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Economic analysis of different weed management practices in chickpea (*Cicer arietinum* L.)

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Abstract

Present study was “Economic Analysis of different weed management practices in chickpea (*Cicer arietinum* L.)” Experiment was conducted IGKV-Raipur during 2023-24 and 2024-25 that application of Effective management involves integrating manual weeding with pre-emergence and post-emergence, The highest seed yield was recorded under the hand weeding twice at 20 and 40 DAS treatment ((T₁₂), yielding 1,830.67 kg ha⁻¹, 1,864.00 kg ha⁻¹, and 1,847.33 kg ha⁻¹ during 2023-24, 2024-25, and in the mean data, respectively. This performance was statistically at par with the sequential application of Oxyfluorefen (PE) fb Topramezone (PoE) ((T₈), which recorded a mean seed yield of 1,765.00 kg ha⁻¹. Among the purely chemical treatments, (T₈) proved to be the most effective, followed closely by Oxyfluorefen (PE) fb Quizalofop-p-ethyl (PoE) ((T₉) and Oxyfluorefen (PE) fb Propaquizafop (PoE) (T₇) Conversely, the lowest seed yield was recorded in the weedy check (T₁₃), with a mean yield of only 987.25 kg ha⁻¹. Estimate cost of cultivation was recorded maximum in treatment T₁₂-hand weeding twice at 20 and 40 DAS (Rs. 34654, 35727 and 35190 ha⁻¹) followed by T₉- oxyfluorfen150 g ha⁻¹ (PE) fb quizalofop-p-ethyl 100 g ha⁻¹ (PoE) (Rs. 31267, 32340 and 31803 ha⁻¹). Gross return was considerably affected because of various weed management practices. Treatment T₁₂- hand weeding twice at 20 and 40 DAS had maximum gross return (Rs. 100222, 103926 and 102074 ha⁻¹) followed by T₈- oxyfluorfen150 g ha⁻¹ (PE) fb topramezone 20.6 g ha⁻¹ (PoE), (Rs. 96645, 98531 and 97588 ha⁻¹). Net return had comparable differences among various weed management practices. The highest net return was recorded under treatment T₈- oxyfluorfen 150 g ha⁻¹ (PE) fb topramezone20.6 g ha⁻¹ (PoE), (Rs. 66778, 68532 and 67655 ha⁻¹) followed by T₁₂- hand weeding twice at 20 and 40 DAS (Rs. 65568, 67591 and 66580 ha⁻¹), T₉- oxyfluorfen150 g ha⁻¹ (PE) fb quizalofop-p-ethyl100 g ha⁻¹ (PoE), (Rs. 62382, 66040 and 64211 ha⁻¹). The maximum benefit cost ratio was noticed under treatment T₈- oxyfluorfen 150 g ha⁻¹ (PE) fb topramezone 20.6 g ha⁻¹ (PoE), (3.24,3.18 and 3.21) followed by T₆-metribuzin 350 g ha⁻¹ (PE) fb propaquizafop 100 g ha⁻¹ (PoE), (3.12, 3.08 and 3.10) However, minimum Cost of cultivation, gross return, net returns and benefit: cost ratio was obtained under Treatment T₁₃- weedy check.

Keywords: Weed management, economics

Introduction

Chickpea (*Cicer arietinum* L.) also known as Chana, is an important pulse crop in India. It is a high-protein food that can be eaten as a seed or ground into flour. It is an extremely nutritious legume that comes in third place behind dry beans and peas in terms of importance. Desi and kabuli chana are two varieties of chana that are grown all over the world. The desi type accounts for 80% of global chana output, while the kabuli type accounts for the remaining 20%. India is the world's largest producer of chana, accounting for roughly 70% of global production (FAOSTAT-2022 ^[4]). Desi chana is primarily grown in India and consists of brown split peas that are small in size and have a thick seed coat, while kabuli (dixit *et al.* & Singh, (2010) ^[2], which allows weed infestation. Weed management is crucial because the crop competes poorly for resources, particularly in the initial 30–60 days. Effective management involves integrating manual weeding with pre-emergence (metribuzin 350 g ha⁻¹, oxyfluorfen 250 g ha⁻¹ and topramezone20.6 g ha⁻¹ (1000 g ha⁻¹ (Kaur *at al.*,2020) and post emergence herbicides (propaquizafop 100 g ha⁻¹), quizalofop-pethyl100 g ha⁻¹) to control weeds.

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Methodology

Economics

Economics of treatments has been worked out in terms of net income (Rs. ha⁻¹) under various treatments based on prevailing market rates of herbicides, fertilizers, wages of labour and market price of produce.

Cost of cultivation (Rs. ha⁻¹)

Cost of cultivation of each treatment was calculated considering the prevailing charges of agricultural operations and market price of inputs involved.

Gross return (Rs. ha⁻¹)

Gross return was obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies for each and every treatment.

Gross return (Rs. ha⁻¹) = (Seed yield x price) + (Stover yield x price)

Net return (Rs. ha⁻¹)

Net returns were obtained by deducting cost of cultivation from gross return.

Net return (Rs. ha⁻¹) = Gross return (Rs. ha⁻¹) - Cost of cultivation (Rs. ha⁻¹)

Benefit: cost ratio

The benefit: cost ratio of each treatment was calculated by dividing gross returns by cost of cultivation of respective treatments.

Benefit: cost ratio = Gross return (Rs. ha⁻¹) / Cost of cultivation (Rs. ha⁻¹)

Statistical analysis

The data found on several parameters of chickpea were tabulated and subjected to statistical analysis. The original data on weed density and weeds dry matter production were transformed in $\sqrt{x} + 0.5$ before the analysis. The original values are given in parenthesis. The influence of treatment was tested with 'F' test, wherever 'F' test shown their significance, the levels of treatment were compared by critical difference at 5% level of probability. The skeleton of analysis of variance and formula used for several valuations are given below (Gomez and Gomez, 1984) [5].

Results and Discussion

Seed Yield

The weed management practices significantly influenced the seed yield of the crop during both years (2023-24 and 2024-25) and in the pooled data analysis.

The highest seed yield was recorded under the hand weeding twice at 20 and 40 DAS treatment ((T₁₂), yielding 1,830.67 ha⁻¹, 1,864.00 kg ha⁻¹, and 1,847.33 ha⁻¹ during 2023-24, 2024-25, and in the mean data, respectively. This performance was statistically at par with the sequential application of Oxyfluorefen (PE) fb Topramezone (PoE) ((T₈), which recorded a mean seed yield of 1,765.00 ha⁻¹. Among the purely chemical treatments, (T₈) proved

to be the most effective, followed closely by Oxyfluorefen (PE) fb Quizalofop-p-ethyl (PoE) ((T₉) and Oxyfluorefen (PE) fb Propaquizafop (PoE) (T₇) Conversely, the lowest seed yield was recorded in the weedy check (T₁₃), with a mean yield of only 987.25 kg ha⁻¹. Unchecked weed growth led to a severe reduction in seed yield—approximately 46.5% lower than the hand weeding treatment—due to intense crop-weed competition for moisture, space, nutrients, and sunlight.

The notable yield increase in treatments like (T₁₂) and (T₈) can be attributed to the minimized weed density and dry weight during critical crop growth stages. Pre-emergence application knocked down early flushes of weeds, while the sequential post-emergence application or hand weeding eliminated later narrow and broad-leaved escapes. This weed-free environment allowed the crop to optimize its vegetative growth and transfer photosynthates effectively into reproductive organs, bolstering final seed yield.

Stover Yield

Stover yield followed a nearly identical trend to seed yield across both experimental years. The maximum mean stover yield was harvested from the hand weeding twice treatment (T₁₂) at 2,540.87 kg ha⁻¹, which remained statistically at par with Oxyfluorefen (PE) fb Topramezone (PoE) (T₈) at 2,499.00 kg ha⁻¹.

All herbicide integration treatments, including sequential chemical applications (T₅) to (T₉) and pre-emergence applications backed by hand hoeing (T₁₀) and (T₁₁), recorded significantly higher stover yields compared to sole pre-emergence or post-emergence treatments (T₁) to (T₄). The lowest stover yield was observed under the weedy check (T₁₃) at 1,850.67 ha⁻¹.

The enhanced stover yield in effective weed management treatments highlights the importance of keeping the crop weed-free during early vegetative stages. Reduced weed competition facilitated better root development, higher nutrient uptake, and improved leaf area index, culminating in superior dry matter accumulation and plant biomass (stover).

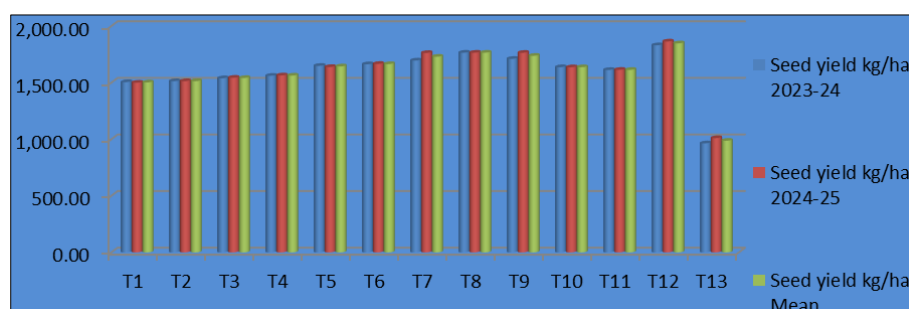
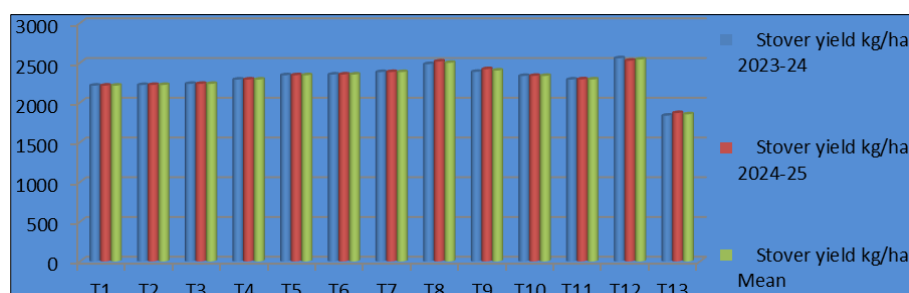
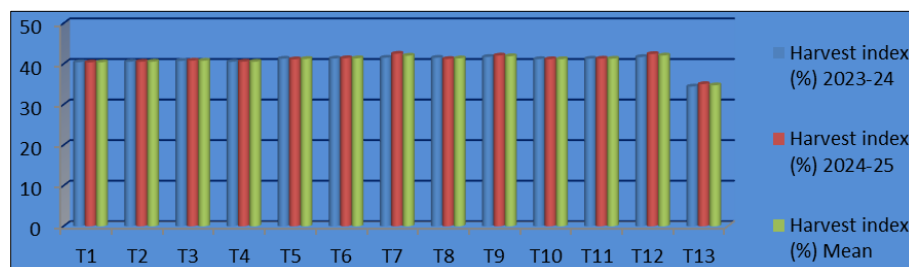
Harvest Index (%)

The physiological efficiency of the crop, reflected by the harvest index (HI), was significantly altered by the various weed control strategies.

The highest mean harvest index was noted in the treatment featuring Oxyfluorefen (PE) fb Propaquizafop (PoE) (T₇) at 42.06%, which was at par with hand weeding twice (T₁₂) at 42.11%, Oxyfluorefen (PE) fb Quizalofop-p-ethyl (PoE) (T₉) at 41.93%, and Oxyfluorefen (PE) fb Topramezone (PoE) (T₈) at 41.41%. Most herbicide treatments successfully maintained a harvest index hovering between 40% and 42%. In sharp contrast, the weedy check (T₁₃) recorded the lowest mean harvest index of 34.76%. This drop indicates that weeds not only restricted overall crop biomass but specifically impaired the crop's source-to-sink partition efficiency. The high critical weed pressure forced the crop to struggle for basic resources, severely limiting grain filling and reducing the ratio of seed weight to total biological yield.

Table 1: Effect of different herbicides on seed yield, stover yield and harvest index of chickpea

Treatment	Herbicide	Dose (g ai. ha ⁻¹)	Seed yield kg ha ⁻¹			Stover yield ha ⁻¹			Harvest index (%)		
			2023-24	2024-25	Mean	2023-24	2024-25	Mean	2023-24	2024-25	Mean
T ₁	Metribuzin (PE)	350	1,505.00	1,500.08	1,502.54	2211.67	2212.34	2212.00	40.48	40.41	40.45
T ₂	Oxyfluorefen (PE)	250	1,513.67	1,513.67	1,513.67	2220.00	2221.00	2220.50	40.59	40.58	40.59
T ₃	Topramezone (PoE)	20.6	1,539.33	1,543.67	1,541.50	2234.67	2234.67	2234.67	40.79	40.86	40.83
T ₄	Propaquizafop (PoE)	100	1,561.00	1,564.33	1,562.67	2288.00	2289.00	2288.50	40.56	40.60	40.58
T ₅	Metribuzin (PE) <i>fb</i> Topramezone (PoE)	350+20.6	1,648.67	1,638.67	1,643.67	2342.33	2343.00	2342.66	41.33	41.18	41.26
T ₆	Metribuzin (PE) <i>fb</i> Propaquizafop (PoE)	350+100	1,662.67	1,666.00	1,664.33	2351.67	2352.67	2352.17	41.38	41.45	41.42
T ₇	Oxyfluorefen (PE) <i>fb</i> Propaquizafop (PoE)	250+100	1,696.00	1,762.67	1,729.33	2382.67	2383.34	2383.00	41.56	42.55	42.06
T ₈	Oxyfluorefen (PE) <i>fb</i> Topramezone (PoE)	250+20.6	1,765.00	1,765.00	1,765.00	2482.33	2515.66	2499.00	41.55	41.26	41.41
T ₉	Oxyfluorefen (PE) <i>fb</i> Quizalofop-p-ethyl (PoE)	150+100	1,710.67	1,764.00	1,737.33	2385.33	2419.33	2402.33	41.75	42.11	41.93
T ₁₀	Metribuzin <i>fb</i> 1 hand hoeing at 25 DAS	350	1,637.33	1,636.33	1,636.83	2333.82	2335.16	2334.49	41.22	41.20	41.21
T ₁₁	Oxyfluorefen (PE) <i>fb</i> 1 hand hoeing at 25 DAS	250	1,612.33	1,613.67	1,613.00	2288.67	2291.33	2290.00	41.33	41.34	41.33
T ₁₂	Hand weeding twice at 20 and 40 DAS	-	1,830.67	1,864.00	1,847.33	2556.70	2525.04	2540.87	41.73	42.48	42.11
T ₁₃	Weedy check	-	964.04	1,010.45	987.25	1834.00	1867.33	1850.67	34.46	35.06	34.76
	SEm±		48.26	56.05	45.70	60.63	1.66	61.01	0.92	0.92	0.94
	CD (P=0.05)		141.69	164.58	134.19	176.96	4.84	178.08	2.70	2.70	2.73

Seed yield kg ha⁻¹Stover yield ha⁻¹

Harvest index (%)

Fig 1: Effect of different herbicides on seed yield, stover yield and harvest index of chickpea**Economics**

The data regarding economics *i.e.*, cost of cultivation, gross return, net returns and B:C ratio of chickpea as influenced by different weed management practices were worked out and have been presented in Table1.

Cost of cultivation (Rs. ha⁻¹)

The cost of cultivation was recorded maximum in treatment T₁₂- hand weeding twice at 20 and 40 DAS (Rs. 34654, 35727 and

35190 ha⁻¹) followed by T₉- oxyfluorefen150 g ha⁻¹ (PE) *fb* quizalofop-p-ethyl100 g ha⁻¹ (PoE) (Rs. 31267,32340 and 31803 ha⁻¹), T₁₁-oxyfluorefen 250 g ha⁻¹ (PE) *fb* 1 hand hoeing at 25 DAS (Rs.31253, 32326 and 31789 ha⁻¹) T₇-oxyfluorefen150 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE), (Rs. 31243, 32316 and 31779 ha⁻¹), T₁₀- metribuzin 350 g ha⁻¹ (PE) *fb* 1 hand hoeing at 25 DAS (Rs.30564,31637 and 31100 ha⁻¹), T₅- metribuzin 350 g ha⁻¹ (PE) *fb* topramezone20.6 g ha⁻¹ (PoE), (Rs. 30554,31627 and 31090 ha⁻¹), T₈- oxyfluorefen150 g ha⁻¹ (PE) *fb* topramezone20.6 g ha⁻¹

(PoE), (Rs. 29867, 30940 and 30403 ha⁻¹), T₃- topramezone 20.6 g ha⁻¹ (PoE), (Rs. 29102, 30175 and 29638 ha⁻¹), T₄- propaquizafop 100 g ha⁻¹ (PoE), (Rs. 27726, 28799 and 28262 ha⁻¹), T₂- oxyfluorfen 250 g ha⁻¹ (PE), (Rs. 27015, 28088 and 27551 ha⁻¹), T₆- metribuzin 350 g ha⁻¹ (PE), (Rs. 26326, 27399 and 26862 ha⁻¹) and lowest cost of cultivation was recorded under treatment T₁₃- weedy check (Rs. 24874, 25947 and 25410 ha⁻¹) during 2023-24, 2024-25 and on mean basis, respectively.

Discussion on economics

In present study, maximum gross return was obtained with treatment T₁₂- hand weeding twice at 20 and 40 DAS, while regarding net return and B: C ratio, T₈- oxyfluorfen 150 g ha⁻¹ (PE) *fb* topramezone 20.6 g ha⁻¹ (PoE) and T₆-metribuzin 350 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE) was proved to be best, where as the minimum were recorded with T₁₃-weedy check. The higher gross return under hand weeding twice was because of higher seed and stover yield. The higher gross return, net return and B: C ratio under above herbicidal treatments was due to the fact that higher

seed and stover yields associated with lower cost of cultivation. Al though higher cost of herbicides increased the cost of cultivation, if a herbicide found appropriate and effective for control of weeds, then increased yield due to less crop- weed competition meet the gap caused by costly herbicides. Similar results were obtained by Dewangan *et al.* (2016) [1] who reported that economics in terms of net return was recorded highest under oxyfluorfen+ metribuzin 125 + 350 g ha⁻¹ as PE, followed by hand weeding twice at 25 and 45 DAS and metribuzin 250 g ha⁻¹ as PE. The highest benefit: cost ratio (2.05) recorded under the treatment of oxyfluorfen + metribuzin at 125 + 350 g ha⁻¹ as PE, followed by metribuzin at 250 g ha⁻¹ as PE and hand weeding twice at 25 and 45 DAS, respectively. However, minimum gross return, net returns and benefit: cost ratio was obtained under control plot. According to Pedde *et al.* (2013) [7], PoE application of oxyfluorfen 200 g + quizalofop-ethyl 60 g ha⁻¹ at 35 DAS gave negative returns because of high cost of cultivation. These above results are in the conform with the work of Meena *et al.* (2011) [6], Ratnam *et al.* (2011) [8] and Dubey *et al.* (2018) [3].

Table 2: Effect of different herbicides on cost of cultivation of chickpea cultivation

Tre	Herbicide	Dose (g a i. ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)		
			2023-24	2024-25	Mean
T ₁	Metribuzin (PE)	350	26326	27399	26863
T ₂	Oxyfluorefen (PE)	250	27015	28088	27552
T ₃	Topramezone (PoE)	20.6	29102	30175	29639
T ₄	Propaquizafop (PoE)	100	27726	28799	28263
T ₅	Metribuzin (PE) <i>fb</i> Topramezone (PoE)	350+20.6	30554	31627	31091
T ₆	Metribuzin (PE) <i>fb</i> Propaquizafop (PoE)	350+100	29183	30251	29717
T ₇	Oxyfluorefen (PE) <i>fb</i> Propaquizafop (PoE)	250+100	31243	32316	31780
T ₈	Oxyfluorefen (PE) <i>fb</i> Topramezone (PoE)	250+20.6	29867	30940	30404
T ₉	Oxyfluorefen (PE) <i>fb</i> Quizalofop-p-ethyl (PoE)	150+100	31267	32340	31804
T ₁₀	Metribuzin <i>fb</i> 1 hand hoeing at 25 DAS	350	30564	31637	31101
T ₁₁	Oxyfluorefen (PE) <i>fb</i> 1 hand hoeing at 25 DAS	250	31253	32326	31790
T ₁₂	Hand weeding twice at 20 and 40 DAS	-	34654	35727	35191
T ₁₃	Weedy check	-	24874	25947	25411
	SEM±		-	-	-
	CD (P=0.05)		-	-	-

Gross return (Rs. ha⁻¹)

Gross return was considerably affected because of various weed management practices. Treatment T₁₂- hand weeding twice at 20 and 40 DAS had maximum gross return (Rs. 100222, 103926 and 102074 ha⁻¹) followed by T₈- oxyfluorfen 150 g ha⁻¹ (PE) *fb* topramezone 20.6 g ha⁻¹ (PoE) (Rs. 96645, 98531 and 97588 ha⁻¹), T₉- oxyfluorfen 150 g ha⁻¹ (PE) *fb* quizalofop-p-ethyl 100 g ha⁻¹ (PoE) (Rs. 93649, 98380 and 96015 ha⁻¹), T₇-oxyfluorfen 150 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE) (Rs. 92864, 98272

and 95568 ha⁻¹) during 2023-24, 2024-25 and on mean basis, respectively. When compared among herbicides, highest gross return was recorded under T₈- oxyfluorfen 150 g ha⁻¹ (PE) *fb* topramezone 20.6 g ha⁻¹ (PoE) followed by T₉- oxyfluorfen 150 g ha⁻¹ (PE) *fb* quizalofop-p-ethyl 100 g ha⁻¹ (PoE) T₇-oxyfluorfen 150 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE) during both the years and on mean basis. The lowest gross return was obtained under treatment T₁₃- weedy check (Rs. 53265, 56835 and 55050 ha⁻¹) during both the years and on mean basis, respectively (Fig.2).

Table 3: Effect of different herbicides on gross return of chickpea cultivation

Tre	Herbicide	Dose (g a i. ha ⁻¹)	Gross return (Rs ha ⁻¹)		
			2023-24	2024-25	Mean
T ₁	Metribuzin (PE)		82503	83817	83160
T ₂	Oxyfluorefen (PE)	350	82974	84564	83769
T ₃	Topramezone (PoE)	250	84358	86210	85284
T ₄	Propaquizafop (PoE)	20.6	85567	87389	86478
T ₅	Metribuzin (PE) <i>fb</i> Topramezone (PoE)	100	90299	91486	90893
T ₆	Metribuzin (PE) <i>fb</i> Propaquizafop (PoE)	350+20.6	91055	92983	92019
T ₇	Oxyfluorefen (PE) <i>fb</i> Propaquizafop (PoE)	350+100	92864	98272	95568
T ₈	Oxyfluorefen (PE) <i>fb</i> Topramezone (PoE)	250+100	96645	98532	97588
T ₉	Oxyfluorefen (PE) <i>fb</i> Quizalofop-p-ethyl (PoE)	250+20.6	93649	98381	96015
T ₁₀	Metribuzin <i>fb</i> 1 hand hoeing at 25 DAS	150+100	89686	91352	90519
T ₁₁	Oxyfluorefen (PE) <i>fb</i> 1 hand hoeing at 25 DAS	350	88307	90075	89191
T ₁₂	Hand weeding twice at 20 and 40 DAS	250	100223	103927	102075
T ₁₃	Weedy check	-	53266	56836	55051
	SEM±	-	2583.5	3044.6	2467.3
	CD (P=0.05)		7570.8	8886.5	7201.5

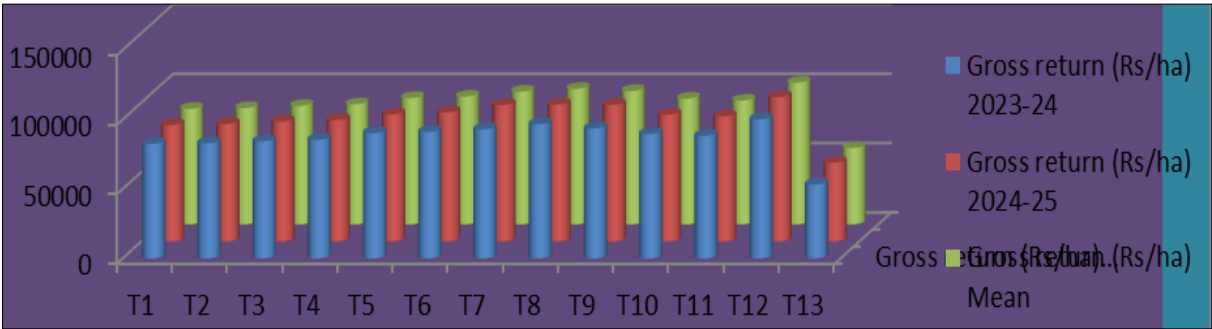


Fig 2: Gross return (Rs ha⁻¹)

Net return (Rs.ha⁻¹)

Net return had comparable differences among various weed management practices. The highest net return was recorded under treatment T₈- oxyfluorfen150 g ha⁻¹ (PE) *fb* topramezone20.6 g ha⁻¹ (PoE), (Rs. 66778, 68532 and 67655 ha⁻¹) followed by T₁₂-hand weeding twice at 20 and 40 DAS (Rs. 65568, 67591 and 66580 ha⁻¹), T₉- oxyfluorfen150 g ha⁻¹ (PE) *fb* quizalofop-p-

ethyl100 g ha⁻¹ (PoE), (Rs. 62382, 66040 and 64211 ha⁻¹), T₇-oxyfluorfen150 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE), (Rs. 61621,65956 and 63788 ha⁻¹) and T₆- metribuzin 350 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE), (Rs. 61871,62732 and 62302 ha⁻¹) where as weedy check was found inferior regarding net return (Rs.28391, 30888 and 29640 ha⁻¹) during 2023-24, 2024-25 and on mean basis, respectively (Fig.3).

Table 4: Effect of different herbicides on net return of chickpea cultivation

Tre	Herbicide	Dose (g a i. ha ⁻¹)	Net return (Rs ha ⁻¹)		
			2023-24	2024-25	Mean
T ₁	Metribuzin (PE)	350	56177	56418	56298
T ₂	Oxyfluorefen (PE)	250	55959	56476	56218
T ₃	Topramezone (PoE)	20.6	55256	56035	55646
T ₄	Propaquizafop (PoE)	100	57841	58256	58049
T ₅	Metribuzin (PE) <i>fb</i> Topramezone (PoE)	350+20.6	59745	59193	59469
T ₆	Metribuzin (PE) <i>fb</i> Propaquizafop (PoE)	350+100	61872	62732	62302
T ₇	Oxyfluorefen (PE) <i>fb</i> Propaquizafop (PoE)	250+100	61621	65956	63789
T ₈	Oxyfluorefen (PE) <i>fb</i> Topramezone (PoE)	250+20.6	66778	68533	67656
T ₉	Oxyfluorefen (PE) <i>fb</i> Quizalofop-p-ethyl (PoE)	150+100	62382	66041	64212
T ₁₀	Metribuzin <i>fb</i> 1 hand hoeing at 25 DAS	350	59122	59381	59251
T ₁₁	Oxyfluorefen (PE) <i>fb</i> 1 hand hoeing at 25 DAS	250	57054	57749	57401
T ₁₂	Hand weeding twice at 20 and 40 DAS	-	65569	67592	66580
T ₁₃	Weedy check	-	28392	30889	29640
	SEm±		2249.3	3068.2	2363.1
	CD (P=0.05)		6565.3	8955.3	6897.3

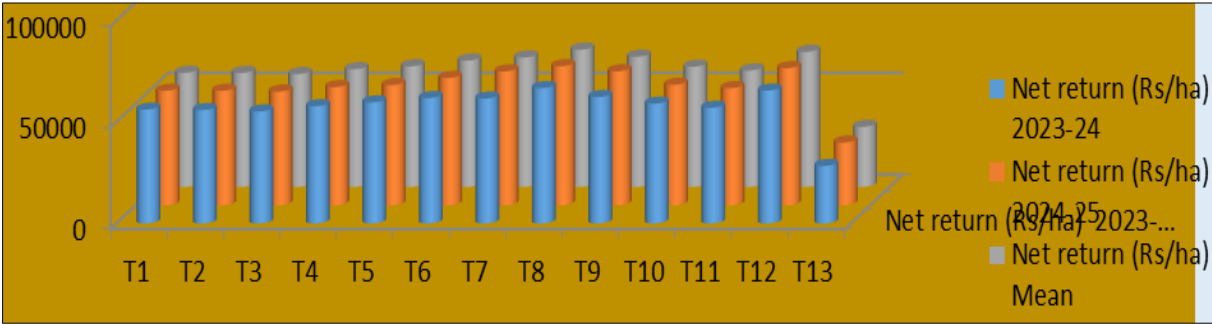


Fig 3: Net return (Rs ha⁻¹)

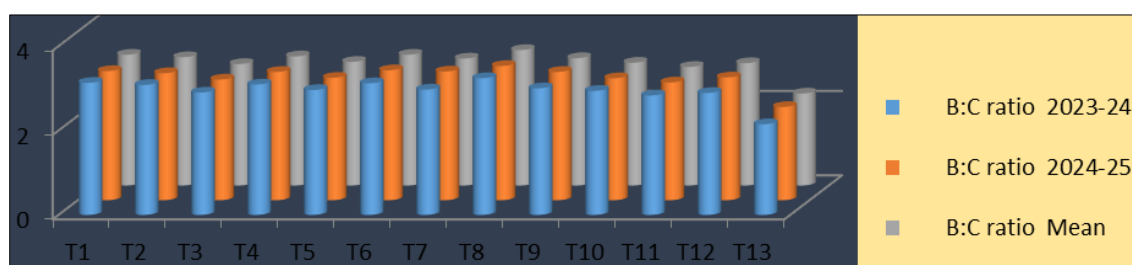
Benefit: cost ratio

It is obvious from data that Benefit: cost ratio had substantial variations due to different treatments. The maximum benefit cost ratio was noticed under treatment T₈- oxyfluorfen150 g ha⁻¹ (PE) *fb* topramezone20.6 g ha⁻¹ (PoE), (3.24,3.18 and 3.21) followed by T₆-metribuzin 350 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹

(PoE), (3.12, 3.08 and 3.10), T₁- metribuzin 350 g ha⁻¹ (PE), (3.13, 3.06 and 3.10), T₂- oxyfluorfen150 g ha⁻¹ (PE) (3.08,3.01and 3.04) and T₉- oxyfluorfen150 g ha⁻¹ (PE) *fb* propaquizafop 100 g ha⁻¹ (PoE), (3.00, 3.04 and 2.84) and the lowest B:C ratio was found under treatment T₁₃-weedy check (2.15, 2.21 and 2.18) during 2023-24,2024-25 and on mean basis, respectively (Fig. 4).

Table 5: Effect of different herbicides on B:C ratio of chickpea cultivation

Tre	Herbicide	Dose (g a i. ha ⁻¹)	B:C ratio		
			2023-24	2024-25	Mean
T ₁	Metribuzin (PE)	350	3.13	3.06	3.10
T ₂	Oxyfluorfen (PE)	250	3.08	3.01	3.04
T ₃	Topramezone (PoE)	20.6	2.90	2.86	2.88
T ₄	Propaquizafop (PoE)	100	3.09	3.04	3.06
T ₅	Metribuzin (PE) fb Topramezone (PoE)	350+20.6	2.96	2.90	2.93
T ₆	Metribuzin (PE) fb Propaquizafop (PoE)	350+100	3.12	3.08	3.10
T ₇	Oxyfluorfen (PE) fb Propaquizafop (PoE)	250+100	2.97	3.05	3.01
T ₈	Oxyfluorfen (PE) fb Topramezone (PoE)	250+20.6	3.24	3.18	3.21
T ₉	Oxyfluorfen (PE) fb Quizalofop-p-ethyl (PoE)	150+100	3.00	3.04	3.02
T ₁₀	Metribuzin fb 1 hand hoeing at 25 DAS	350	2.94	2.89	2.91
T ₁₁	Oxyfluorfen (PE) fb 1 hand hoeing at 25 DAS	250	2.83	2.79	2.81
T ₁₂	Hand weeding twice at 20 and 40 DAS	-	2.89	2.91	2.90
T ₁₃	Weedy check	-	2.15	2.21	2.18
	SEm±		0.07	0.12	0.08
	CD (P=0.05)		0.21	0.35	0.24

**Fig 4:** B:C ratio

Conclusion

Treatment T₁₂- hand weeding twice at 20 and 40 DAS had maximum gross return (Rs. 100222, 103926 and 102074 ha⁻¹) followed by T₈- oxyfluorfen150 g ha⁻¹ (PE) fb topramezone20.6 g ha⁻¹ (PoE) and T₉- oxyfluorfen150 g ha⁻¹ (PE) fb quizalofop-p-ethyl100 g ha⁻¹ (PoE) and T₇-oxyfluorfen150 g ha⁻¹(PE) fb Propaquizafop 100 g ha⁻¹ (PoE) during 2023-24, 2024-25 and on mean basis, respectively. When compared among herbicides, highest gross return was recorded under T₈- oxyfluorfen150 g ha⁻¹ (PE) fb topramezone20.6 g ha⁻¹ (PoE) followed by T₉- oxyfluorfen150 g ha⁻¹ (PE) fb quizalofop-p-ethyl100 g ha⁻¹ (PoE) during both the years and on mean basis.

Highest net return was recorded under treatment T₈- oxyfluorfen150 g ha⁻¹ (PE) fb topramezone20.6 g ha⁻¹(PoE), (Rs. 66778, 68532 and 67655 ha⁻¹) followed by T₉- oxyfluorfen150 g ha⁻¹ (PE) fb quizalofop-p-ethyl100 g ha⁻¹ (PoE), (Rs. 62382, 66040 and 64211 ha⁻¹) and T₇- oxyfluorfen150 g ha⁻¹ (PE) fb propaquizafop 100 g ha⁻¹ (PoE), (Rs. 61621, 65956 and 63788 ha⁻¹), T₆- metribuzin 350 g ha⁻¹ (PE) fb propaquizafop 100 g ha⁻¹ (PoE), (61871,62732,62302) and T₁₂- hand weeding twice at 20 and 40 DAS (Rs. 65568, 67591 and 66580 ha⁻¹), whereas treatment T₁₃- weedy check control was found inferior regarding net return (Rs. 28391, 30888 and 29640 ha⁻¹) during 2023-24, 2024-25 and on mean basis, respectively.

The maximum benefit cost ratio was noticed under T₈- oxyfluorfen150 g ha⁻¹ (PE) fb topramezone20.6 g ha⁻¹ (PoE), (3.24, 3.18 and 3.21) followed by T₆- metribuzin 350 g ha⁻¹ (PE) fb propaquizafop 100 g ha⁻¹ (PoE), (3.12, 3.08 and 3.10) and lowest B:C ratio was found under weedy check (2.15, 2.21 and 2.18) during both the years and on mean basis, respectively.

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