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Effect of integrated weeds management on growth and development of Okra

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Abstract

It was observed that the plant population was almost under all the different weed control practices at both the stages. The maximum plant height at harvest stage was also recorded in T₈ (2 H.W. at 30 and 60 DAS), Maximum number of branches at harvest stage were noted under T₈ (7.92/plant), which was at par with T₅ (7.47/plant) treatment. At harvest, the maximum number of leaves per plant was recorded under the treatment weed free (8.20/plant) which was statistically at par with T₅ (grass mulch 5 t/ha one week after germination). The maximum dry weight per plant was recorded under the treatment weed free (22.02/plant) which was statistically superior over all the weed control treatments. Among all the weed management treatments, weed free T₈ (2 H.W. at 30 and 60 DAS) recorded significantly higher number of pod per plant. The maximum length of pod (12.20 cm) was recorded in T₈ treatment, which was statistically at par with T₅ and T₄ and former treatment recorded significantly longer pod than rest of the treatments. The maximum girth of pod (1.37 cm), yield (1102kg/ha) and maximum harvest index (15.39%) was observed under T₈ (2 HW at 30 & 60 DAS).

Keywords: Plant height, Branches, Pod, Yield, Harvest index

1. Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable crop of the tropic and sub-tropic. It is grown during summer and rainy season and hence classified as warm season crop. Okra is cultivated for its immature edible fruits known as pods; the mature fruits are also dried and stored in parts of Africa for local use in high temperature season. Okra is a wonderful vegetable that is used in all sorts of soups and stews. It is pretty Versatile. The root and stem are used for clearing cane juice in preparation gur. The fruit also help in cases of renal colic, leucorrhoea and general weakness. It has yet multiple uses; the dry seed contains 13-22% good edible oil and 20-24% protein. UP, Bihar and Orissa are major okra growing state in India. India is the leading country in okra production having an area of 5.33 lakh ha production 63.46 mt and productivity-11.9 mt/ha. In M.P, the area of okra is 0.26 lakh ha and production is 3.05 mt. (Anon.2014) [1]. Weeds that interfered with okra from 2WAP (weeks after planting) resulted in 79.8% and 72.5% fresh fruit yield reduction in 2006 and 2007, respectively. and weed interference with okra from 8WAP(weeks after planting) resulted in 19.8% and 19.6% yield losses in 2006 and 2007 (Rasheed *et al.*, 2009) [4]. During the monsoon months, weeds dominate and besides other factors for lower yield, lack of proper weed control is the most important one. Weeds not only reduce the yield of vegetable but also deteriorate the quality of vegetable. The combination of chemical, cultural and manual weed control methods was more effective in controlling weeds than their isolated application but their application also affects the growth and yield of main crops. Hence, the present investigation was carried out to see the effect of different methods of weed control on growth and yield parameters of Okra.

2. Materials and Methods

The experimental on "Integrated weed management in okra (*Hibiscus esculentus* L. Moench) cv. VRO-6" was conducted during kharif season in R.V.S.K.V.V. Research Farm, College of Agriculture, Gwalior (M.P.). The topography of the field was uniform with proper drainage. The soil of the experimental field was sandy clay loam. The summer is hot and dry, May and June are the hottest months and their temperature varies from 47 °C to 28.5 °C, respectively. December and January constitutes the cooler months of the year, temperature ranges from 7 °C to 4 °C.

The maximum temperature goes up to 47 °C during summer and minimum go as low as 4 °C during winter. The average rainfall ranges between 80 to 90 cm most of which is received in the months of July, August and September, with few showers in winter months. The total rainfall received during the rainy season from July to October 2011 was 53.8 mm. The seed of VRO-6 was used at the rate of 15 kg/ha and sowing was done by seed-drill at the depth of 1.5-2.0 cm. There were eight rows in gross plot and six rows in net plot size with a uniform distance of forty five centimeters between rows and ten centimeters distance between plant to plant. The sowing was done on 11th July 2012. No irrigation was given prior to land preparation due to the proper moisture in the soil during crop growth period.

Table 1: Treatments details

S. No.	Treatment	Symbols
1	Oxyfluorfen (23.5EC) @ 0.125 kg/ha as PE	T ₁
2	Pendimethalin (30 EC) @ 1.00 kg/ha as PE	T ₂
3	T ₁ + 1 H.W. at 30 DAS	T ₃
4	T ₂ + 1 H.W. at 30 DAS	T ₄
5	Grass mulch (5 t/ha) one week after germination	T ₅
6	1 Hoeing at 30 DAS	T ₆
7	1 H.W. at 30 DAS	T ₇
8	2 H.W. at 30 and 60 DAS (Weed free)	T ₈
9	Weedy Check	T ₉

PE - Pre-emergence, H.W. = Hand Weeding, DAS = Days after sowing

2.1 Plant population per meter row length at initial and harvest stages

One metre row was selected randomly at five different places

in each plot. After that the number of plants from each such selected row was counted, their average was worked out for the calculation.

2.2 Growth characters

The following growth characters; Height per plant (cm), Number of branches per plant, Number of leaves per plant, Dry weight per plant (g), Total number of pods per plant etc were studied.

3. Results and discussion

3.1 Plant population/m row length

Plant population was counted and recorded on the basis of per metre row length at initial and harvest stages. The data presented in Table 2 revealed that there was non-significant effect in plant population per meter row length due to different integrated weed management treatments. All the treatments showed more or less same the plant population of okra. The plant population ranged between 6.60 to 7.62 and 6.30 to 7.07 per metre row length at initial and harvest stage, respectively.

Plant population was recorded at initial and harvest stages. It was observed that the plant population was almost under all the different weed control practices at both the stages (at initial and harvest stages). It is possible due to the fact that an application of these chemical weed control treatment could not vacillate the initial conditions pre-requisite for proper germination of seeds. Thus, all the treatments received uniform environmental condition, necessary for proper germination of seeds. Tiwari *et al.* (1986)^[7] also found that the plant population was at par amongst different treatments of herbicide.

Table 2: Plant population per metre row length at initial and harvest stage as influenced by integrated weed management.

Treatment	Symbol	Plant population/m row length at	
		Initial	Harvest
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	7.00	5.66
Pendimethalin @ 1.00 kg/ha as PE	T ₂	7.00	7.00
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	6.00	6.00
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	6.00	7.00
Grass mulch (5 t/ha) one week after germination	T ₅	6.00	6.00
One hoeing at 30 DAS	T ₆	6.33	5.33
One H.W. at 30 DAS	T ₇	6.00	6.33
2 H.W. at 15 and 30 DAS (weed free)	T ₈	7.33	5.66
Weedy check	T ₉	5.67	5.00
S.E.(m)±		0.75	0.50
C.D. (at 5%)		NS	NS

PE – Pre-emergence, DAS – Days after sowing, HW – Hand weeding

3.2 Plant height (cm)

The plant height at various stages of crop growth has been presented in Table 3. In general, 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 30 to 60 DAS as compared to 60 DAS to harvest stage. The effect of various treatments with respect to plant height was found significant at all the stages of crop growth.

At 30 DAS, all the integrated weed management treatments increased the plant height significantly superior over weedy check. The minimum plant height was recorded under T₉ (Weedy check), treatment followed by T₁, T₃ and T₆. Maximum plant height was observed under weed free treatment T₈ (2 H.W. at 15 and 30 DAS) which was at par

with T₅ (grass mulch 5 t/ha one week after germination).

At 60 DAS, 2 H.W. at 30 and 60 DAS followed by T₅ (Grass mulch 5 t/ha one week after germination), T₄ (Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS), T₂ (Pendimethalin @ 1.00 kg/ha as PE) and T₇ (One H.W. at 30 DAS) resulted in significantly tallest plant over rest of the treatments but it was at par with T₅ (grass mulch 5 t/ha one week after germination). Minimum plant height was observed under weedy check.

The maximum plant height at harvest stage was also recorded in T₈ (2 H.W. at 30 and 60 DAS), which was significantly superior to all other treatments except T₅ and T₄. All the weed control treatments produced significantly higher plant height than weedy check which was at par with T₃ and T₁

Table 3: Plant height at successive crop growth stages as influenced by integrated weed management.

Treatment	Symbol	Plant height (cm) at		
		30 DAS	60 DAS	Harvest
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	30.40	73.70	83.12
Pendimethalin @ 1.00 kg/ha as PE	T ₂	33.67	75.66	88.75
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	38.26	85.83	89.70
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	41.33	93.34	100.40
Grass mulch (5 t/ha) one week after germination	T ₅	45.53	92.10	100.20
One hoeing at 30 DAS	T ₆	28.60	70.42	80.14
One H.W. at 30 DAS	T ₇	32.40	72.40	83.04
2 H.W. at 15 and 30 DAS (weed free)	T ₈	46.93	95.28	104.73
Weedy check	T ₉	15.46	45.33	70.33s
S.E.(m)±		1.29	1.68	3.04
C.D. (at 5%)		2.74	3.50	6.45

PE – Pre-emergence, DAS – Days after sowing, HW – Hand weeding

3.3 Number of branches per plant

Data presented in Table 4 revealed that number of branches per plant increased rapidly in all the integrated weed management treatments with the advancement of plant growth up to 60 days stage, thereafter it slowly increased with increase in plant growth stages from harvest stages. Analysis of variance revealed that number of branches per plant differed significantly among various treatments at 60 DAS and harvest stage.

At 60 DAS, all the integrated weed management treatments increased the branches significantly superior over weedy check. Minimum number of branches was noted under T₉

(0.47/plant), which was significantly less than that noted under any of the treatment. The maximum number of branches was recorded under weed free treatment of T₈ (2 H.W. at 15 and 30 DAS), treatment followed by T₅, T₄ and T₂ but it was at par with T₅ (grass mulch 5 t/ha one week after germination).

Maximum number of branches at harvest stage were noted under T₈ (7.92/plant), which was at par with T₅ (7.47/plant) treatment. Minimum number of branches was noted under T₉ (0.70/plant), which was significantly less than that noted under any of the treatments except T₁& T₃.

Table 4: Number of branches per plant at successive crop growth stages as influenced by integrated weed management

Treatment	Symbol	Number branches per plant at	
		60 DAS	Harvest
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	1.33	2.33
Pendimethalin @ 1.00 kg/ha as PE	T ₂	2.33	5.33
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	2.67	3.67
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	4.00	6.67
Grass mulch (5 t/ha) one week after germination	T ₅	4.67	6.67
One hoeing at 30 DAS	T ₆	2.33	4.33
One H.W. at 30 DAS	T ₇	3.00	6.00
2 H.W. at 30 and 60 DAS (weed free)	T ₈	4.67	7.00
Weedy check	T ₉	1.00	1.00
S.E.(m)±		0.49	0.61
C.D. (at 5%)		1.04	1.30

PE – Pre-emergence DAS – Days after sowing HW – Hand weeding

3.4 Number of leaves per plant

The number of leaves per plant was significantly influenced by the integrated weed management treatments at all the stages of crop growth (Table 5). It was observed that there

was a continuous increase in the number of leaves upto 60 days crop growth stages after that the leaves was decreased at harvest stage.

Table 5: Number of leaves per plant at successive crop growth stages as influenced by integrated weed management

Treatment	Symbol	Number leaves per plant at		
		30 DAS	60 DAS	Harvest
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	5.00	5.33	2.00
Pendimethalin @ 1.00 kg/ha as PE	T ₂	5.33	6.33	3.33
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	6.60	7.00	3.60
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	6.00	7.67	4.00
Grass mulch (5 t/ha) one week after germination	T ₅	6.30	8.00	4.67
One hoeing at 30 DAS	T ₆	4.33	5.33	2.33
One H.W. at 30 DAS	T ₇	4.67	6.33	4.00
2 H.W. at 15 and 30 DAS (weed free)	T ₈	6.67	8.30	5.33
Weedy check	T ₉	3.60	4.60	1.00
S.E.(m)±		0.64	0.40	0.39
C.D. (at 5%)		1.36	0.85	0.84

PE – Pre-emergence, DAS – Days after sowing, HW – Hand weeding

At 30 DAS, the maximum number of leaves /plant were recorded in T₈ (Two H.W. at 30 and 60 DAS) which was significantly superior over all treatment except T₅ (grass mulch 5 t/ha one week after germination) at 30 DAS.

At 60 DAS, the maximum number of leaves per plant was recorded in weed free T₈ (2 H.W. at 30 and 60 DAS). Data presented in Table 4.13 & fig.4.11 further reveals that weed free (2 HW at 15 and 30 DAS) treatment was statistically superior over all the treatment except T₅ (grass mulch 5 t/ha one week after germination). The minimum number of leaves was recorded under the weedy check.

At harvest, the maximum number of leaves per plant was

recorded under the treatment weed free (8.20/plant) which was statistically at par with T₅ (grass mulch 5 t/ha one week after germination) and T₄ (Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS) and significantly superior to rest of the treatments. The minimum number of leaves was recorded under weedy check.

3.5 Dry weight per plant (g)

The data recorded in respect of dry weight per plant were analysed statistically. The mean dry weight per plant is presented in Table 6.

Table 6: Dry weight per plant (g) at successive crop growth stages as influenced by integrated weed management

Treatment	Symbol	Dry weight per plant (g) at		
		30 DAS	60 DAS	Harvest
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	2.51	11.75	20.30
sPendimethalin @ 1.00 kg/ha as PE	T ₂	2.53	12.58	21.43
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	2.48	11.80	20.49
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	2.61	12.83	21.78
Grass mulch (5 t/ha) one week after germination	T ₅	2.63	12.89	21.80
One hoeing at 30 DAS	T ₆	2.43	11.97	21.40
One H.W. at 30 DAS	T ₇	2.48	12.00	21.48
2 H.W. at 15 and 30 DAS (weed free)	T ₈	2.68	12.97	21.83
Weedy check	T ₉	2.30	9.63	19.36
S.E.(m)±		0.15	0.73	0.44
C.D. (at 5%)		0.32	1.53	0.94

PE: Pre-emergence, DAS: Days after sowing, HW: Hand weeding

At 30 DAS, all the integrated weed management treatments significantly higher dry weight per plant over weedy check. The maximum dry weight per plant was recorded in Weed free T₈ (2 H.W. at 30 and 60 DAS) which was significantly higher than that other treatment except T₅ (Grass mulch 5 t/ha one week after germination) and T₄ (Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS). The minimum per plant weight noted under the weedy check.

At harvest, the maximum dry weight per plant was recorded under the treatment weed free (22.02/plant) which was statistically superior over all the weed control treatments. The minimum dry weight per plant was recorded under weedy check.

The significant increase in plant height was observed at all the growth stages (at 30, 60 DAS and harvest) under different chemical weed control treatments. However, at 30, 60DAS and harvest stage, plant height was recorded maximum under treatment of 2 HW at 30 & 60 DAS.

Significant increase in number of branches per plant was recorded at all the growth stage of stages under the different weed control treatment. At 30 DAS branches were not founded but at 60 days after sowing (DAS), maximum number of branches were noted under treatment T₈ (5.28/plant), followed by treatments T₅ (4.98/plant), T₄ (3.83/plant) and T₂ (3.59/plant) but it at par with T₅ treatment only. Minimum number of branches was noted under treatment weedy check T₉ (0.47/plant), which was significantly less than other weed management practices. Maximum number of branches at harvest stage was noted under T₈ (7.92/plant), which was at par with T₅ (7.47/plant). Minimum number of branches was noted under T₉ (0.70/plant), which was significantly less than that noted under any of the treatments except T₁ & T₃. It can be stated that all treatments significantly reduced the dry matter compared with unweeded control. The dry matter of weeds was directly related to removal of nutrients. In the unweeded

plot highest dry matter of weeds was produced because of their higher population and unchecked growth. Moreover, reduced competition from weeds, ultimately improved the growth attributes in okra. They observed that parameters like plant height, dry matter and number of branches were significantly affected by the various integrated weed management treatments on okra. They also found that two hand weeding resulted in an increased plant height, dry matter and branches per plant. Moreover, they could mention that weed free treatment produced significantly heavier plants, with more branches than the weedy check. Superiority of hand weeding was attributed not only to control weeds satisfactorily but also to provide better aeration to the crop. It was concluded that grass mulch and Pendimethalin were superior because of better branching and more pod production, caused by satisfactory control of weeds in the early stages of crop growth. The reason for better plant growth under these treatments was due to the fact that the crop weed competition for nutrients and moisture under these treatments was minimum, which facilitated increase in all plant growth under near to treatment 2 hand weeding at 15 & 30 DAS.

3.6 Total number of pod per plant

Analysis of variance indicated that integrated weed management treatments exerted significant upon this yield attributing character. It is obvious from the data (Table 7) that number of pod per plant showed a positive response to most of the integrated weed management at 60 DAS and harvest stages. Among all the weed management treatments, weed free T₈ (2 H.W. at 30 and 60 DAS) recorded significantly higher number of pod per plant, but it was at par with T₂ (Pendimethalin @ 1.00 kg/ha as PE), T₄ (Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS), T₅ (Grass mulch (5 t/ha) one week after germination) and T₇ (One H.W. at 30 DAS) treatment. The minimum number of pod per plant (8.4)

was found in weedy check, which was at par with T₁, T₃, T₆ and T₇ treatments.

3.7 Length of pod (cm)

The maximum length of pod (12.20 cm) was recorded in T₈ treatment, which was statistically at par with T₅ and T₄ and former treatment recorded significantly longer pod than rest of the treatments. The minimum length of pod (5.49 cm) was recorded in T₉ followed by T₁, treatment without significant margin (Table 7).

Table 7: Total number of pod/plant. Length of pod (cm), Girth of pod (cm) as influenced by integrated weed managements

Treatment	Symbol	Total number of pod/plant	Length of pod (cm)	Seed yield (kg/ha)	Harvest index (%)
Oxyfluorfen @ 0.250 kg/ha as PE	T ₁	5.86	6.00	454	12.77
Pendimethalin @ 1.00 kg/ha as PE	T ₂	7.00	7.70	583	13.31
Oxyfluorfen @ 0.250 kg/ha as PE + 1 H.W. at 30 DAS	T ₃	6.67	6.50	620	13.58
Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS	T ₄	9.20	9.98	740	14.03
Grass mulch (5 t/ha) one week after germination	T ₅	9.33	10.12	796	14.70
One hoeing at 30 DAS	T ₆	6.00	7.40	491	13.00
One H.W. at 30 DAS	T ₇	6.80	7.69	648	13.83
2 H.W. at 15 and 30 DAS (weed free)	T ₈	10.00	10.20	852	14.99
Weedy check	T ₉	4.48	4.38	352	11.87
S.E.(m)±		0.61	0.19	49.31	0.66
C.D. (at 5%)		1.30	0.57	104.53	1.40

PE – Pre-emergence, DAS – Days after sowing, HW – Hand weeding

Significantly increase in yield attributing characters viz., number of pod per plant, length of pod, girth of pod were observed in weed free plots. The treatment 2 HW at 15 and 30 DAS gave the maximum number of pod per plant (16.20/plant), but it was on at par with T₅ (grass mulch 5 t/ha one week after germination) T₄ (Pendimethalin @ 1.00 kg/ha as PE + 1 H.W. at 30 DAS) T₂ (Pendimethalin @ 1.00 kg/ha as PE) and T₇ (1 H.W. at 30 DAS) each other 2 H.W. at 15 and 30 DAS) treatment, which produced significantly higher number of pod over the remaining treatments. The lowest number of pod per plant was noted in treatment weedy check. The maximum length of pod (12.20 cm) was recorded in T₈ treatment, which was statistically at par with T₅ and T₄ and former treatment recorded significantly longer pod than rest of the treatments. The minimum length of pod (5.49 cm) was noted in T₉ followed by T₁, treatment without significant margin but girth of pod was significant. The maximum girth of pod (1.37 cm) was recorded in T₈ treatment, which was statistically at par with T₅ and T₄ and former treatment recorded longer girth of pod than rest of the treatments. The minimum girth of pod (1.03 cm) was recorded in T₉ which was at par with T₁ and T₃ treatments

Weed free with two hands weeding at 30 & 60 DAS treatment gave that maximum and significantly higher seed yield, which was significantly at par with treatment grass mulch 5t/ha one week after germination and Pendimethalin 1.0 kg/ha PE +1 HW at 30 DAS. The significant lowest seed yield was produced under weedy check. The superiority of these treatments over unweeded check in increasing yield had also been reported by Sootrakar *et al.* (1995)^[5], Punia *et al.* (2001)^[3], and Yadav *et al.* (2002)^[8] and Sukhadia *et al.* (2004)^[6], Awodoyin *et al.* (2009)^[2]. Maximum harvest index (15.39%) was observed under 2 HW at 15 & 30 DAS, which was at par with treatments T₅ (Grass mulch (5t/ha) One week after germination) and T₄ (Pendimethalin 1.0 kg/ha PE + one HW at 30 DAS). Minimum harvest index was computed under weedy check (12.27%). These findings corroborate the observations made earlier more or less by Sootrakar *et al.*

3.8 Girth of pod (cm) at harvest stage

The maximum girth of pod (1.37 cm) was recorded in T₈ treatment, which was statistically at par with T₅ and T₄ and former treatment recorded longer girth of pod than rest of the treatments. The minimum girth of pod (1.03 cm) was recorded in T₉ which was at par with T₁ and T₃ treatments (Table 7).

(1995)^[5], Punia *et al.* (2001)^[3], and Yadav *et al.* (2002)^[8] and Sukhadia *et al.* (2004)^[6] and Awodoyin *et al.* (2009)^[2].

4. Conclusion

It is concluded that two hands weeding at 30 & 60 DAS treatment gave maximum plant height, highest number of branches per plant, maximum number of leaves per plant, dry weight per plant, maximum length of pod (12.20 cm), maximum girth of pod (1.37 cm), maximum number of pod per plant (16.20/plant), maximum seed yield (1102 kg/ha) and maximum harvest index (15.39%).

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