Effect of weed management practices on growth, yield and quality of Okra (Abelmoschus esculentus (L.) Moench) under temperate conditions of Kashmir valley

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Abstract
The present investigation was conducted during Kharif 2017 and 2018 at experimental field Division of Vegetable Sciences, SKUAST-Kashmir to assess the effect of weed management on growth, yield, and quality of Okra (Abelmoschus esculentus (L.) Moench) under temperate conditions of Kashmir valley. The trail was carried out in okra cv. Prabhani Kranti consisting of 7 treatments. T₁ = weed free check, T₂ = weed control, T₃ = pre-emergence application of pendimethalin @ 6 ml/litre, T₄ = pre-emergence application of pendimethalin + one hand weeding, T₅ = pre-emergence application of pendimethalin @ 6 ml/litre + quizalofop ethyl @ 40-50 gms/ha 20 days after sowing, T₆ = post-emergence application of metribuzin @ 525 gms/ha and T₇ = post-emergence application of metribuzin @ 525 gms/ha and T₈ = post-emergence application of metribuzin @ 525 gms/ha and T₉ = post-emergence application of metribuzin @ 525 gms/ha.

Keywords: Okra, pre-emergence, growth, and pod quality

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. It is a member of the Malvaceae family. Okra is quite popular in India because of easy cultivation, dependable yield and adaptability to varying moisture conditions. It is pretty versatile crop and considered as lucrative vegetable used in fresh form as well as canned food. 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. High iodine content of fruit help control goiter. Besides the crop is also used in paper industry as well as for the extraction of fibre. Weed competition is especially dramatic in a direct-seeded vegetable like okra. The critical period of weed competition is usually longer in direct-seeded than in transplanted crops. Weed competition with the crop causes substantial yield losses (40-80%) which depends upon the type of weed flora, their intensity and stages (Sharma and Patel, 2011) [8]. 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. 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) [7].

Besides this, weeds are preferred by hosts of insect pests and vectors of many important organisms and thus act as source of several diseases to okra. Therefore, it is greatly needed to evolve appropriate weed management strategy either through cultural or physical and mechanical or herbicidal or by combining herbicides with physical or mechanical and cultural weed control methods. Hence, the present investigation was designed to find out the effective measures of weed management with combination of herbicide and physical methods.
Materials and Methods
A field experiment was conducted during Kharif, 2017 and 2018 at experimental field Division of Vegetable Sciences, SKUAT-Kashmir. The experiment was laid in a randomised block design with three replications. The seeds of Okra cv. Prabhani Kranti were sown in May at a spacing of 60 × 45cm. Recommended package of practices were followed. The plant protection measures were taken up to control pest and diseases as and when required along with intercultural operations. In each plot 10 plants were tagged for taking all observations. Plant height, was recorded at final pickings in cm. Number of leaves per plant at full vegetative stage. Number of Pods plant⁻¹, were recorded by counting total no. of pickings. Pod length and Pod weight were estimated using average of ten pods from 10 tagged plants in centimetres and grams respectively. Pod yield was estimated on per plot basis and converted in pod yield per hectare in quintals. T.S.S⁰ Brix was recorded with Digital Refractometers, ascorbic acid (mg/100g) content of pods from each treatment was determined by 2, 6 dichlorophenol indophenols visual titration method suggested by AOAC (1975) and expressed in milligram per 100 g of fresh weight for all the treatment combinations in all replications. The protein content was calculated by multiplying a factor 6.25 (protein factor) with total nitrogen content in bulbs. Total nitrogen content in bulbs was determined by Kjeldahls method as outlined by Tandon (1993).

Data recorded were tabulated and statistically analysed as per Gomez and Gomez, 1976. 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.

| The treatment details are |
|--------------------------|
| T₁ = Weedy check |
| T₂ = Weed free check (two to three hand weeding) |
| T₃ = Pre-emergence application of pendimethalin @6ml/lt |
| T₄ = Pre-emergence application of pendimethalin @6ml/lt + one hand weeding |
| T₅ = Pre-emergence application of pendimethalin @6ml/lt +quizalofop ethyl@40-50gms/ha 20 days after sowing |
| T₆ = Pre-emergence application of metribuzin@525grm/ha |
| T₇ = Post emergence application of metochlor@0.75kg ai/ha |

Results and Discussion
Effect of weed management on growth and yield parameters of okra (Abolmoschus esculentus Moench) L.)

The results of the present study showed that weed management has significantly affected the growth and yield attributes of okra. The effect of different treatments on the growth and yield parameters is described here under:-

As per table -1 it was revealed that treatment T₇ - (Pre-emergence application of pendimethalin @6ml/lt + one hand weeding)recorded maximum plant height (104.41cm), no of leaves per plant (33.01) and pod length (14.65 cm) which was significantly superior to rest of other treatment but at par with treatment T₅ in case of plant height and pod length where as no. of leaves were at par with treatment T₂. Further as table-2 revealed that the maximum no of pods per plant (17.00) was found with treatment T₃ (Pre-emergence application of pendimethalin @6ml/lt) which was significantly superior to rest of all treatments but at par to treatment T₇ whereas maximum average pod weight (11.97 g) and pod yield (156.66 q ha⁻¹) were found with treatment T₂ (Weed free check (two to three hand weedicings) which was significantly superior to rest of all treatments in case of pod yield whereas the values were at par with rest of all other treatments except treatment T-1. These results are in agreement with Mekki et al., (2010)⁵. The plant height varied significantly due to different treatments. Pre emergence application of pendimethalin @1.0 kg/ha + one hand weeding (T4) showed superior performance in plant height than all other treatments tested except weed free check (T2), with an plant height of (146.43 cm) indicating pre emergence application of pendimethalin + hand weeding practice had positive effect on the growth and development of okra followed by weed free check T3 (143.80 cm). The lowest plant height (73.73 cm) was recorded in weedy check. The herbicides when used in combination with one or two hand weedicings, improves their efficiency and the pre-emergent herbicides are beneficial to keep the crop weed free in the early stages. During later stages, hand weeding helps to reduce the cost of weeding and keep the weed population below the economic threshold level throughout the crop growth period. and also it might be due to the reason that, the crop faced minimum crop weed competition because of herbicidal action and hand weeding practice and it resulted into maximum values for growth, yield and yield related parameters. Rajasree et al. 2017 ⁶, Smith et al., (2009)⁹ and M. Baraïya et al. 2017 ⁷, Punia et al. (2001), Yadav et al. (2002)⁸ and Sukhadia et al. (2004), Awodoyin et al.(2009).

| Table 1: Influence of weed management on growth and yield parameters of okra (Abolmoschus esculentus Moench) L.) |
|---------------------------|-------------------|-----------------|-----------------|-----------------|-------------------|-------------------|
| Plant Height (cm) | No. of Leaves plant⁻¹ | Pod Length (cm) |
| (2017) | (2018) | pooled | 2017 | 2018 | pooled | 2017 | 2018 | pooled |
| T₁ = 58.14 | 60.06 | 59.10 | 15.22 | 16.43 | 15.82 | 10.67 | 10.87 | 10.77 |
| T₂ = 69.85 | 71.34 | 70.60 | 33.36 | 31.51 | 32.43 | 12.62 | 12.47 | 12.54 |
| T₃ = 97.00 | 95.11 | 96.05 | 24.00 | 22.16 | 23.08 | 13.12 | 13.23 | 13.17 |
| T₄ = 105.19 | 103.64 | 104.41 | 34.02 | 32.00 | 33.01 | 14.50 | 14.80 | 14.65 |
| T₅ = 100.15 | 100.70 | 100.42 | 24.90 | 26.17 | 25.53 | 13.71 | 13.83 | 13.77 |
| T₆ = 66.00 | 66.56 | 66.28 | 21.28 | 22.67 | 21.97 | 13.10 | 13.15 | 13.12 |
| T₇ = 63.67 | 65.74 | 64.71 | 20.36 | 21.30 | 20.83 | 11.80 | 11.83 | 11.81 |
| C.D≤0.5 | 4.23 | 5.01 | 4.62 | 4.36 | 4.88 | 4.62 | 1.00 | 0.97 | 1.02 |
Table 2: Influence of weed management on pod yield and yield related parameters of Okra.

| No. of pods/plant | Average pod Weight gms | (Pod Yield q/hac) |
|-------------------|------------------------|-------------------|
| 2017 | 2018 | pooled | 2017 | 2018 | pooled | 2017 | 2018 | pooled |
| T1 = | 10.63 | 11.65 | 11.14 | 8.60 | 8.57 | 8.58 | 56.28 | 58.26 | 57.27 |
| T2 = | 16.75 | 17.20 | 16.97 | 11.82 | 12.12 | 11.97 | 154.19 | 159.14 | 156.66 |
| T3 = | 16.00 | 18.01 | 17.00 | 9.53 | 10.20 | 9.86 | 101.44 | 105.05 | 103.24 |
| T4 = | 14.89 | 16.41 | 15.65 | 11.50 | 8.45 | 9.97 | 137.57 | 138.47 | 138.02 |
| T5 = | 15.22 | 16.85 | 16.03 | 11.67 | 12.02 | 11.84 | 135.57 | 136.58 | 136.07 |
| T6 = | 14.82 | 16.44 | 15.63 | 11.70 | 11.94 | 11.82 | 106.77 | 107.57 | 107.17 |
| T7 = | 13.04 | 15.04 | 14.04 | 10.87 | 11.44 | 11.15 | 104.22 | 101.21 | 106.75 |
| C.D≤0.5 | 1.33 | 1.63 | 1.48 | 0.85 | 4.12 | 2.12 | 8.60 | 10.80 | 8.90 |

2. Effect of weed management on quality parameters of okra (Abelmoschus esculentus Moench.) (Table -3)

Poole analysis revealed that as per table-3 the treatment T4 (Pre-emergence application of pendimethalin @6ml/lt + one hand weeding) recorded maximum T.SS° Brix (7.81), Vitamin C (14.95 mg /100 g) and protein content (1.75%) which was significantly superior to rest of treatments but at par with treatment T3, T5 and T6 in case of Vitamin C content, T4 and T5 in case of T.S.S Brix0 and with treatment T3 in case of protein content. Similar reports were given by by Yadav et al. (2002) (4) and Sukhadia et al. (2004), Awodoyin et al. (2009).

Table 3: Influence of weed management, on quality attributes of okra

| T.S.S (Brix) | Vitamin C mg/100 g | Protein content % | Pooled |
|--------------|--------------------|-------------------|--------|
| (2017) | (2018) | pooled | 2017 | 2018 | pooled | 2017 | 2018 | pooled |
| T1 = | 6.70 | 6.68 | 6.69 | 11.09 | 11.36 | 11.23 | 1.28 | 1.29 | 1.27 |
| T2 = | 7.26 | 7.24 | 7.25 | 12.97 | 13.04 | 13.00 | 1.45 | 1.47 | 1.46 |
| T3 = | 7.84 | 7.60 | 7.72 | 14.05 | 14.77 | 14.41 | 1.73 | 1.74 | 1.74 |
| T4 = | 7.71 | 7.90 | 7.81 | 14.84 | 15.06 | 14.95 | 1.75 | 1.75 | 1.75 |
| T5 = | 7.71 | 7.70 | 7.70 | 14.50 | 15.00 | 14.75 | 1.55 | 1.55 | 1.55 |
| T6 = | 7.12 | 7.13 | 7.12 | 13.90 | 14.55 | 14.22 | 1.63 | 1.63 | 1.63 |
| T7 = | 7.30 | 7.28 | 7.29 | 12.50 | 12.50 | 12.50 | 1.44 | 1.44 | 1.44 |
| C.D≤0.5 | 0.30 | 0.28 | 0.29 | 0.74 | 0.74 | 0.73 | 0.039 | 0.039 | 0.039 |

Conclusion
The results can be summarised as, the treatment T4 (Pre-emergence application of pendimethalin @6ml/lt + one hand weeding) was recorded maximum values for most of the growth, yield, and quality parameters although Pod yield was found maximum with treatment T2 (Weed free check (two to three hand weedicings)). However further research trials should carried in different locations to assess the best possible results.

References
1. AOAC. (Association of Official Analytical Chemist) Official Method of Analysis. 12th Ed. Washington, DC 1975.
2. Gomez KA, Gomez AA. Statistical procedures for agriculture research. Second Ed. Wiley Interscience Publication John Willey and Sons, New York 1984.
3. Ijoyah MO, Atanu SO, Unah PO. Productivity of okra (Abelmoschus esculentus L. Moench) varieties as influenced by seasonal changes in Makurdi, Nigeria. Proc. of 27th Annual Conference of the Horticultural Society of Nigeria held at Kano, Nigeria 11th - 16th October 2009, 159-165.
4. Manju Baraiya, KS Yadav, Satish Kumar, Narayan Lal, Govind Shiurkar. Effect of integrated weeds management on growth and development of Okra. The Pharma Innovation Journal 2017; 6(7):1024-1028.
5. Mekki BB, Faida AA, Kowthar G. Effect of weed control treatments on yield and seed quality of some Canola cultivars and associated weeds in newly reclaimed sandy soils. American-Eurasian J Agri., & Env., Sci 2010; 7(2):202-209.
6. Rajasree VA, Sathiyanurthy T, Shanmugasundaram, T Arumug. Integrated Weed Management on Growth, Yield and Economics in Okra (Abelmoschus esculentus (L.) Moench) Under Kharif V. Madras Agric. J 2017; 104(1-3):81-84.
7. Rao AN, Nagmani A. Eco-efficient weed management approaches for rice in tropical Asia. Pp 78-87. (In.) Proc. 4th Trop. Weed Sci. conf. Weed management and utilization in the Tropics”. January, 2013 at the Empress Hotel, Chiang mai, Thailand 2013, 23-25.
8. Sharma S, Patel BD. Weed management in okra grown in Kharif season under middle Gujarat conditions. Indian J. Weed Sci 2011; 43(3&4):226-27.
9. Smith AE, Aubin AJ, McIntosh TC. Field persistence studies with emulsifiable concentrates and granular formulations of the herbicide pendimethaline in Saskatchewan, J Agric Food Chem 2009; 43:2988-2991.