg ha⁻¹).

The trial was carried out in a randomized block design (RBD), which contains nine treatments and three replications. The size of each experimental plot was 15 m². The treatments include, pre and post emergence application of imazethapyr 10% SL at varying doses viz., 30, 40, 50 g ha⁻¹, pre-emergence application of pendimethalin 30% EC at 750 g ha⁻¹, weed free and weedy check. Pre emergence herbicides were applied on the same day, while post emergence herbicide is applied 20 days after sowing utilizing a knapsack sprayer equipped with flat fan nozzles. The weed free check underwent four manual weedings. Chickpea variety Anuradha (WBG-39) was cultivated with 30 cm × 10 cm spacing. The recommended fertilizer dosage of 30:60:60 kg ha⁻¹ of N, P₂O₅ and K₂O was applied. Observations on weeds and chickpea were made throughout the study period.

Weed samples were randomly collected by uprooting weeds within a 0.5 m² quadrant at 30 and 60 days after sowing (DAS) in each plot. The uprooted weeds were counted after categorized into different groups and thoroughly cleaned by washing with clean water. The cleaned samples were initially sun-dried and subsequently dried in a hot air oven at 60°C until they reached a stable dry weight. Weed control efficiency was determined using the formula gave by Mani *et al.* (1973).

$$\text{Weed control efficiency (\%)} = \frac{\text{DMC} - \text{DMT}}{\text{DMC}} \times 100$$

Where, DMC refers to the weed dry weight in the control plot and DMT refers to the weed dry weight in the treated plot. The weed index was calculated using the formula suggested by Gill and Kumar (1969).

$$\text{Weed index (\%)} = \frac{X - Y}{X} \times 100$$

Where, X represents the yield from weed free plot and Y represents the yield from treated plot.

At first, five plants were selected randomly from each plot. These chosen plants were then tagged for identification. Subsequently, all the comprehensive crop observations were recorded with these tagged plants.

The expense of cultivation was determined by considering the current input costs and the market price of the economic produce. The incurred expenditure was expressed in Indian Rupees per hectare. Using the aforementioned information, the benefit-cost ratio for each treatment was calculated.

$$\text{Benefit cost ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}}$$

The data underwent statistical analysis in accordance with the methodology outlined by Gomez and Gomez (1984) for Randomized Block Design. The data on density and dry weight of weeds underwent a square root transformation ($\sqrt{X + 0.5}$) prior to undergoing statistical analysis. Additionally, the critical difference (CD) at a 5% probability level was computed.

Results and Discussion

Weed flora

Dominant weed flora present at the study area were *Cynodon dactylon*, *Echinochloa colonum*, *Digitaria sanguinalis* among grasses and *Polygonum plebeium*, *Malvastrum chromandlianum*, *Euphorbia hirta*, *Chenopodium album*, *Eclipta alba* among broad leaved weeds. No sedges were found in the experimental field during this course of investigation. The similar weed flora was observed by Niranjana *et al.* (2020).

Weed parameters

Weed density, weed dry weight, weed control efficiency and weed index of chickpea were significantly influenced by various treatments (Table 1). Among weed control methods, the weed free check enumerated significantly lower weed density (0.71 m⁻²), lower weed dry weight (0.71 g m⁻²) and higher weed control efficiency (100%) at both 30 and 60 DAS. Consistent weeding during the critical period of crop-weed interference led to a decrease in weed density and consequently improved weed control efficiency. This was followed by application of pendimethalin at 750 g ha⁻¹ as a pre-emergence, which observed lower weed density (5.71 and 8.64 m⁻²), lower weed dry weight (3.10 and 7.48 g m⁻²) and higher weed control efficiency (77.10 and 59.43%) at 30 and 60 DAS, respectively, compared to other plots treated with imazethapyr. These results are reliable with the findings of Poonia and Pithia (2013).

Among the different imazethapyr treatments, the post

Table 1 : Effect of different weed management practices on weed density, weed dry weight, weed control efficiency and weed index of chickpea.

Treatments	Weed density (Numbers m ⁻²)		Weed dry weight (g m ⁻²)		Weed control efficiency (%) *		Weed index (%)
	30DAS	60DAS	30DAS	60DAS	30DAS	60DAS	
T ₁	14.96(223.48)	17.66(311.29)	5.76(33.52)	10.56(111.53)	13.63	23.54	72.03
T ₂	14.48(209.60)	17.07(291.52)	5.43(29.33)	10.23(105.01)	19.94	26.92	69.61
T ₃	13.79(190.15)	16.56(273.60)	5.08(25.53)	10.05(101.19)	32.89	30.88	66.70
T ₄	12.68(160.98)	16.04(256.73)	4.88(23.82)	9.68(94.37)	36.75	34.09	61.81
T ₅	11.80(140.29)	15.48(239.17)	4.41(19.36)	9.48(90.96)	52.03	34.70	53.62
T ₆	11.30(127.50)	13.16(172.81)	3.69(13.47)	8.61(74.99)	64.42	46.54	40.37
T ₇	5.71(32.13)	8.64(74.62)	3.10(9.57)	7.48(56.53)	77.10	59.43	16.59
T ₈	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	100.00	100.00	0.00
T ₉	16.61(276.16)	18.13(328.24)	6.32(39.90)	12.08(146.10)	0.00	0.00	79.16
SEm(±)	0.51	0.28	0.59	0.68			3.57
CD (5%)	1.48	0.81	1.21	1.98			10.71

The weed density and weed dry weight data were subjected to square root ("X + 0.5) transformation before statistical analysis. The values in parentheses represent the original data.

T₁ - PE Imazethapyr 30 g ha⁻¹, T₂ - PE Imazethapyr 40 g ha⁻¹, T₃ - PE Imazethapyr 50 g ha⁻¹, T₄ - POE Imazethapyr 30 g ha⁻¹, T₅ - POE Imazethapyr 40 g ha⁻¹, T₆ - POE Imazethapyr 50 g ha⁻¹, T₇ - PE Pendimethalin 750 g ha⁻¹, T₈ - Weed free check and T₉ - Weedy check.

Table 2 : Effect of different weed management practices on growth parameters and yield attributes of chickpea.

Treatments	Plant height (cm)		Number of branches plant ⁻¹		Number of pods plant ⁻¹	Number of seeds pod ⁻¹	100 seeds weight(g)
	30DAS	60DAS	30DAS	60DAS			
T ₁	12.8	20.0	11.5	33.9	9.8	1.0	12.37
T ₂	12.8	20.4	12.4	34.2	10.2	1.1	12.27
T ₃	13.6	21.4	15.0	34.6	10.5	1.1	12.20
T ₄	13.9	22.6	15.9	37.0	11.9	1.2	12.40
T ₅	14.1	23.3	16.4	37.5	13.6	1.2	12.60
T ₆	14.5	23.7	17.1	44.1	15.9	1.2	13.30
T ₇	14.9	24.8	17.6	47.0	21.4	1.3	13.67
T ₈	15.1	26.2	18.5	49.3	23.7	1.3	14.50
T ₉	12.6	19.2	9.8	30.3	7.6	1.0	12.00
SEm(±)	0.6	1.3	1.1	1.9	1.1	0.5	0.55
CD (5%)	1.7	3.8	3.3	5.8	3.2	0.2	1.65

T₁ - PE Imazethapyr 30 g ha⁻¹, T₂ - PE Imazethapyr 40 g ha⁻¹, T₃ - PE Imazethapyr 50 g ha⁻¹, T₄ - POE Imazethapyr 30 g ha⁻¹, T₅ - POE Imazethapyr 40 g ha⁻¹, T₆ - POE Imazethapyr 50 g ha⁻¹, T₇ - PE Pendimethalin 750 g ha⁻¹, T₈ - Weed free check and T₉ - Weedy check.

emergence application at 50 g ha⁻¹ bring about in lower weed density (11.30 and 13.16 m⁻²), lower weed dry weight (3.69 and 8.61 g m⁻²), higher weed control efficiency (64.42 and 46.54%) and a lower weed index (40.37%) compared to other doses of imazethapyr and the weedy check at 30 and 60 DAS, respectively. The weedy check obtained the higher weed density (16.61 and 18.13 m⁻²) and higher weed dry weight (6.32 and 12.08 g m⁻²) than others. The uncontrolled weed growth caused 79.16% yield reduction in chickpea.

Growth parameters

The growth parameters of chickpea exhibited significant deviation across various chemical weed control practices. (Table 2). Among the different approaches, the weed free check resulted notably greater plant height (15.1 and 26.2 cm) and number of branches per plant (18.5 and 49.3) at 30 and 60 DAS compared to others. This improvement can be attributed to regular weeding, which enhanced the weed management efficacy and allowed the crop to make better use of available resources,

Table 3 : Effect of different weed management practices on yield and economics of chickpea.

Treatments	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Harvest index (%)	Cost of cultivation* (INR ha ⁻¹)	Benefit cost ratio*
T ₁	417	865	32.38	28425	1.19
T ₂	443	904	32.90	28585	1.26
T ₃	485	983	32.98	28745	1.37
T ₄	575	1155	32.75	28425	1.64
T ₅	686	1367	33.34	28585	1.95
T ₆	867	1600	35.15	28745	2.44
T ₇	1234	2013	37.94	29195	3.41
T ₈	1486	2343	38.68	48405	2.48
T ₉	304	640	32.23	27505	0.89
SEm(±)	65	76	1.58	-	-
CD (5%)	189	222	4.73	-	-

* Data not statistically analysed

T₁ - PE Imazethapyr 30 g ha⁻¹, T₂ - PE Imazethapyr 40 g ha⁻¹, T₃ - PE Imazethapyr 50 g ha⁻¹, T₄ - POE Imazethapyr 30 g ha⁻¹, T₅ - POE Imazethapyr 40 g ha⁻¹, T₆ - POE Imazethapyr 50 g ha⁻¹, T₇ - PE Pendimethalin 750 g ha⁻¹, T₈ - Weed free check and T₉ - Weedy check.

resulting in improved growth parameters. These results were at par with the pre-emergence application of pendimethalin at 750 g ha⁻¹, which recorded plant heights of 14.9 and 24.8 cm and branch numbers of 17.6 and 47.0 at 30 and 60 DAS, respectively. This outcome is aligned with the discoveries made by Kaushik *et al.* (2014). In contrast, the pre and post emergence application of various doses of imazethapyr resulted in lower plant height and fewer branches than the weed free check and pendimethalin treatment. Weedy check plot exhibited the lowest plant growth parameters, as continuous crop weed interference throughout the critical period led to poor growth in chickpea.

Yield attributes

Chickpea yield attributes were notably altered by all the weed control techniques (Table 2). Among methods used, the weed free check produced maximum number of pods per plant (23.7), seeds per pod (1.3) and test weight (14.50 g). These outcomes were in line with the discoveries of Rathod *et al.* (2016). Similarly, the application of pendimethalin at 750 g ha⁻¹ registered significantly higher yield attributes, with 21.4 pods per plant, 1.3 seeds per pod and a test weight of 13.67 g, compared to the different pre and post emergence imazethapyr treatments. Buttar *et al.* (2008) also observed a maximum mean number of pods per plant and seeds per pod with 0.75 kg ha⁻¹ pendimethalin. Conversely, the weedy check plot obtained lower yield attributes than others.

Yield and economics

The chickpea yield and economics were significantly

altered with various weed control methods (Table 3). Among these treatments, the weed free check yielded the maximum seed yield (1486 kg ha⁻¹), stover yield (2343 kg ha⁻¹) and harvest index (38.68) than others. Dubey *et al.* (2018) also reported maximum chickpea seed and stover yield with a weed free check. Similarly, application of pendimethalin at 750 g ha⁻¹ as a pre-emergence produced significantly higher seed yield (1234 kg ha⁻¹), stover yield (2013 kg ha⁻¹) and harvest index (37.94) than all imazethapyr treatments. These findings were aligning with the research outcomes of Parmar *et al.* (2022). The weedy check plot observed the lowest seed and stover yield than others. This was predominantly as a result of persistent competition from weeds throughout the growing season led to suboptimal utilization of available resources by the crop, resulting in diminished growth and yield.

In terms of economics, the best herbicidal weed control treatment pendimethalin at 750 g ha⁻¹ obtained lower cultivation cost (INR 29,195) and a higher benefit cost ratio (3.41) compared to the weed free check. This likely owing to the increased labor requirements and higher labor wages associated with maintaining weed free plots. Consequently, these higher labor costs and the need for frequent manual weeding resulted in a higher production cost and a lower benefit cost ratio than herbicidal weed management. Pre and post emergence application of diverse dosage of imazethapyr recorded in lower cost of cultivation and a lower benefit cost ratio compared to pendimethalin and the weed free check. This is because of the lower weed control efficiency and productivity of chickpea under imazethapyr treatments, which ultimately reflected with lower economics in

chickpea.

Conclusion

Considering the labour shortage, the field study concludes that, pre emergence application of pendimethalin at 750 g ha⁻¹ is effective for better weed control, higher productivity and increased profitability of chickpea. Among the various timings and doses of imazethapyr, the post emergence application of imazethapyr at 50 g ha⁻¹ proves to be the next best option in terms of weed control and crop productivity, following pendimethalin.

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