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Response of chickpea varieties to herbicide combinations for effective weed control strategies

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Abstract

A field experiment was carried out during *rabi/summer* of 2024-25 at Agricultural Research Station, Adilabad of Professor Jayashankar Telangana Agriculture University, to evaluate the response of chickpea varieties to herbicide combinations for effective weed control strategies in chickpea. The experiment was laid out in split-plot design which consists of three main plot (Chickpea cultivars) and six sub plot (Weed control treatments) including pre- emergence, post-emergence herbicide mixtures and manual weeding. The results indicated that the Weed-free treatment (Hand weeding both at 20 and 40 DAS) recorded the lowest weed density (7.9) and highest crop yield (2189 kg ha⁻¹). However, herbicide-based treatments particularly, T₁-Pendimethalin + Imazethapyr as PE *fb*. Topramezone @ 25.2 g ha⁻¹ as PoE, followed by T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE were performed on par with weed-free plots. These treatments have higher weed control efficiency (55.9% and 46.1%, respectively) and yield of crop (1742 and 1954 kg ha⁻¹, respectively).

Keywords: Chickpea, weed control measures, pre and post-emergence herbicides, weed control efficiency and yield.

Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop around the world. India is the largest chickpea-producing country, it accounts for 75% of the world's production. The estimates of chickpea area, production and productivity in India during 2023-24 are 95.87 m ha, 11.03 mt and 1151 kg ha⁻¹ (Indiastat, 2024) [3]. In India, major chickpea growing states are Madhya Pradesh, Rajasthan, Maharastra, Andhra Pradesh and Telangana. It can grow from light sandy loam to heavy textured clay soils, and it fixes biological nitrogen. Due to slow early growth rate and inadequate leaf area at initial phases of crop growth, weeds in such conditions caused higher yield losses. The initial 30 to 60 day period is serious for crop-weed competition in chickpea. As the chickpea being a pulse crop, it has higher amount of proteins, carbohydrates, vitamins and minerals and it is a good dietary source also, but the major yield loss of the crop are affected by the weeds, reported to be of 24-63% by Muhammad *et al.*, 2011 [6]. Introduction of herbicides has made it possible to control a wide spectrum of weeds in pulses effectively at a remunerative cost. Chickpea is a poor competitor to weeds because of its slow initial growth and vegetative cover, resulting in yield loss up to 80% under season long weed infestation. Presently, PE application of Pendimethalin @ 1000 g a.i. ha⁻¹ *fb*. hand weeding is advocated for weed management in chickpea (Kumar *et al.*, 2015) [5]. However, hand weeding is a cumbersome process because of limited availability of labour at critical crop growth period and increasing cost. Also, the application of Pendimethalin as PE does not control the later flush of weeds after one month of sowing (Singh *et al.*, 2014) [13]. Therefore, PoE herbicides are essential but there is no such herbicide recommended especially for controlling broad-leaved species. Some studies have suggested the application of Imazethapyr in chickpea (Kachhadiya *et al.*, 2009) [4] lower weed control efficiency and phytotoxicity to crop hinder its wider adoption (Kumar *et al.*, 2016) [5]. Quizalofop-p-ethyl @ 100 g a.i.ha⁻¹ (Kumar *et al.*, 2015) [5] and Fenoxaprop-p-ethyl @ 100 g a.i. ha⁻¹ (Ansar *et al.*, 2010) [1] are recommended in chickpea to control grassy weeds, but the

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dominant broad-leaved weeds such as *Medicago polymorpha* L., *Vicia sativa* L., *Convolvulus arvensis* cause severe yield loss in chickpea (Nath *et al.*, 2018) [7]. Thus, there is a need to investigate the selectivity of different PoE herbicides for their broad- spectrum activities in chickpea to minimize the yield loss and higher weed control efficiency.

Keeping in view of these facts, the present investigation was undertaken to test the performance of post-emergence herbicide either alone or combination with other weed management practices for providing effective weed control in chickpea.

Materials and Methods

A field experiment was carried out during *rabi*/summer 2024-25 at Agricultural Research Station, Adilabad, PJTAU. The soil at the study location was clay in texture, neutral soil reaction (pH 7.79), non-saline (0.19 dS m⁻¹), medium organic carbon content (0.65%), low nitrogen availability (164 kg ha⁻¹), medium phosphorous availability (47 kg ha⁻¹) and high potassium availability (456 kg ha⁻¹). The experiment was laid out in split-plot design with three cultivars as mainplot and six weed control measures as subplot treatments with three replications having gross plot size of 21.6 m² (3.6 x 6.0 m). The cultivars are JG-11 (Desi), JAKI-9218 (Desi) and NBeG-810 (Kabuli). The treatments are T₁- Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE; T₂- Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE; T₃-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE; T₄-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE; T₅-Weed-free (Hand weeding at 20 and 40 DAS) and T₆-Unweeded (control). Seed rates of 75 kg ha⁻¹ (desi) and 125 kg ha⁻¹ (kabuli) were used, with spacings of 45 x 10 cm and 30 x 10 cm correspondingly. Fertilization included 20-50-20 NPK kg ha⁻¹ in conjunction with 5 tons ha⁻¹ of farmyard manure along with *Rhizobium inoculation*. The data on density (no m⁻²) and biomass (g m⁻²) of weeds was recorded with the help of quadrat of one meter square. Yield attributes, grain and straw yields were recorded as per standard procedures and economics was computed using the prevailing market price for inputs and outputs (grain and straw). The data on total weed density and biomass were subjected to square root transformation ($\sqrt{}$) before subjecting to statistically analysis.

Results and Discussion

Weed composition

The field experiment was infested with different kinds of weeds. *Cynodon doctylon*, *Phalaris minor*, *Echinochloa colona* and *Avena fatua* are predominant among grasses. *Cyperus rotundus* is predominant in case of sedges and *Chenopodium album*, *Digera arvensis*, *Portulaca oleracea*, *Parthenium hysterophorus*, *Phyllanthus niruri* and *Rumex dentatus* are mainly observed among the broad-leaved weeds. Application of right dosage of treatments markedly reduced the weed density and dry matter accumulation as compared to weedy check.

Weed density

The cultivars does not show any significant effect on total weed density at any stage of the observations. However, variety V1-JG-11 (Desi) had a slightly greater overall weed density than V2- JAKI-9218 (Desi) and V3-NBeG-810 (Kabuli) at all stages. But among the herbicide treatments at 60 DAA, significant differences emerged among the treatments. The lowest weed density was recorded in T₅-Weed free (Hand weeding both at 20

and 40 DAS) which was (7.9 m⁻²) which is significantly superior over rest of the weed control treatments of T₁-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE, T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE, T₃-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE and T₄-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (11.1-12.8 m⁻²) and T₆-weedy check recorded highest weed density (18.2 m⁻²) in (Table 1). With respect to the species wise weed density (grasses, sedges and BLws) similar trend was observed as that of the total weed density across the weed control treatments. BLws were predominant category followed by grasses and sedges. The lower total weed density under integrated herbicide treatments can be attributed to early-season weed suppression by pre-emergence herbicides, followed by effective control of later-emerging weeds by post-emergence herbicides, ensuring prolonged weed-free conditions. Similar findings were reported by Patil *et al.* (2021) [8]. However, weed-free treatment remained superior, but un-weeded (control) had substantial weed infestation. The interaction between varieties and weed control measures found to be non significant in terms of total weed density.

Weed dry matter

The varieties does not show any significant effect on weed dry matter at any point of the observation stages. At 15 DAA, total weed dry matter varied between 8.0 to 8.1 g m⁻² in V1-JG- 11 (Desi), V2-JAKI-9218 (Desi) and V3-NBeG-810 (Kabuli) varieties. Similarly at 30 DAA (9.5-9.7 g m⁻²), 45 DAA (10.2-10.5 g m⁻²) and 60 DAA (11.6-11.7 g m⁻²) also there is no significant variation in all the varieties. This demonstrated that varietal differences had no significant effect on total weed dry matter accumulation during the total crop growth period. Weed control strategies had a significant impact on total weed dry matter at all phases of crop development. At 60 DAA also, T₅ - Weed free (Hand weeding at 20 and 40 DAS) resulted in significantly reduced weed dry matter (7.2 g m⁻²), which is significantly superior over rest of the weed control treatments of T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE, T₁-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE, T₃-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE and T₄- Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (11.7-12.7 g m⁻²), while T₆-weedy check showed the maximum weed dry matter accumulation (15.4 g m⁻²) (Table 1). The sequential herbicide application of Pendimethalin + Imazethapyr (PE) *fb*. Topramezone (PoE), T₁-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE recorded lower weed dry matter compared to T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb*. Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE. The higher dose of Topramezone 33.6% SC @25.2 g ha⁻¹ as PoE was more effective in controlling late-emerging grasses and broad-leaved weeds, leading to reduced biomass accumulation. According to Soltani *et al.* (2014) [12], Topramezone effectively inhibits 4-hydroxyphenylpyruvate dioxygenase (HPPD), disrupting carotenoid synthesis and causing bleaching and death of weeds. The interaction between varieties and weed control methods was found to be non-significant for weed dry matter of grasses,

sedges, BLWs and total weeds at all stages of observation. This suggests that the response of weed dry matter to different weed control methods was similar across all varieties.

Yield attributes: Seed yield

Significant differences were observed in yield and its components among varieties and weed control measures. JAKI-9218 (V2) variety consistently achieved the highest seed yield (2081 kg ha⁻¹) and harvest index (39.6%), demonstrating its superior productivity. NBeG-810 (V3) registered the lowest yield parameters. The higher seed yield of JAKI-9218 may be attributed to its better yield attributes such as higher number of pods per plant, improved seed setting, and better translocation of photosynthates to reproductive sinks, as reflected in its relatively higher harvest index. These findings are in close conformity with Rao *et al.* (2017) [9], who reported significant variation in seed yield among chickpea varieties due to differences in genetic yield potential and assimilate partitioning. The weed control treatment T₅-Weed-free (Hand weeding at 20 and 40 DAS) produced the maximum seed yield (2189 kg ha⁻¹) which was significantly on par with T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (1954 kg ha⁻¹) followed by T₄-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (1806 kg ha⁻¹). In contrast, the unweeded control (T₆) recorded the lowest seed yield (1384 kg ha⁻¹) due to severe weed competition throughout the crop growth period, which drastically reduced nutrient uptake, photosynthetic efficiency and yield attributes. These results are in agreement with the findings of Dewangan *et al.* (2016) [2] who reported that increased seed yield of pulses under integrated weed management practices compared to unweeded conditions. Topramezone did not show any considerable phytotoxic symptoms as compared to higher dosage while using as PoE herbicide. The interaction effect between sowing varieties and treatment levels found to be non significant for seed yield and harvest index (Table 2).

Haulm yield

Significant variations were observed in yield and its components among varieties and weed control measures. JAKI-9218 (V2) variety consistently achieved the highest haulm yield (3147 kg ha⁻¹), demonstrating its superior productivity. NBeG-810 (V3) registered the lowest yield parameters. Higher haulm yield observed in T₅-Weed-free (Hand weeding at 20 and 40 DAS) (3153 kg ha⁻¹) which was significantly on par with T₂-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (3106 kg ha⁻¹) and T₄-Oxyfluorfen 23.5% EC @ 140 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE (3000 kg ha⁻¹). The lowest haulm yield was observed in T₆-Weedy check (2762 kg ha⁻¹). Higher Haulm yield in weed free (Hand weeding at 20 and 40 DAS) could be ascribed to better

weed control efficiency that promoted the crop to grow luxuriantly as evident from higher dry matter accumulation and nutrient uptake. Lower haulm yield associated with the weed control treatments (T₄, T₃, T₂ and T₁) as compared to weed free treatment was due to phytotoxic effect during peak vegetative and flowering stage, that had slight stunting that reflected in lower dry matter accumulation and growth. On the other side, lowest haulm yield in T₆- weedy check treatment could be ascribed to high weed density, weed dry matter coupled with low nutrient uptake. The results are in accordance with findings of Yadav *et al.* (2019) [16]. The interaction effect was found to be non significant in terms of haulm yield between the varieties and treatments (Table 2).

Phytotoxic symptoms

Herbicide phytotoxicity observations were recorded at 3, 5, 7, 10 and 15 DAA of herbicide spraying like yellowing, scorching, vein clearing and inter veinal chlorosis symptoms were observed. Among the different doses and time of applications of herbicides, application of T₁-Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE and T₃-Oxyfluorfen 23.5% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE after 14 DAA of herbicides found more phytotoxic than 3, 5, 7 and 10 DAA of herbicide applications (rating 5-6). Application of Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE and Oxyfluorfen 23.5% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 25.2 g ha⁻¹ as PoE after 14 DAA noticed severe yellowing and discoloration of crop plants but other days of sowing found less toxicity as comparable to other time of applications of herbicides (Table 3 and 4). However, spray of Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE and Oxyfluorfen 23.5% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE days of application of herbicides, both controlled weed properly but after 14 DAA of herbicides applied dose more toxic to crop, as well as weeds also emerge due to slow early crop growth. However, T₅-Weed free (Hand weeding at 20 and 40 DAS) and T₆-Weedy check does not show any phytotoxic symptoms as both rated with 0 scale value. This yellowing symptom may be attributed to herbicide interference with chlorophyll synthesis and photosynthetic activity, which is common with herbicides like Imazethapyr and Topramezone. Similar transient chlorosis symptoms in chickpea were reported by Chaudhary *et al.* (2016), who observed temporary yellowing after application of post-emergence herbicides, which diminished as the crop recovered. No symptoms of stunting, necrosis, epinasty, hyponasty or germination inhibition were observed in any treatment throughout the observation period. This indicates that although some treatments caused temporary phytotoxic effects, they did not cause severe or permanent crop injury.

Table 1: Effect of weed management practices on weed density (no.m-2), weed dry matter (g.m-2) and WCE (%) during (Rabi 2024-25)

Treatments	Total Weed density (no m-2)	Total Weed dry matter (g m-2)	WCE (%)
Main plot: 03 (Varieties)			
V1 -JG-11 (Desi)	12.3	11.6	42.9
V2 – JAKI-9218 (Desi)	12.4	11.7	41.4
V3- NBeG-810 (Kabuli)	12.4	11.7	41.9
S.em+	0.10	0.10	1.77
CD (at 5%)	NS	NS	NS

Sub-plot: 06 (WCM)			
T ₁ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	11.1	11.8	51.8
T ₂ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	11.9	11.7	45.1
T ₃ -Oxyfluorfen 23.5% EC @ 140 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	12.3	12.1	40.8
T ₄ -Oxyfluorfen 23.5% EC @ 140 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	12.8	12.7	34.9
T ₅ -Weed-free (HW at 20 & 40 DAS)	7.9	7.2	79.8
T ₆ -Un-weeded (check)	18.2	15.4	0.0
S.em+	0.12	0.11	0.96
CD (at 5%)	0.33	0.32	2.76
Interaction			
F(A) on F(B)			
S.em+	0.2	0.2	1.7
CD (at 5%)	NS	NS	NS
F(B) on F(A)			
S.em+	0.2	0.2	2.3
CD (at 5%)	NS	NS	NS

Table 2: Effect of weed manangement practices on seed yield, Haulm yield (kg ha⁻¹) and Harvest index (%) during *Rabi* 2024-25

Treatments	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	HI (%)
Main plot: 03 (Varieties)			
V1 – JG-11 (Desi)	1734	2920	37.0
V2 – JAKI-9218 (Desi)	2081	3147	39.6
V3- NBeG-810 (Kabuli)	1465	2777	34.3
S.em+	24.6	55.6	0.7
CD (at 5%)	96.5	218.3	2.7
Sub-plot: 06 (WCM)			
T ₁ - Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	1742	2934	37.1
T ₂ - Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	1954	3106	38.4
T ₃ - Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	1485	2735	34.9
T ₄ - Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	1806	3000	37.4
T ₅ - Weed-free (HW at 20 & 40 DAS)	2189	3153	40.8
T ₆ - Un-weeded (check)	1384	2762	33.2
S.em+	51.0	57.7	0.8
CD (at 5%)	147.2	166.6	2.4
Interaction			
F(A) on F(B)			
S.em+	88.3	99.9	1.4
CD (at 5%)	NS	NS	NS
F(B) on F(A)			
S.em+	84.3	106.8	1.5
CD (at 5%)	NS	NS	NS

Table 3: Phytotoxicity symptoms of yellowing on chickpea crop affected by the post-emergence herbicide treatments during *rabi* 2024-2025

Treatments	Yellowing on chickpea at					
	1 DAA	3 DAA	5 DAA	7 DAA	10 DAA	15 DAA
T ₁ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	0	2	2	2	4	5
T ₂ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	0	1	1	1	2	3
T ₃ -Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	0	2	2	2	3	4
T ₄ -Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	0	1	1	2	3	3
T ₅ -Weed-free (HW at 20 & 40 DAS)	0	0	0	0	0	0
T ₆ - Un-weeded (check)	0	0	0	0	0	0

Table 4: Phytotoxicity symptoms of scorching on chickpea crop affected by the post-emergence herbicide treatments during *rabi* 2024-2025

Treatments	Scorching on chickpea at					
	1 DAA	3 DAA	5 DAA	7 DAA	10 DAA	15 DAA
T ₁ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	0	2	3	5	5	6
T ₂ -Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	0	1	2	3	4	5
T ₃ -Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 25.2 g ha ⁻¹ as PoE	0	2	3	4	5	5
T ₄ -Oxyfluorfen 23.5% EC @ 1000 g ha ⁻¹ as PE <i>fb.</i> Topramezone 33.6% SC @ 20.0 g ha ⁻¹ as PoE	0	1	2	3	4	4
T ₅ -Weed-free (HW at 20 & 40 DAS)	0	0	0	0	0	0
T ₆ - Un-weeded (check)	0	0	0	0	0	0

Conclusion

The findings of the present study highlights that the weed-free treatment had higher WCE and yield of the chickpea. But among various pre and post-emergence herbicide treatments, spraying application of Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE followed by Oxyfluorfen 23.5% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE was proved equally effective in controlling the weeds and improving the growth and yield of chickpea as compared to other chemical weed control treatments and Weedy check. Thus, it can be concluded that in the event of shortage of labour, the combined application of pre and post-emergence herbicides of Pendimethalin 30% EC + Imazethapyr 2% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone 33.6% SC @ 20.0 g ha⁻¹ as PoE followed by Oxyfluorfen 23.5% EC @ 1000 g ha⁻¹ as PE *fb.* Topramezone % SC @ 20.0 g ha⁻¹ as PoE will be helpful in reducing the weed competition, increasing the yield and the net monetary returns of the chickpea crop without any phytotoxic symptoms considerably

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