Effect of weed management practices on growth and yield ofzero-till chickpea (*Cicerarietinum* L.)

ABSTRACT

A field experiment to compareweed management practices on growth and yield of zero till chickpea (*Cicerarietinum* L.) during*rabi*, 2022 at RARS, Jagtial, Telangana.Treatments includePendimethalin 38.7 % CS @ 700 g *a.i.* ha^{-1},Topramezone 33.6 % SC @ 20.6 g *a.i.* ha^{-1},Quizalofop ethyl 7.5 % + Imazethapyr 15 % EC@ 100 g *a.i.* ha^{-1}, T_4- Propaquizafop 2.5 % + Imazethapyr 3.75 % (w/w) ME @ 125 g *a.i.* ha^{-1}, two hand weedings at 15 and 30 DAS, weed free (Season long) and Un-weeded (Check).Weed free treatment and hand weeded plots showed highest growth and yield attributing characters because of season-long weed-free conditions and better microclimate during critical period of crop respectively. Among different herbicides,Topramezone treated plotrecorded highergrowth parameters viz.; plant height (38.7 cm), dry matter accumulation(320.8g m^{-2}) and yield attributing characters viz.; total number of pods plant^{-1} (30.97), with seed yield (1397 kg ha^{-1}), haulm yield (2518 kg ha^{-1}) and harvest index (35.7 %).Post emergence herbicidetopramezone can be effectively adopted for getting higher yield of chickpea in rice fallow zero tillage conditions.

*Key words:*zero till,chickpea,weed management,herbicides,topramezone, toxicity,growth and yield parameters.

INTRODUCTION

Pulses are the third-largest crop in India next to cereals and oilseeds in terms of production, acreage and economic value (Choudhary, 2009).Chickpea (*Cicerarietinum* L.) ranks as the second-most important pulse crop and the third-most important food legume(Niranjan*et al*., 2020).Worldwide chickpea is grown in13.7 million ha of area with a yield of 12.8 million tonnes annually (Afzal, 2021). In India, chickpea is cultivated in 9.9 million ha with a production of 11.9 million tonnes and productivity of1192 kg ha^{-1}(Indiastat, 2021).

Due to the vulnerability of the chickpea to weeds, severe weed infestation is one of the significant factors limiting higher output (Nath*et al*., 2018).Chaudhary*et al*. (2005) reported thatweed infestation can cause up to 75 % yield losses in chickpea due to its shorter plant and poor early vigour. The first 30 days are too crucial for weed crop competitiveness in chickpea (Singh and Singh, 2000).

Recent years, conservation tillage techniques such as minimal or zero-tillagesystems have gained relevance. In comparison to conventional tillage, zero tillage systems typically needed less maintenance and provided higher economic returns (Smart and Bradford, 1999) and is an option for low-income farmers (Quddus*et al*., 2020).But, in comparison to conventional systems, weed control is more difficult in conservation tillage systems (Rajkumar*et al*., 2014;Bergtold and Sailus, 2020).

Chemicals are anticipated to be more commonly used in zero till agriculture due tolabour shortage and rising labour costs makingmanual weeding problematic.Though the pre-emergence herbicide pendimethalinis effective, identification of a selective post-emergence herbicide is required to manage broad-leaved weeds in this crop.Hence this study was taken up to evaluate different weed management practices on zero- till chickpea, which can be cost effective and acceptable to the chickpea growers.

MATERIALS AND METHODS

A field experiment was conducted at Regional Agricultural Research Station (RARS), Polasa, Jagtial, Telangana during *rabi*, 2022. The RARS was located at an altitude of 243.4 m above mean sea level (MSL) . The weekly mean maximum and minimum temperature during the crop growth period ranged from 30.4°C to 34.2°C and 13.4 ◦C to 19.6 °C respectively. The total rainfall received during the crop growth period was nil.

The experiment was laid out in randomized block design with seven treatments by replicating thrice. The treatments include T_1- Pendimethalin 38.7 % CS @ 700 g *a.i.* ha^{-1} at 48 hours after sowing, T_2- Topramezone 33.6 % SC @ 20.6 g *a.i.* ha^{-1} applied at 2-3 leaf stage of weeds, T_3- Quizalofop ethyl 7.5 % + Imazethapyr 15 % EC @ 100 g *a.i.* ha^{-1} applied at 2-3 leaf stage of weeds, T_4- Propaquizafop 2.5 % + Imazethapyr 3.75 % (w/w) ME @ 125 g *a.i.* ha^{-1} applied at 2-3 leaf stage of weeds, T_5- Hand weeding done twice at 15 and 30 DAS, T_6- Weed free (Season long) and T_7- Un-weeded (Check). The soil of experimental field was a sandy clay loams in texture,soil pH (7.31), EC (0.30 dsm^{-1}), low in available nitrogen (179.7 kg ha^{-1}) and available phosphorus (10.9 kg ha^{-1}) but high in available potash (358.4kg ha^{-1}). After harvesting of rice crop, in *rabi* season within a week' timeparaquat was sprayed at 5 ml L^{-1} to kill the rice stubbles and existing weeds.For ensuring good germination, healthy and good quality NBeG-3 varietychickpesseeds were used at a seed rate of 65 kg ha^{-1} with planting geometry of 30 cm x 10 cm. The recommended dose of fertilizer 20:50:20 kg ha^{-1} of NPK was applied at the time of sowing. Three uniform irrigations were given to the crop at pre sowing, pre flowering and pod development stages. The pre-emergence herbicidewas sprayed at 48 hours after sowing and post emergence herbicides were sprayed when the weeds are 2-3 leaf stage (18 DAS).The amount of various herbicides needed for the corresponding plots was calculated based on the amount of the active ingredient mentioned in the treatment. Herbicides were sprayed using a knapsack sprayer with a flat fan nozzle to the corresponding plots by mixing the exact amount of herbicides and measured water at a rate of 500 L ha^{-1}. The data was analysed by the method of "Analysis of Variance" as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSIONS

GROWTH PARAMETERS: All the growth parameters were significantly influenced by different weed management practices in zero- till chickpea and are presented in Table 1. The plant height, number of branches $plant^{-1}$, leaf area, and dry matter accumulationwerethe highest in weed free plots as well as hand weeding olots followed by the topramexone plots.

Weed free treatment produced the tallest plants (43.6 cm)and it was on par with hand weeding treatment (42.0 cm). Among herbicides, treatment topramezonerecorded higher plantheight (38.7 cm).Similar results were found with Qudduset *al*. (2020) and Ratnamet *al*. (2011).he number of branches plant^{-1}was thehighest in weed free plots(30.51) followed by those in hand weeding plots(26.32). Among herbicides, higher number of branches plant^{-1} registered in plots applied with topramezone (25.95).Similar results documented with Sankethet *al*. (2021).At 75 DAS, higher leaf area plant^{-1} recordedinweed free treatment (433.99 cm^{2}) which was comparable with hand weeding treatment (410.48 cm^{2}). Among herbicides, topramezonerecorded higher leaf area plant^{-1}(403.75 cm^{2}). These results are in line with those of Thakur *et al*. (2019).

Again,weed free plotaccumulated maximum dry matter (383.5 g m^{-2}) which was followed by hand weeded plot (344.2 g m^{-2}). Among herbicides, topramezone accumulated maximum dry matter (320.8 g m^{-2}). This might be due to improved crop growth parameters viz.; (Plant height, Number of branches plant^{-1} and Leaf area plant^{-1}).Similar findings were seen with Kumar and Hiremath (2018) and Thakur *et al*. (2019).

YIELD PARAMETERS: An overview of the yield attributes data from table 2 revealed that there were significant differences among different weed management treatments except pod weight, number of seeds pod^{-1} and test weight.

From the data on yield attributes, weed free treatment depicts significantly higher number of branches plant^{-1} (30.51) followed by hand weeding treatment (26.32). Among herbicides, topramezonerecorded higher number of branches (25.95).Similar results were earlier documented by Sankethet *al*. (2021).Higher number of pods branch^{-1} (2.78) was obtained from weed free plots which was comparable with hand weeding (2.52)and among herbicidal treatments higher number of pods branch^{-1} observed intopramezone (2.19).

An overview on yield attributes,weed free plot registered highest total number of pods plant^{-1} (33.93) and it was statistically on par with hand weeding plot (31.20). While, among herbicidal treatments highest total number of pods plant^{-1} were registered in topramezone (30.97) due to higher number of branches plant^{-1} and number of pods branch^{-1}.These results find support from those of Tiwariet *al*. (2019).No significant differences among different weed management practices on pod weight or on number of seeds pod^{-1}. This could be attributed to the fact that number of seed weight, seeds pod^{-1}and test weight of 100 seedsare a genetic characters and hence are not altered by any weed management practices. The results are in accordance with findings of Sankethet *al*.,(2021) and Ratnamet *al*.,(2011).

Seed yield of zero till chickpea was significantly influenced by different weed management practices and it ranged from 903 to 1621 kg ha^{-1} across the treatments which were presented in Table 2 and Fig 1.

Weed free plotrecorded significantly higher seed yield (1621 kg ha^{-1}) followed by hand weeding (1453 kg ha^{-1}) but among the herbicidal treatment topramezone recorded highest seed yield (1397 kg ha^{-1}). It was due to the proper utilization of moisture, nutrients, light and space by the chickpea crop in the absence of weed competition during critical period of crop. While, lowest seed yield was recorded from Un-weeded (Check) plot (903 kg ha^{-1}) due to highest crop-weed competition.Similar results were reported by those of Kumari*et al*. (2021),Mishra *et al*. (2012),Quddus*et al*. (2020),Banjara*et al*. (2022) andSeshareee*et al*. (1996).

Weed free plot registered higher haulm yield (2648 kg ha^{-1}) followed by hand weeding plot (2527 kg ha^{-1}). On the other hand, topramezone (2518 kg ha^{-1}) treatment among herbicides recorded highest haulm yield.The higher stover yield in above treatments might be due to lesser weeds during early crop growth period, higher yield attributes and pod yield which leads to higher stover yield.Quddus*et al*. (2020) and Banjara*et al*. (2022) found similar results.

Significantly higher harvest index (38.0 %) observed in weed free treatment, which was statistically comparable with hand weeding treatment but different from remaining treatments.This might be due to proper reproductive growth aided by timely translocation of photosynthesis from source to sink thus increasingthe seed production ratio in total produce.Quddus*et al*. (2020) and Thakur *et al*. (2019) observed similar output.

CROP PHYTOTOXICITY

Visual scoring for crop phytotoxic symptoms such as yellowing, stunting, chlorosis and necrosis were taken at 3rd day after spray of herbicide up to 25 daysbased on the rating of 1-9 scale method(Jiddimani*et al*., 2017). A score of < 3 was considered asacceptable (Rao, 2000).

Topramezonetreated plot showed yellowing and stunting symptoms (Scale < 2)and recovered completely 10 days after application (DAA).Similar findings on yellowing and stunting in chickpea crop were documented earlier by (Nath*et al*., 2018) and (Sanketh*et al*., 2021).In contrast, treatment T_3 and T_4 showed chlorotic symptoms of phytotoxicity(Score < 4) which was higher at 7 DAA leading to necrosis due to death of apical tissue. Though by 30 DAA the crop recovered, theprolonged phytotoxicity affected the crop phenological development as evident from lower seed yield. Similar results of phytotoxicity due to application of imazethapyrleading to leaf chlorosisand subsequentnecrosis have been reported by earlier workers (Kumar *et al*., 2015;Dubey*et al*., 2018;Dubey and Chaudhary, 2021;Lyon and Wilson, 2005; Sanketh*et al*., 2021).

CONCLUSION

Experimental results revealed that weed free plots as well as manual weeding were the best weed management practices for growth and yield contributing characters in zero-tillage chickpea cultivation. However, in the absence of these, among herbicides, topramezone33.6 % SC @ 20.6 g *a.i.* ha^{-1} applied at 2-3 leaf stage of weedis suggestedfor management ofthe diversified weed flora under zero tillage chickpeain rice-fallow areas.

Table. 1 Growth parameters of zero- till chickpea as influenced by weed management practices

Treatment details	Plant height (cm)	Number of branches $plant^{-1}$	Leaf area (cm^{-2} $plant^{-1}$)	Dry matter accumulation ($g\ m^{-2}$)
T_1-Pendimethalin 38.7 % CS @ 700 g a.i. ha^{-1} at 48 hours after sowing	35.5	19.61	372.42	277.9
T_2-Topramezone 33.6 % SC @ 20.6 g a.i. ha^{-1} applied at 2-3 leaf stage of weeds	38.7	25.95	403.75	320.8
T_3-Quizalofop ethyl 7.5 % + Imazethapyr 15 % EC @ 100 g a.i. ha^{-1} applied at 2-3 leaf stage of weeds	34.2	16.66	321.29	244.0
T_4-Propaquizafop 2.5 % + Imazethapyr 3.75 % (w/w) ME @ 125 g a.i. ha^{-1} applied at 2-3 leaf stage of weeds	34.6	17.13	337.64	263.9
T_5-Two hand weedings at 15 and 30 DAS	42.0	26.32	410.59	344.2
T_6-Weed free (Season long)	43.6	30.51	433.99	383.5
T_7-Un-weeded (Check)	31.0	14.14	285.92	233.2
SEm±	0.6	0.8	4.8	13.9
CD (P=0.05)	1.9	2.3	14.8	42.9

Table. 2 Yield and yield attributes of zero till chickpea as influenced by weed management practices

Treat No.	Total number of branches $plant^{-1}$ at harvest	Number of pods $branch^{-1}$	Total no. of pods $plant^{-1}$	Pod Weight (g)	No. of seeds pod^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index (%)
T_1	19.61	1.70	26.80	0.27	1	23.00	1129	2253	33.4
T_2	25.95	2.19	30.97	0.28	1	23.67	1397	2518	35.7
T_3	16.66	1.08	20.67	0.27	1	23.00	1000	1922	34.2
T_4	17.13	1.18	21.43	0.27	1	23.00	1067	2014	34.6
T_5	26.32	2.52	31.20	0.28	1	23.67	1453	2527	36.5
T_6	30.51	2.78	33.93	0.29	1	24.00	1621	2648	38.0
T_7	14.14	1.08	18.67	0.27	1	23.00	903	1802	33.3
SEm±	0.8	0.3	1.3	0.008	-	0.4	31.4	37.9	0.5
CD (P=0.05)	2.3	0.8	3.9	NS	-	NS	96.6	116.9	1.6

Table. 3Phytotoxicityrating (Scale 1-9) as influenced by weed management practices on zero till chickpea

Treatment details	Dosage (ml ha^{-1})	Phytotoxicity rating
T_1-Pendimethalin 38.7 % CS @ 700 g a.i. ha^{-1} at 48 hours after sowing	1808	-
T_2-Topramezone 33.6 % SC @ 20.6 g a.i. ha^{-1} applied at 2-3 leaf stage of weeds	61.3	1-2
T_3-Quizalofop ethyl 7.5 % + Imazethapyr 15 % EC @ 100 g a.i. ha^{-1} applied at 2-3 leaf stage of weeds	444.4	3-4
T_4-Propaquizafop 2.5 % + Imazethapyr 3.75 % (w/w) ME @ 125 g a.i. ha^{-1} applied at 2-3 leaf stage of weed	2000	3-4
T_5-Two hand weedings at 15 and 30 DAS	-	-
T_6-Weed free (Season long)	-	-
T_7-Un-weeded (Check)	-	-

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