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Effect of different weedicides on growth, yield and quality of okra

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Abstract
The present investigation entitled, "Effect of different weedicides on growth, yield and quality of okra" The field experiment was carried out during 2024-25 at Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. To study the relative performance of different herbicides for control of weeds for better growth, yield and quality of okra. The experiment was conducted in randomized block design (RBD) with three replications and eight treatments *viz*, T_1-Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS, T_2 -Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS, T_3 -Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS, T_4 -Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS, T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS, T_6-Imazethapyer 35% + Imazamox 35% WG 0.070 kg a.i./ha as PoE at 20 DAS fb 1 HW, T_7- Farmers practice HW at 20,40,60 DAS, T_8 -Weedy Check were tested. Significantly lower density and dry matter of weeds were recorded with farmers practice of 3 HW followed by post emergence application of Propaquizofop 5% + Oxyfluorfen 12% followed by one hand weeding at 60 DAS. The average plant height, number of fruits per plant, fruit yield per plant and fruit yield per hectare were also highest in farmers practice while it was at par with Propaquizofop 5% + Oxyfluorfen 12% followed by one hand weeding at 60 DAS. The maximum B:C ratio 2.52 was obtained in combined spray of Propaquizofop and Oxyfluorfen followed by one hand weeding at 60 DAS. Post-emergence herbicide application was found to be an effective method for broad-spectrum weed management and improving economic returns in okra cultivation. Propaquizafop 5% + Oxyfluorfen 12% w/w EC at 0.150 kg a.i./ha applied at 20 DAS followed by one hand weeding at 60 DAS was the most effective treatment for enhancing growth and yield parameters.

Keywords: Okra, propaquizofop, pendimethalin, oxyfluorfen, weed management

Introduction

Okra (*Abelmoschus esculentus* (L.) *Moench*.) belongs to family Malvaceae, is one of the important vegetable grown in tropical and sub-tropical region of the world. Among the problems encountered in cultivation of okra, the control of weed is most important. Weeds are the silent robbers of plant nutrients, moistures, sunlight and also compete for space that would otherwise be available to main crop. Weeds are harbor pest and disease causing organisms, cause adverse allelopathic effect on okra and reduce the yield and quality of the produce. The leading okra producing country in the world is India, India produced 4.39 million tonnes of okra production from 0.23 million hector area and Maharastra produced 0.95 million tones of okra production from 0.05 million hector area (Anonymous, 2023) [1]. Crop is infested by repeated flushes of diversified weed flora throughout its growing season and weed competition is especially greater in a direct-seeded vegetable like okra. The crop-weed competition remains maximum during the early growth stage which slows initial growth rate of the crop and consequently causes poor competitive ability. The uncontrolled weeds exert severe competition for nutrients, water and light, resulting in reduced pod yield of okra by 73-75% (Imoloame and Muinat, 2018) [7] depending on the type of weed flora, their intensity and stages. Continuous monitoring and refinement in management strategies is essential for alleviating adverse effects of weeds on agricultural productivity and environmental health (Rao and Nagmani, 2013) [18]. Hand-weeding is a predominant weed- control method used by farmers.

However, it is very tedious, sometime inefficient, time-consuming and associated with high labour demands (Adigun *et al*., 2018; Patel *et al*., 2020) [2, 17]. Besides, availability of labour for manual weeding is scarce and often too expensive. Hence, use of herbicide in sequence or in combination with other weed-management practices is more advisable for farmers for season-long weed control. We hypothesized that, integration of physical and chemical (alone or sequential) weed-management practices could help improve weed-control efficiency, reduce the high cost associated with multiple hand-weeding and increase the yield of okra.

Materials and Methods

The present investigation entitled, "Effect of different weedicides on growth, yield and quality of okra" was carried out using eight treatments during *Kharif* season of 2024-25 at the Instructional Farm, Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.).

Planting material

The seed of okra variety, PDKV Pragati, was procured from the Chilli and Vegetable Research Unit, Dr. PDKV Akola. The flat bed were prepared and the seed of okra was sown on the bed dated 12 July, 2024. The experiment was laid out on plot size 4.8m × 1.8m and plant spacing of 60×45 cm in a Randomized Block Design (RBD) with three replications and eight treatments.

In the present experimentation, eight treatments *viz*; T_1 -Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS, T_2 -Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS, T_3 -Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS, T_4 -Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS, T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS, T_6-Imazethapyer 35% + Imazamox 35% WG 0.070 kg a.i./ha as PoE at 20 DAS fb 1 HW, T_7-Farmers practice HW at 20,40,60 DAS, T_8 -Weedy Check were tested. Observations were recorded on different aspects of weeds, morphological growth, yield parameters realated to crop in which per hectare and B:C ratio was also work out.

Results and Discussion

Weed Study

The prominent weed species observed in experiment site were *Cyperus rotundus, Cynodon dactylon, Eleusine indica, Commelina bengalensis, Parthenium hysterophorus, Euphorbia hirta, Amaranthus viridis, Chenopodium album, Portulaca oleraceae, Celosia argentea etc.*

Influence of herbicides on monocot weeds

The data in respect of monocot weed count recorded at 90 DAS are presented in Table 1 It revealed that, the monocot weed population was significantly influenced due to herbicidal treatments. At the stage of 90 DAS, significantly minimum monocot weeds were counted in the treatment T_7-Farmer practice of 3 HW (37.92). Among herbicidal treatments, at the stage of 90 DAS significantly minimum monocot weed count was found in the treatment T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS (41.57). However, At the stage of 90 DAS, significantly the maximum monocot weeds were counted in the treatment T_8 -Weedy Check (186.30). This happened due to any of the herbicide did not show satisfactory control for *cynodon dactylon* and *cyperus rotundus* due to their deep rhizome and root system whereas Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha gives better result to control against monocot weeds. Similar result were earlier reported by Jalendhar *et al*. (2016) [9] and Manju *et al*. (2017) [13] in okra, Dechen and Chopra (2020) [6] in onion.

Influence of herbicides on dicot weeds

The data in respect of dicot weed count recorded at 90 DAS are presented in Table 1 It revealed that, the dicot weed population was significantly influenced due to herbicidal treatments. At the stage of 90 DAS, significantly minimum dicot weeds were counted in the treatment T_7-Farmer practice of 3 HW (16.25). Among herbicidal treatments, at the stage of 90 DAS significantly minimum monocot weed count at was found in T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS. (17.82). However, significantly the maximum dicot weeds were counted in the treatment T_8 -Weedy Check (79.84). This might be due to the fact that, the pre and post emergence application of herbicides gave better control of dicot weeds. Similar result were earlier reported by Jalendhar *et al*. (2016) [9] and Manju *et al*. (2017) [13] in okra. Dechen and Chopra (2020) [6] in onion.

Influence of herbicides on total weed population

The data in respect of total weed count recorded at 90 DAS are presented in Table 1 It revealed that, the total weed population was significantly influenced due to herbicidal treatments. At the stage of 90 DAS, significantly minimum total weeds were counted in the treatment T_7-Farmer practice of 3 HW (54.17). Among herbicidal treatments, at the stage of 90 DAS significantly minimum monocot weed count at was found in T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS (59.39). However, At the stage of 90 DAS, significantly the maximum monocot weeds were counted in the treatment T_8 -Weedy Check (266.15).

The weed population was effectively controlled by application of different integrated herbicidal combinations than the control. This might be due to the reason that, post emergence application of various herbicides, the weed emergence was checked in the pre emergence herbicide treated plots and later on the emergence of weeds was not controlled due to loss of residual effect of herbicides in the field. Thereby, good control of weed was achieved whenever pre and post emergence herbicides is followed by hand weeding.Similar result were earlier reported by Jalendhar *et al*. (2016) [9] and Manju *et al*. (2017) [13] in okra.

Influence of herbicides on dry matter of weed (gm^{-2})

The data regarding dry matter accumulation of weed m^{-2} recorded at 90 DAS are presented in Table 1. It is revealed that, dry matter accumulation of weed was significantly influenced due to herbicidal treatments. At the stage of 90 DAS, significantly minimum dry matter accumulation of weed were recorded in the treatment T_7-Farmer practice of 3 HW (37.06 g). Among the herbicidal treatments, at the stage of 90 DAS significantly minimum dry matter accumulation of weed was recorded in T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS. (85.74 g). However, significantly highest dry matter accumulation of weed were recorded in the treatment T_8 -Weedy Check (388.95 g).

Lowest weed dry weight at 90 DAS were seen in treatment sprayed with T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS as post emergence along with one hand weeding. One week after germination demonstrated a very effective mortality of weeds resulting decline in dry matter accumulation and proved best of all the treatments for weed control. This trend of reduction in dry weight of weed at the harvesting stage coincided with the total weed population and hence, the post emergence application of herbicides were found to be much effective in reducing the dry weight of weed as compared to weedy check. Similar result were earlier reported by Jalendhar *et al*. (2016) [9] and Manju *et al*. (2017) [13] in okra.

Weed control efficiency (%) as influenced by different herbicidal treatments

The data regarding Weed control efficiency of weed recorded at 90 DAS are presented in Table 1. Weed control efficiency was calculated on the basis of dry weight of weeds recorded in different treatments at 90 DAS in comparison to unweeded control. The treatment T_7-Farmer practice was found to be superior by recording the highest weed control efficiency (90.47%) at the 90 DAS over all the treatments. Among the herbicidal treatment, T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS, recorded highest control weed efficiency (82.07%). However, lowest weed control efficiency was recorded in T_3-Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS (33.68%) followed by T_2-Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS (37.98%). Weed control efficiency (WCE) was the highest in plots with post emergence spraying of T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS. However, farmer practice gave consistent weed control efficiency till at harvest. This might be due to lower dry weight of weeds where the lowest WCE was observed under control treatment because of increase in density, growth and dry matter of weeds. Similar results were reported by Anzalone *et al.* (2010) [3] in tomato, Manju *et al.* (2017) [13], Shamla *et al.* (2017) [20], Dechen and Chopra (2020) [6] in onion.

Influence of herbicides on Weed Index

Weed index was calculated on the basis of fruit yield per hectare in different treatments in comparison to control treatment and The minimum weed index (7.66%) was recorded by the treatment T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS than all the treatments and it was followed by T_1-Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS (11.49%) and T_2-Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS (19.09%). However, maximum weed index was computed in the treatment T_8-Weedy check (60.71%) followed by T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS (51.84). The lower dry weight and lesser weed density resulted in better weed index with the treatment of T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS. This might be due to better control of weeds under investigation which might had provided comparitively stress free environment to crop.These findings are to be close proximity of that reported by Anzalone *et al.* (2010) [3], Manju *et al.* (2017) [13], Shamla *et al.* (2017) [20], Dechen and Chopra (2020) [6] in onion.

Crop Phytotoxicity

Phytotoxicity symptomps due to herbicides on crop were recorded by using a visual score of 0-10. The phytotoxic effect on crop was observed in Propaquizafop + Imazethapyer (0.150 kg a.i./ha) and Imazethapyer + Imazamox (0.070 kg a.i./ha) treated plots. Due to moderate injury level, the plants were moderately injured but not persistant. The result pertaing to phytotoxicity scoring was slight stunting injury or discolouration, but no plants died from the treatment.

Table 1: Number of monocot weeds, Number of dicot weed, Total numbers of weed (m²), Dry matter of weed (gm⁻²), Weed control efficiency (%) and Weed index (%) as influenced by different herbicidal treatments

Treatments	Number of monocot weeds (m^{-2})	Number of dicot weed (m^{-2})	Total weed population (m^{-2})	Dry matter of weed (gm^{-2})	Weed control efficiency (%)	Weed index (%)
	90 DAS	90 DAS	90 DAS	90 DAS		
T_1 Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS	60.59 (8.28)	25.97 (5.59)	86.55 (9.80)	147.66 (12.65)	62.03	11.49
T_2 Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS	71.70 (8.97)	30.73 (6.04)	102.43 (10.62)	241.22 (16.03)	37.98	19.09
T_3 Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS	79.84 (9.43)	34.22 (6.35)	114.06 (11.18)	257.93 (16.56)	33.68	31.49
T_4 Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS	41.57 (6.94)	17.82 (4.72)	59.39 (8.20)	69.77 (8.85)	82.07	7.66
T_5 Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS	47.15 (7.35)	20.21 (4.99)	67.35 (8.69)	85.74 (9.76)	77.95	51.84
T_6 Imazethapyer 35% + Imazamox 35% WG 0.070 kg a.i./ha as PoE at 20 DAS fb 1 HW	50.19 (7.58)	21.51 (5.14)	71.70 (8.97)	.04 (10.09)	76.33	33.68
T_7 Farmers practice HW at 20,40,60 DAS	37.92 (6.63)	16.25 (4.51)	54.17 (7.83)	37.06 (6.59)	90.47	--
T_8 Weedy Check	186.1 (4.15)	79.84 (9.43)	266.15 (16.81)	388.95 (20.22)	--	60.71
SE(m)±	0.21	0.14	0.23	0.19	--	--
CD at 5%	0.64	0.42	0.69	0.58	--	--

(Figures in parenthesis indicates square root transformation $\sqrt{X+0.5}$), PE- Pre-emergence, PoE- Post-emergence; HW-handweeding, Fb- followed by.

Influence of herbicides on height of okra plant (cm)

The data in respect to height of okra plant are presented in Table 2. At the stage of 90 DAS, the treatment T_7-Farmer practice recorded significantly maximum plant height (148.12 cm) and which was found to be at par with the treatment T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS (145.90 cm) and T_1 -Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS (143.65 cm) and T_3 -Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS (139.12 cm). However, significantly the minimum plant height was observed in T_8-Weedy check treatment (131.51 cm). The plant height increased with the advancement in crop age, irrespective of the treatment and reached maximum at harvest. The rate of increase in plant height was more at 60 DAS to harvest stage. Farmer practice recorded the highest plant height throughout the crop growth period. Followed by T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS. This may be due to better moisture conservation for plants under hand weeding. It may also be attributed to better weed control. These results are similar to the results of Suresh *et al.* (2014) [23], Manju *et al.* (2017) [13] in okra, Ritesh *et al.* (2018) [19], Arumughan *et al.* (2024) [4] in lentil, Chaudhari *et al.* (2024) [5] in onion.

Influence of herbicides on days required for first harvesting

The data in respect of days required for first harvesting are presented in Table 2. Significantly minimum days requied for first harvesting (38.71 days) was recorded in the treatment T_7-Farmer practice and found to be at par with the treatments T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS (39.21 days), T_1-Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS (41.26 days) and T_2-Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS (43.22 days), However significantly the maximum period was required for first harvesting in T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS (47.79 days). This might be due to the fact that, the plant turn to reproductive phase early after completing their vegetative growth period in the Farmer practice followed by the application of post emergence herbicide Propaquizofop+ Oxyfluorfen, that results in early harvesting of okra fruits. Similar results under different herbicidal treatments were reported by Maleki *et al.* (2010) [12], Kumar *et al.* (2011) [11] and Sharma and Patel (2011) [21].

Table 2: Influence of herbicides on growth and yield of okra.

Treatments	Height of okra plant (cm) 90 DAS	Days to first harvest	Number of fruits per plant	Fruit yield per plant (g)	Fruit yield per plot (kg)	Fruit yield per hectare (q)
T_1 Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW At 30 DAS	143.65	41.26	32.47	454.53	10.91	126.21
T_2 Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS	137.72	43.22	31.43	415.46	9.97	115.37
T_3 Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS	139.12	45.91	29.46	351.79	8.44	97.69
T_4 Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS	145.90	39.21	35.02	474.17	11.38	131.67
T_5 Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS	136.72	47.79	22.98	247.30	5.94	68.67
T_6 Imazethapyer 35% + Imazamox 35% WG 0.070 kg a.i./ha as PoE at 20 DAS fb 1 HW	133.65	46.25	26.50	340.53	8.17	94.56
T_7 Farmers practice HW at 20,40,60 DAS	148.12	38.71	36.37	513.54	12.33	142.60
T_8 Weedy Check	131.51	45.16	20.11	201.74	4.84	56.02
SE(m)±	3.23	1.75	1.87	23.02	0.55	6.39
CD at 5%	9.79	5.31	5.66	69.80	1.68	19.38

Table 3: Influence of herbicides on economics of okra crop.

Treatments	GMR (Rs/ha)	Cost of cultivation (Rs/ha)	NMR (Rs/ha)	B:C Ratio
T_1 Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS	252000	71826	180174	2.50
T_2 Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS	230740	70881	159859	2.20
T_3 Metribuzin 70% WP as PE 0.60 kg a.i./ha fb 1 HW at 30 DAS	195380	71303	124077	1.74
T_4 Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS	263440	74626	188714	2.52
T_5 Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS	137340	72626	64714	0.89
T_6 Imazethapyer 35% + Imazamox 35% WG 0.070 kg a.i./ha as PoE at 20 DAS fb 1 HW	169120	70776	98344	1.38
T_7 Farmers practice HW at 20,40,60 DAS	284000	82626	199374	2.35
T_8 Weedy Check	112040	61626	50414	0.81

Influence of herbicides on number of fruits per plant

The data in respect to number of fruits per plant are presented in Table 2. Significantly, the maximum number of fruits per plant was recorded in T_7-farmer practice (36.37) which was found to be at par with the treatments T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS (35.02), T_1- Pendimethalin 38.7% as PE 1.0 kg a.i/ha fb 1HW at 30 DAS (32.47), T_2-Oxyfluorfen 23.5% as PE 0.150 kg a.i./ha fb 1HW at 30 DAS (31.43) and the Significantly minimum number of fruits per plant recorded in T_8-Weedy check (20.11) and found to be at par with T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS (22.98). However, significantly the maximum number of fruits were observed in the Farmers practice followed by the application of Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i/ha as PoE at 20 DAS fb 1HW at 60 DAS. This might be due to the fact that, the plant turn to reproductive phase early therefore, maximum fruits per plant after completing their vegetative growth period in the plots. Similar results under different herbicidal treatments were reported by Patel *et al.* (2004) [16], Singh *et al.* (2005) [22] and Kumar *et al.* (2011) [11] in okra.

Influence of herbicides on fruit yield per plant (g)

The data in respect of fruit yield per plant as influenced by different herbicidal treatments are presented in Table 2. It is showed that, the treatment differences were significantly influenced by different herbicidal treatments. Fruit yield per plant of okra was significantly maximum under the treatment T_7-farmer practice (513.54 g). Among the herbicidal treatments, post emergence application of T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS (474.17 g) recorded maximum fruit yield per plant and found to be at par with the treatment T_1-Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS (454.53 g). Whereas, significantly minimum yield per plant was recorded in

T_8-Weedy check (201.74 g) and found to be at par with the treatment T_5-Propaquizafop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha at 20 DAS fb 1 HW at 60 DAS (247.30 g). This might be due to the reason that, herbicides treated plots as in combination with herbicide along with hand weeding, weed infestation was controlled from early stage and due to less crop weed competition during the critical growth stage of the crop, the maximum fruit yield per plant was produced. Similar result reported by Manju *et al*. (2017) [13], Shamla *et al.* (2017) [20] in okra and, Arumughan *et al.* (2024) [4] in lentil and Chaudhari *et al.* (2024) [5] in onion.

Influence of herbicides on fruit yield per hectare (q)

The data pertaining to per hectare fruit yield of okra as influenced by different herbicidal treatments are presented in Table 2. Significantly maximum per hectare fruit yield of okra was recorded in the treatment T_7-farmer practice (142.60 q ha^{-1}). Among herbicidal treatments, post emergence application of T_4-Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS recorded significantly maximum fruit yield per hectare (131.67 q ha^{-1}) and found to be at par with the treatment T_1-Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS (126.31q ha^{-1}). Significantly minimum per hectare fruit yield of okra was noted in T_8-Weedy check treatment (56.02 q ha^{-1}) and found to be at par with the treatment T_5-Propaquizofop 2.5% + Imazethapyer 3.75% w/w ME 0.125 kg a.i./ha as PoE at 20 DAS fb 1 HW at 60 DAS (68.67 q ha^{-1}). This might be due to direct effect of improved soil nutrients, structure and moisture content and reduced weed pressure. The minimum weed population effect makes for higher nutrient availability results in higher yields. Post emergance significantly influenced the yield of okra. Weed control by cultural methods were earlier reported by Pandey and Mishra (2012), Jain and Tomar (2005) [8] and weed control by pre and post emergence herbicides were reported by Manju *et al*. (2017) [13], in okra, Arumughan *et al.* (2024) [4] in lentil, Chaudhari, *et al*. (2024) [5] and Dechen and Chopra (2020) [6] in onion.

Economics

The data in respect of economics as influenced by different herbicidal treatments are presented in Table 3. The maximum gross returns (Rs.284000 ha^{-1}), net income (Rs.199374 ha^{-1}) and B:C ratio (2.35) was recorded in hand weeding treatments. Among herbicidal treatments, maximum gross returns (Rs.263440 ha^{-1}), net income (Rs.188714 ha^{-1}) and B:C ratio (2.52) was observed with the application of T_4 -Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS applied at 20 DAS. The minimum gross returns, net income and benefit: cost ratio was recorded in weedy check. In farmer practice of 3 HW plot, the cost of cultivation increased remarkably due to regular weeding operation followed for clean cultivation. It increased the cost of manual weeding and this increased the cost of cultivation. Similar results were obtained by Manju *et al*. (2017) [13], Shamla *et al.* (2017) [20]. Maleki *et al.* (2010) [12] in okra, Arumughan *et al.* (2024) [4] in lentil, Chaudhari, *et al.* (2024) [5] and Dechen and Chopra (2020) [6] in onion, Nandanwar *et al.* (2006) [14] in cabbage.

Conclusion

On the basis of present investigation, the farmers practice of 3 HW at 20, 40 and 60 DAS proved most effective in control of weeds with good performance on crop growth at all the stages, yield attributes, where maximum per plant fruit yield of okra (g), per plot fruit yield of okra (kg) per hectare and fruit yield of okra (q ha^{1}). Application of post-emergence herbicide Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS was found superior among herbicidal treatment for growth and yield character of okra. Application of pre- emergence of T_1 -Pendimethalin 38.7% as PE 1.0 kg a.i./ha fb 1HW at 30 DAS was found to be second option. Application of Propaquizofop 5% + Oxyfluorfen 12% w/w EC 0.150 kg a.i./ha as PoE at 20 DAS fb 1HW at 60 DAS which gave the highest B:C ratio of 2.52 and fruit yield (142.60 q ha^{-1}) with net return (Rs.188714 ha^{-1}) and weedy check gave the lowest net return (Rs 50414 ha^{-1}) with B:C ratio of (0.81) in the comparision to the control. It is concluded from the experiment that, post emergance herbicide is suitable method for broad spectrum weed management for more economic returns to the farmer. These conclusions are based on the finding of one year study, however, an extensive trial may be conducted to confirm these results.

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