Original Research Article

Effect of Weed Management Practices on Growth, Yield and Quality of Okra [*Abelmoschus esculentus* (L.) Moench].

Abstract

The present investigation entitled **"Effect of weed management practices on growth, yield and qu ality of okra *Abelmoschus esculentus* (L.) Moench)**" was conducted at Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during *kharif* season 2022. The experiment was laid out in Randomized Block Design with seven different treatments *viz.* T_1 = Pre-emergence application of Pendimethalin @ 6 ml /L, T_2= Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha ,T_3 = Pre-emergence application of pendimethalin @ 6 ml/L + one hand weeding at 40 DAS , T_4 = Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding , T_5 = Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS , T_6 = Weed free check (Three hand weeding) 20, 40 and 60 DAS , T_7 = weed check control replicated thrice. The result of the study revealed that at 30 DAS maximum plant height (30.96cm) was reported in treatment **T_3 :** Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 days of sowing whereas at 60 and 90 DAS maximum plant height (75.50 and 113.53 cm) was reported in T_6 : Weed free check (Three hand weeding) 20, 40 and 60 DAS. Maximum number of branches per plant (4.60)at 60 DAS was found in **T_3** : Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS and 90 DAS maximum number of branches per plant (5.86) was reported in T_6 : Weed free check (Three hand weeding) 20, 40 and 60 DAS. Maximum number of nodes (17.83) at 60 days after sowing was noticed in treatment T_3 = Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS and 90 Days after of sowing maximum number of nodes () was in treatment T_6 = Weed free check (Three hand weeding) 20, 40 and 60 DAS. Maximum Pod diameter(1.74cm) , fruit weight (12.88gm), pod length(14.1cm) , number of pods per plant(25.66) , pod yield per plant (304.73gm) , pod yield per hectare (16.91 t), TSS(3.2 Brix), crude fibre (8.46%) and cholorophyll content (1.18 mg) and relative cholorophyll content (54.39) .

Keywords: ***Crude Fibre, Hand Weeding, Pre Emergence and Post Emergence***

1. INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench.) also called as bhendi or lady's finger belongs to family Malvaceae. It is widely cultivated in warmer parts of globe. it is grown during the summer and rainy season. Okra is grown for its developing edible pods, or fruits. Fruit with a high iodine concentration aids in the treatment of goitre, diarrhoea and inflammation are treated with leaves. The fruit is also beneficial for leucorrhoea, overall weakness, and renal colic. The dry seed contains 13-22% good food oil and has numerous other uses. The fruits have the following biochemical components: moisture 89.6g, protein 1.9g, fat 0.2 g, fiber 1.2 g, calories 35, phosphorous 56 mg, sodium 6.9 mg, sulphur 30 mg, riboflavin 0.1 mg, oxalic acid 8 mg,

minerals 0.7mg, carbohydrates 6.4g, calcium 66 mg, iron 0.3 5mg, potassium 103 mg, thiamine 0.07 mg, nicotinic acid 0.6mg, vitamin c 13 mg, magnesium 53 mg and copper 0.19 mg, (**Gopalan *et al,* ICMR; 2007**). Because of its modest initial growth rate and canopy coverage for efficient shading, the crop cannot withstand weed competition. Weeds use moisture, soil fertility, and other environmental factors to their advantage in order to hinder crop growth. Weeds have negative allelopathic effects on okra, harbour pests and disease-causing organisms, and lower yields and produce quality. The crop continues to be poor and sickly as a result of this weed competition. Depending on the type, intensity, and stage of the flora, there is a yield loss of between 40 and 80 percent **(Sharma and Patel, 2011)**. Hand weeding is time-consuming, labor-intensive, increases production costs, and harms crop roots. Mechanical or manual weed control measures frequently fall short of the requirements, making it difficult to realize the potential output of okra. Manual, mechanical, and chemical weed management techniques should be evaluated before being recommended to farmers in order to avoid drudgery and labour costs. So, it was decided to conduct a study to determine the effectiveness of various pre-emergence and post-emergence herbicides administered with other weed control techniques in order to reduce the additional costs farmers experience for hand weeding. Pre-emergence herbicide spraying keeps the crop weed-free in the early stages. In the following stages, post-emergence herbicides assist in keeping the weed population below the economic threshold level and in lowering the expense of weeding during the crop growth period. Herbicide effectiveness is determined by how they behave in various soil types, their organic matter content, weather patterns, soil moisture, etc. In order to effectively control weeds, it is crucial to analyse a number of recently released herbicides and methods under specific agro climatic conditions. There is less data about the effectiveness and selectivity of weed management when using pre- and post-emergence herbicides. Given this background, an effort was made to find an appropriate herbicide, mix of herbicides, and combination of herbicide with manual weeding to effectively control weeds in okra.

2. Materials and Methods

The trial was conducted at Department of Vegetable Science Chandra Shekhar Azad University of Agriculture and Technology in Kalyanpur Kanpur, Uttar Pradesh, during the Kharif season of 2022. The experiment was layout in randomized block design with three replication consisted 7 treatments viz. T_1= Pre-emergence application of Pendimethalin @ 6 ml /L, T_2 = Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha, T_3 = pre-emergence application of pendimethalin @ 6 ml/L + one hand weeding at 40 DAS, T_4 = post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding, pendimethalin @ 6 ml /L, T_5 = pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS, T_6 = weed free check (Three hand weeding) 20, 40 and 60 DAS, T_7 = weed check control (As shown is table 1).

Table 1: Treatment Details

Treatment Details	
T_1	Pre-emergence application of Pendimethalin @ 6 ml /L
T_2	Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha
T_3	Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS
T_4	Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding

T_5	Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-^{1} at 25 DAS
T_6	Weed free check (Three hand weeding) 20, 40 and 60 DAS
T_7	Weed check control

Observation recorded

1. Plant height (cm)

The height of the plant was measured from the first cotyledonary node to the tip of the growing point at every 30, 60, 90 DAS and expressed in centimetres.

2. Number of branches per plant

The number of branches arising from the main stem were counted at 60 and 90 DAS and expressed in number.

3. Number of nodes on main stem per plant

The number of nodes on the plant was recorded at 60, 90 DAS and means were computed.

4. Pod Diameter (cm)

Five fruits that were at the marketable maturity stage (i.e., the sixth day after anthesis) were randomly chosen for each treatment and replication, and the width of the pods was measured at its widest point. The mean was then represented in centimetres.

5. Fresh weight of pod (g)

The weight of five pods was recorded separately with the help of weighing balance and average was worked out for each treatment.

6. Pod length (cm)

With the aid of a thread and scale, the length of the pod was measured in centimetres from where it was joined to the bunch up to the tip, and the average length was calculated. At the time of harvest, five pods were chosen at random for this use

7. Number of pods / plant

In each treatment, the number of pods harvested from five randomly chosen plants were counted, added up, and the average number of pods per plant was computed..

8. Pod yield/ plant (g)

The pods in the marketable maturity stage were weighed immediately following each harvest. The total yields were then multiplied by each weighing and represented in grams.

9. Total pod yield (t/ha)

By multiplying the total pod weight of all the pickings by the number of plants, the hectare's pod yield was calculated and expressed in tonnes.

10. Total soluble solids (TSS)

The total soluble solids (TSS) was recorded from five randomly selected tender fruits by using hand refractometer and were expressed in degree Brix after making necessary temperature correction at room temperature (28 ºC) and the mean was worked out.

11. Crude fiber (%)

Crude fibre content of dry sample of okra fruits harvested at 6th days after anthesis was determined by using AOAC, 2005 method.

12. Total chlorophyll content (mg 100-1 g)

Total chlorophyll content of okra fruits harvested at 6th day after anthesis was estimated with DA-meter. The DA-meter is a hand held device which non-destructively measures the difference of absorbance between 670 and 720 nm. The IAD value correlates with the chlorophyll content in the mesocarp (flesh) of the okra fruit and the values displayed in the instrument were recorded.

13. Relative chlorophyll content (SPAD units)

The chlorophyll content in the leaves was estimated using at LEAF + Chlorophyll meter. The first fully opened leaf from the top was selected for observation. Observations were taken from five leaves from a plot and mean was worked out.

Biometrical analysis

Experimental data was subjected to biometrical analysis as per the standard as procedure given by **Gomez and Gomez (1984**). Significant difference between treatment means was tested through 'F ' test and critical difference (CD) was worked out wherever 'F ' value was found to be significant for treatment effect.

3. Results and Discussion

1. Effect of weed management practices on Growth parameters of Okra *[Abelmoschus esculentus* (L.)

1. Plant Height (cm)

It is evident from the data (Table : 1) that plant height was influenced significantly by different treatments of weed management practices. At 30 DAS, significantly highest plant height (30.96 cm) was observed under treatment T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS.) which was found at par with treatments T_6 (Three hand weeding 20, 40 and 60 DAS.), T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding), T_5 (Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS), and T_1 (Pre-emergence application of Pendimethalin @ 6 ml /L) during experimentation. However, Weedy check (T_7) recorded significantly the lowest plant height (22.40 cm).

At 60 DAS, significantly highest plant height (75.50 cm) was observed under treatment T_6 (three hand weeding at 20, 40, and 60 DAS) which was found at par with treatments T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS.), T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding) and T_5 (Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS) with plant height (72.56, 69.16 and 66.76 cm, respectively) during investigation. Weedy check (T_7) recorded significantly the lowest plant height (44.32 cm).

At 90 DAS, maximum plant height (113.53 cm) was found under treatment T_6 (three hand weeding at 20, 40, and 60 DAS) followed by T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS), T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding) and T_5 (Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS). The treatment T_7 (weedy check)recorded significantly the lowest plant height (69.60 cm).Similar results were reported by **Jain and Tomar (2005) , Patel *et al.* (2004) and Pandey and Mishra (2013).**

2. Number of branches

The mean data on number of branches per plant (table 1) recorded at 60 and 90 DAS as influenced by different treatments. At 60 DAS, Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS (T_3) produced maximum number of branches (4.60) but remained statistically at par with other

treatments T_6, T_5 and T_4 (3.80, 3.40 and 3.13, respectively) with respect to this character. However, treatment T_7 (Weedy check) was recorded significantly the lowest number of branches (2.46) during the experimentation.

At 90 DAS, maximum number of branches per plant (5.86) was recorded with the application treatment T_6 (three hand weeding at 20, 40 and 60 DAS)and remained at par with treatments T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS). Significantly the lowest maximum number of branches (2.73) was recorded with treatment T_7 (weedy check) and it being at par with treatment T_4, T_5, and T_2 (5.20, 4.43, and 3.73, respectively) during the investigation. The above findings are in close harmony with the results of Patel *et al.* (2004), Zinzala, *et al.* (2004).

3. Number of Nodes

At 60 DAS, number of nodes per main stem was significantly influenced by various treatments of weed management and Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS (T_3) recorded maximum nodes per main stem (17.83) but remained statistically at par with other treatments T_6, T_4, and T_5 (16.63, 15.76 and 15.36, respectively) with respect to this character. However, treatment T_7 (Weedy check) was recorded significantly the lowest nodes per main stem (13.33) during the experimentation.

At 90 DAS, maximum number of nodes per main stem (20.05) was recorded with treatment T_6 (three hand weeding at 20, 40 and 60 DAS) and remained at par with treatments T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS). Significantly the lowest numbers of nodes per main stem (14.21) was recorded with treatment T_7 (weedy check) and it being at par with treatment T_4, and T_5 (17.67 and 16.25, respectively) during the investigation Similar findings are reported by Singh *et al.* (2010), Patel *et al.* (2009) and Pandey and Mishra (2013).

2. Effect of weed management practices on Yield parameters of Okra *Abelmoschus esculentus* (L.)

Fruit Diameter (cm)

That higher fruit diameter of okra (1.74 cm) was recorded under three hand weeding at 20, 40 and 60 DAS (T_6) but it was statistically at par with treatment T_3, T_4, and T_5. Significantly lower fruit diameter (1.37 cm) was observed under treatment weedy check (T_7).These findings are supported by Manju, *et al.* (2017) , Kumar *et al*. (2011) .

Fruit Weight (gm)

fruit weight of okra was significantly influenced by weed management treatments (Table, 1). Treatment receiving three hand weedings at 20, 40, and 60 DAS (T_6) recorded maximum fruit weight (12.88 g), but remained at par with treatments T_3,T_4, and T_5. Significantly lower fruit weight (9.61 g) was recorded with weedy check (T_7).These findings are supported by Singh *et al*. (2010) Kumar *et al*. (2011) and Sharma and Patel (2011).

Pod Length (cm)

Fruit length of okra data clearly indicates that managing the weed by three hand weeding at 20, 40 & 60 DAS significantly increased the fruit length T_6, (14.10 cm) and it was remained at par with treatments T_3, T_4, and T_5 (table 1) . However, the lowest fruit length (8.95 cm) was observed under treatment T_7, (weedy check). These findings are supported by Singh *et al*. (2010) , Kumar *et al*. (2011) and Sharma and Patel (2011) Dash, S *et al*., (2020) .

Number of pods / plant (gm)

The highest number of pods / plant (25.6) was observed under treatment T_6 (three hand weeding at 20, 40 and 60 DAS), followed by T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha^{-1} at 25 DAS + one hand weeding), T_5 (Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS), T_1 (Pre-emergence application of Pendimethalin @ 6 ml /L),T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS), T_2 (Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha). However, significantly the lowest number of fruit per plant (15.3) recorded under treatment T_7 (weedy check). (Table 2).

Yield per plant(gm)

Pod production / plant of okra was significantly influenced by different weed management treatments. The maximum pod production / plant (304.7 g) was observed under treatment T_6 (three hand weeding at 20, 40 and 60 DAS), followed by T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS), T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding), T_5 (Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS), T_1 (Pre-emergence application of Pendimethalin @ 6 ml /L), T_2 (Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha). Significantly the lowest fruit yield per plant (170.0 g) recorded under treatment T_7 (weedy check). The findings corroborate the observations made earlier more or less by by Patel *et al.* (2004) , Khalid *et al*. (2005) , Singh *et al.* (2005) and Sharma and Patel (2011) .

Yield per hectare (t/ha)

The data clearly revealed that the total pod yield of okra was significantly affected due to different weed management treatments. Among different weed control treatments T_6 (three hand weeding at 20, 40 and 60 DAS) recorded maximum okra fruit yield (16.9 t/ha) and being at par with treatment T_3 and T_4. Significantly the lowest okra green fruit yield (10.1 t/ha) was recorded under treatment weedy check T_7. The fruit yield of okra obtained under different weed control treatment was in order $T_6<T_3<T_4<T_5<T_1<T_2<T_7$. These findings are accordance with those obtained by (Khadar and Reddy, 2001) , Khalid *et al*. (2005) and Sharma and Patel (2011).

3. Effect of weed management practices on Quality parameters of

TSS (^{o}Brix)

The highest total soluble solids (3.21 ^{o}Brix) was observed under treatment T_6 (three hand weeding at 20, 40 and 60 DAS), followed by T_1 (Pre-emergence application of Pendimethalin @ 6 ml /L), T_3 (Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS), T_4 (Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding), T_2 (Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha). However, significantly the lowest total soluble solids (1.98 ^{o}Brix) recorded under treatment T_7 (weedy check). These findings are in the agreement with the findings of Minal, S et al., (2010) , Adeyemi, et al., (2022) and Narayan, S *et al*., (2020) .

Crude Fibre (%)

Crude fibre However, maximum & minimum crude fibre (8.76 & 7.25 %, respectively) were recorded under treatment T_7 weedy check and T_6 three hand weeding at 20, 40 and 60 DAS, respectively. The above findings are in close harmony with the results of Narayan, S et al., (2020) [11] and Adeyemi, O et al., (2022) .

Chlorophyll content (mg /100 gm)

That higher chlorophyll content in pod (1.18 mg 100-1 g) was recorded under three hand weedings at 20, 40 and 60 DAS (T_6) but it was statistically at par with treatment T_4, T_1, and T_3. Significantly lower chlorophyll content in pod (0.85mg 100-1 g) was observed under treatment weedy check (T_7). The results are in propinquity with the result of Minal, S *et al*., (2010), Narayan, S *et al.*, (2020), and Adeyemi, O *et al*., (2022).

Relative Chlorophyll Content (mg/ 100 gm)

As data presented in table 2 shows that maximum relative cholorophyll content (54.39mg) was recorded in T_6 : Weed free check (Three hand weeding) 20, 40 and 60 DAS followed by T3 : Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS. While minimum relative cholorophyll content (46.50 mg)was recorded in T_7 : Weed check control.

Table 2. Effect of weed management practices on Growth parameters of Okra

Treatment details	Plant height (cm)			Number of branches per plant		Number of nodes		Pod diameter (cm)	Fresh weight of pod (g)	Pod Length (cm)
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	60 DAS	90 DAS			
T_1 : Pre-emergence application of Pendimethalin @ 6 ml /L	25.00	63.93	91.50	2.73	3.13	14.68	15.86	1.58	10.87	11.80
T_2 : Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha	24.08	60.30	86.76	2.86	3.53	14.36	15.28	1.55	10.45	11.63
T_3 : Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS	30.96	72.56	102.70	4.60	5.20	17.83	18.61	1.68	12.62	13.81
T_4 : Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding	27.68	69.16	97.26	3.13	4.43	15.76	17.67	1.66	12.31	13.13
T_5 : Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS	26.60	66.76	95.71	3.40	3.73	15.36	16.25	1.65	11.90	12.15
T_6 : Weed free check (Three hand weeding) 20, 40 and 60 DAS	28.16	75.50	113.53	3.80	5.86	16.63	20.05	1.74	12.88	14.10
T_7 : Weed check control	22.4	44.32	69.60	2.46	2.73	13.33	14.21	1.37	9.61	8.95
CD at 5%	3.13	3.32	1.94	0.65	0.63	N/A	2.83	0.17	1.41	0.45
CV%	6.59	2.86	1.14	11.00	8.62	12.51	9.34	6.13	6.80	0.17

Table 3. Effect of weed management practices on Yield parameters of Okra

Treatment details	Number of pods/plant	Pod yield/ plant(g)	Total pod yield (t/ha)	TSS (^{o}Brix)	Crude fiber (%)	Total chlorophyll content Pods (mg 100-1g)	Relative chlorophyll content in leaves (SPAD units)
T_1 : Pre-emergence application of Pendimethalin @ 6 ml /L	20.00	217.40	12.07	3.06	7.63	1.15	49.70
T_2 : Post emergence application of Quizalofop-ethyl @ 0.040 kg/ha	19.33	201.66	11.24	2.79	7.93	0.92	50.29
T_3 : Pre-emergence application of Pendimethalin @ 6 ml/L + one hand weeding at 40 DAS	19.30	284.14	15.85	3.03	7.30	1.07	50.83
T_4 : Post emergence application of Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS + one hand weeding	21.33	260.52	14.56	2.87	8.10	1.15	49.97
T_5 : Pendimethalin @ 6 ml /L as pre-emergence + Quizalofop-ethyl @ 0.040 kg ha-1 at 25 DAS	20.66	245.66	13.66	2.57	7.56	1.00	50.54
T_6 : Weed free check (Three hand weeding) 20, 40 and 60 DAS.	25.66	304.73	16.91	3.21	8.46	1.18	54.39
T_7 : Weed check control.	15.33	170.00	10.12	1.98	7.13	0.85	46.50
CD at 5%	4.75	7.31	3.04	0.47	0.78	0.06	NS
C. V%	13.06	1.69	12.53	9.53	5.62	3.25	5.22

Conclusion

On the basis of this field trail, it can be concluded that the okra variety Kashi Lalima responded favorably with growth, quality and yield with weed management practices. Treatment T_6 in which three hand weeding was done manually at 20, 40 and 60 days after sowing was found best treatment among all. It may be recommended for farmers of the central plain zone of Uttar Pradesh for better growth, quality and yield in Okra.

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