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Effect of different weed management practices on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench.)

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Abstract
The experiment was conducted during *Kharif* seasons of 2019-20 at AICRP (Vegetables) RHREC, Dharwad, Karnataka. The experiment was laid out in a randomized block design (RBD) with seven treatments with three replications. Significantly lowest dry weight of total weed biomass and Number of weeds per m^2 area are registered under the treatment Pre-application of Pendimethalin @ 6 ml/L + one hand weeding of 7.43 g and 6.67 respectively at 60 DAS and also Higher gross return (Rs.175095), net return (Rs.108768) and B:C ration of 1.64.

Keywords: Weed management, okra, pendimethalin, growth, yield, economics

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench.) is a warm season vegetable crop cultivated widely all over the world mainly for its immature fruits. India ranks first in the world with 6.09 million tonnes of okra produced from over 0.50 million ha land and productivity of 11.9 tonnes per hectare (NHB, 2017-18) [1]. It is quite popular in India because of easy cultivation, dependable yield and adaptability to varying moisture conditions. It is a tropical direct sown vegetable with duration of 90-110 days. It is the best source of iodine and calcium. The nutritional composition of okra includes calcium, protein, oil and carbohydrates, iron, magnesium and phosphorus. Weather conditions and weed density have a great influence on the length of critical periods. Weeds also harbour pests and disease causing organisms; cause adverse allelopathic effects on okra and reduce the yield and quality of the produce. Because of the slow growth rate of okra during the initial stages, weeds take advantage of moisture, soil fertility and environmental conditions to suppress the growth of the crop. Due to this weed competition, the crop remains weak and unhealthy; this results in the reduction of yield and quality of the crop. A yield loss of about 54.1 to 90.6 per cent was reported in okra due to weed competition. The most critical period of crop weed competition in okra is upto 2-6 weeks after sowing (Singh *et al.*, 1981) [9]. Weeds are generally controlled by physical and cultural methods, and hand weeding is the most efficient method of weed control. However, these methods are tedious, time consuming and laborious. The easiest way to control weeds is through herbicides, which is quicker and cheaper as compared to other methods. Okra suffers heavy yield losses in rainy season (*kharif*) due to weed infestation owing to congenial environmental conditions for luxurious weed growth coupled with wider row spacing and slow growth at early stages. Yield losses due to weeds varied from 40 to 80% depending on the type of flora, their intensity and stages (Patel *et al*., 2004). Scarcity of man power at critical period of crop-weed competition, costly herbicides and their availability in desired quantity are also problematic. The cumulative effects of weeds on crop production eventually lead to crop losses due to weed activities including competition, allelopathy, acting as alternative host to pests and pathogens, adulteration of farm produce etc. It was, therefore, considered necessary to undertake a study to find the performance of integrated weed management on growth, yield of okra (*Abelmoschus esculentus* (L.) Moench).

Material and Methods

The experiment was conducted during *Kharif* seasons of 2019-20 at AICRP (Vegetables) RHREC, Dharwad, Karnataka, (15.475° N latitude, 74.979° E longitude and 655 m altitude), the experimental soil was well drained and sandy loam in texture. The experiment was laid out in a randomized block design (RBD) with seven treatments with three replications. The experimental fields was ploughed three times and all the cultural practices were done as per the package of Practices of University of Horticultural Sciences Bagalkot. The treatments Details shown in table No.1

Table 1: Treatment Details

	Treatments
T_1	Weedy Check (control)
T_2	Weed free check (2-3 hand weeding) (first HW at 25 DAS)
T_3	Pre-emergence application of Pendimethalin @ 6 ml/L
T_4	Pre-application of Pendimethalin @ 6 ml/L + one HW
T_5	Pre-application of Pendimethalin @ 6 ml/L + Quizalofopehtyl 40-50 g/ha at 25 DAS
T_6	Pre-emergence application of Metribuzin @ 525 g/ha at 25 DAS
T_7	Post-emergence application of Quizalofop ehtyl 40-50 g/ha at 25 DAS + 10 g urea/L as protected spray at 25 DAS

Results and Discussions

Significantly lowest dry weight of total weed biomass and Number of weeds per m^2 area are registered under the treatment Pre-application of Pendimethalin @ 6 ml/L + one hand weeding of 7.43 g and 6.67 respectively at 60 DAS. Use of only herbicide and integrated weed control treatment were having very low weed population at different stages of crop growth because there was no chance of emergence of weed seedling and if emerged they were not grown in herbicide and weed control practices. Similar, results were obtained by Khalid *et al.* (2005) [2], Singh *et al.* (2010) [8] and Sheela *et al.* (2010) [6].

All the weed management treatments had significant effect on growth of Okra plants. Treatment (T_4) Pre-application of Pendimethalin @ 6 ml/L + one hand weeding recorded highest number of fruits /plant (18.07) and yield /ha. (103.70 q/ha.) Fallowed by treatment (T_2) Weed free check (2-3 hand weeding) (first HW at 25 DAS) recorded (17.91) and (93.11 q/ha number of fruits/plant and fruit yield per ha. respectively. Similar, results were obtained by Muhammed *et al.* (2015) [3], Shamla *et al.*, 2017 [5] and Rajasree *et al.*, 2017 [4].

The data parenting to Economics presented in (Table3) result raveled that Higher gross return (Rs.175095), net return (Rs.108768) and B:C ration of 1.64 were reported in Treatment (T_4) Pre-application of Pendimethalin @ 6 ml/L + one hand weeding. While lower gross return (Rs.107775), net return (Rs.45150) and B:C ration of 0.75 were reported in T_1Weedy Check (control).this results aggress the findings of Sharma and Patel 2011 [7].

Table 2: Effect of different treatments on weeds, growth and fruit yield of okra

Treatments	Plant height (cm)	Fruit length (cm)	Fruit girth (mm)	No. of fruits/ plant	Fruit yield d/plot (kg)	Fruit yield (q/ha)	No of weeds/m^2 area at 60 DAS	Weeds dry wt./M^2 (g) area at 60 DAS
Weedy Check (control)	75.78	12.61	12.61	9.51	6.74	74.89	54.67 (7.45)	142.27 (11.96)
Weed free check (2-3 hand weeding) (first HW at 25 DAS)	189.78	14.02	14.02	17.91	8.38	93.11	9.00 (3.16)	10.37 (3.37)
Pre-emergence application of Pendimethalin @ 6 ml/L	174.89	14.48	14.48	15.64	8.10	90.04	12.00 (3.91)	14.83 (3.97)
Pre-application of Pendimethalin @ 6 ml/L + one HW	187.55	14.54	14.88	18.07	9.33	103.70	6.67 (2.75)	7.43 (2.89)
Pre-application of Pendimethalin @ 6 ml/L + Quizalofop Ethyl 40-50 g/ha at 25 DAS	167.56	12.71	12.71	15.85	8.20	91.07	16.67 (4.17)	14.97 (3.96)
Pre-emergence application of Metribuzin @ 525 g/ha at 25 DAS	168.22	13.18	13.18	14.61	8.14	90.48	19.00 (4.45)	17.13 (4.25)
Post-emergence application of Quizalofop Ethyl 40-50 g/ha at 25 DAS + 10 g urea/L as protected spray at 25 DAS	149.67	13.79	13.79	14.41	7.87	87.48	18.33 (4.39)	19.07 (4.46)
S.Em ±	6.99	1.22	1.23	0.44	0.39	4. 41	1.99	2.78
C.D. @ 5%	21.55	NS	NS	1.37	1.22	13.59	6.15	8.58
c.v.%	7.61	15.62	15.66	5.09	8.47	8.47	17.76	14.93

Table 3: Effect of different treatments on economics of okra

Treatments	Fruit yield q/ha	Cost of cultivation (Rs./ha)	Gross Return (Rs./ha)	Net returns (Rs./ha)	B:C Ratio
Weedy Check (control)	75.78	62625	107775	45150	0.72
Weed free check (2-3 hand weeding) (first HW at 25 DAS)	189.78	68030	165465	97435	1.43
Pre-emergence application of Pendimethalin @ 6 ml/L	174.89	63625	152610	88985	1.40
Pre-application of Pendimethalin @ 6 ml/L + one HW	187.55	66327	175095	108768	1.64
Pre-application of Pendimethalin @ 6 ml/L + Quizalofop Ethyl 40-50 g/ha at 25 DAS	167.56	65638	145185	79547	1.21
Pre-emergence application of Metribuzin @ 525 g/ha at 25 DAS	168.22	64440	139410	74970	1.16
Post-emergence application of Quizalofop Ethyl 40-50 g/ha at 25 DAS + 10 g urea/L as protected spray at 25 DAS	149.67	65136	136650	71514	1.10

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