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Response of okra [*Abelmoschus esculentus* (L.) Moench.] to weed management under fertility levels in north Gujarat conditions

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Abstract

A field experiment was carried out during summer season at Regional Research Station, S D A U, Sardarkrushinagar to find out the suitable weed management practices for Okra cultivation in Gujarat. The highest green fruit yield (96.48 q ha^{-1}) was recorded under the treatment of hand weeding at 20, 40 and 60 days after sowing *i.e.*, Weed free (W_1) and it was at par with Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha (Blanket application) + Hand Weeding at 40 DAS (W_7) and Hand weeding at 20 and 40 DAS (W_2). The highest plant height, number leaves per plant, number of branches per plant, stem girth and number of nodes per main stem was recorded with application of 100 per cent recommended dose of fertilizers *i.e.*, 150:50:50 N, P_2O_5 and K_2O kg/ha. Monocot, dicot, sedge and total weeds population at 20 DAS were found significantly lowest under treatment (W_1) *i.e.*, pre-emergence application of pendimethalin @ 1.0 kg a.i./ha (W_4) + Hand Weeding at 40 DAS (3.20, 2.75, 2.99 and 5.07 per m^2, respectively) as compare to rest of treatments but it was found at par with treatment (W_5) *i.e.*, W_4 + interculturing at 20 DAS (3.22, 2.77, 3.04 and 5.13 per m^2), W_6 *i.e.*, W_4 + interculturing at 40 DAS (3.26, 2.84, 3.05 and 5.20 per m^2) and W_4 *i.e.*, pre-emergence application of pendimethalin @ 1.0 kg a.i./ha (3.27, 2.85, 3.06 and 5.21 per m^2), respectively. The highest Benefit : Cost Ratio (4.04) was noted with weed free treatment (*i.e.*, Hand Weeding at 20, 40 and 60 DAS) (W_1), followed by W_2 *i.e.*, Hand weeding at 20 and 40 DAS (3.90) and W_7 *i.e.*, Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha (Blanket application) + Hand Weeding at 40 DAS (3.77). Application of 100 per cent recommended dose of NPK fertilizers proved beneficial (BCR of Rs.3.15) over 75 per cent of the recommended dose. The results revealed that higher summer okra green fruit yield of cv. Parbhani Kranti can be acheived by adopting hand weeding at 20, 40 and 60 DAS or hand weeding at 20 and 40 DAS or with pre-emergence application of pendimethalin @ 1.00 kg a.i./ha (Blanket application) coupled with hand weeding at 40 DAS.

Key words: *Okra, weed management, pre-emergence, weedicide, North Gujarat.*

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench.] belongs to the family Malvaceae, is one of the important vegetable crop of subtropical and tropical regions. It is widely grown all over India for its immature tender fruits, which are used as vegetable in a variety of ways. India produces around 3.5 million tonnes from 0.36 million hectares of land with productivity of 9.72 t ha^{-1}. According to Aykroyd (1941) okra fruit contains carbohydrate 7.7%, protein 2.2%, fat 0.2%, fibre 1.2%, mineral matters 0.7%, calcium 0.09%, phosphorus 0.04%, iron 0.0015%, vitamin A 58 I.U., vitamin B 63 I.U. and vitamin C 16 mg/100 g. Among agronomic factors, known to augment crop yield, the fertilization and weed management are considered the most productive inputs. Weed management is one of the most serious problems in modern intensive farming, as the total loss of crop yield, increased cost of cultivation would cause a greater economic loss. Crop yield losses due to weeds have been estimated to the tune of 49 to 100 per cent (Adejonwo *et al.*, 1991).Fertilizers, though costly inputs of production, is essential for securing higher yields. The optimum doses of fertilizers suggested by research workers are variable due to soil and climatic condition of the region. The extent of nutrient competition differs with the dose, time and method of fertilizer application. The benefit of added fertilizers increased markedly with better weed control. Ambare *et al.* (2005) observed that yield loss caused by weeds is greater at low and high rates of applied nitrogen than at intermediate leaves. Since there is lack of information on aforesaid aspects particularly for this region, therefore a field experiment on weed management in Okra under two fertility levels in North Gujarat conditions was conducted during summer season to find out suitable weed management treatment for higher Okra production.

Materials and Methods

Experiment was carried out during summer season of 2008 at Regional Research Station, Sardarkrushinagar Dantiwada Agricultural University.

Sardarkrushinagar, (Gujarat). The treatments comprised eight weed management practices *i.e.*, Unweeded control (W_0), Weed free (*i.e.*, Hand Weeding at 20, 40 and 60 DAS) (W_1), Hand weeding at 20 and 40 DAS (W_2), Interculturing at 20 and 40 DAS (W_3), Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha (Blanket application) (W_4), W_4 + Interculturing at 20 DAS (W_5), W_4 + Interculturing at 40 DAS (W_6) and W_4 + Hand Weeding at 40 DAS (W_7) along with two fertility levels *i.e.*, 75 % recommended dose of NPK (*i.e.*, 112.5 - 37.5 - 37.5 NPK kg/ha) (F_1) and 100 % recommended dose of NPK (*i.e.*, 150 50 - 50 NPK kg/ha) (F_2) in Factorial Randomized Block Design with four replications. The experimental soil was loamy sand in texture, low in organic carbon and available nitrogen, medium in available phosphorus and potash. The seeds of okra variety 'Prabhani Kranti' were dibbled manually on 28th February, 2008 @10 kg ha^{-1}. Two seeds per hill were dibbled at 30 cm apart in the same furrow in which fertilizers were band placed. The fertilizers were applied as per the treatments. Half dose of the nitrogen and entire dose of phosphorus and potash were applied in the form urea, DAP and MOP, respectively. The fertilizers were applied before sowing in previously opened furrow by manual labour in each plot, keeping the spacing of 45 cm between two rows. The remaining half dose of nitrogen was applied as top dressing in the form of urea after 30 DAS when irrigation was given. The green and tender marketable fruits were picked up by manual continuously at every Monday and Thursday after the first picking (*i.e.*, 17-04-2008). Five tagged plants were harvested separately for taking observations. Observations on plant height, number of leaves/plant, number of branches/plant, stem girth, number of nodes/main stem, days required for 50 per cent flowering, number of fruits/plant, yield/plant, fruit length, fruit girth, average fruit weight, weeds (monocots, dicots and sedges)/m^2 at 20 and 40 DAS, dry weight of weeds/m^2 at 60 and 80 DAS, weed control efficiency, economics and Benefit : Cost Ratio (BCR) were recorded and analysed as per the statistical methods.

Results and Discussion

Effect on weed population

Prusal of data in Table 1 showed that lowest monocot (2.84 per m^2), dicot (2.72 per m^2), sedge (2.58 per m^2) and total weeds (4.60 per m^2) were noted under pre-emergence application of pendimethalin @ 1.0 kg a.i./ha + Inter culturing at 20 DAS (W_5) but it was found at par with treatments W_1 (H.W. at 20, 40 and 60 DAS) and W_2 (H.W. at 20 and 40 DAS) (Table 1). Lower monocot weed population was found in these treatments due to effective control of weeds by pendimethalin and hand weeding and interculturing. In addition to this dense crop canopy might have and smothering effect on weeds. The lowest dicot weeds were observed under pendimethalin treated condition at this stage of crop growth due to complete elimination of weeds by herbicide. The lowest sedge weeds were observed under treatment W_5 might be due to effective control of sedge weeds by pendimethalin as pre-emergence since beginning and weeds those escaped from herbicidal control were removed by interculturing at 20 DAS. The lowest total weeds were observed under pendimethalin treated condition at this stage of crop growth due to complete elimination of weeds by herbicide (Kumar and Choudhary 2004).

Effect on growth parameters

Plant height, Number of leaves per plant, Number of branches per plant, stem girth (cm) and Number of nodes per main stem were recorded highest at 80 DAS weed free treatments W_1 (H.W. at 20, 40 and 60 DAS) and it was at par with treatments W_2 (H. W. at 20 and 40 DAS) and W_7 (W_4 + H.W. at 40 DAS) (Table 2). Weeds were effectively controlled under these treatments and hence there was no severe competition by weeds for moisture and nutrients resulted into comparatively taller plant and as result of higher number of inter node the higher number of leaves per plant were recorded. Effective and timely weed control in these treatments resulted in lesser competition for resources and which become easily available to plant nutrient supply system, and which have accelerated the metabolic activities of plant and ultimately enhanced plant growth. Similar results with weed control in okra are also reported by Singh and Batra (1994). The maximum number of nodes per main stem under these treatments mainly ascribed to better control of weeds throughout the growth period, which may have resulted in better availability of moisture and nutrients to the crop which may be increase the growth attributes of the okra crop. (Tiwari *et al.* 1985). The data on plant height, number of leaves per plant, number of branches per plant, stem girth and number of nodes per main stem significantly influenced by fertility levels at all the stage of crop growth. The highest value of growth parameters were noted with application of 100 per cent recommended dose of fertilizers *i.e.*, 150: 50 : 50 N, P_2O_5 and K_2O kg/ha. The increase in growth parameters with 100 per cent recommended dose of fertilizers might be due to favorable function of fertilizers to produce more and large cells which promote the vegetative growth and encourage the formation of more foliage by producing more carbohydrates. Further, fertilizers might have increased the photosynthetic efficiency of leaves (Saimbhi *et al.* 1991).

Effect on yield and yield attributing characters

The maximum fruit length (14.80 cm), fruit girth (5.60 cm) and average fruit weight (13.99 g) (Table 3) were obtained under weed free treatments W_1 (H.W. at 20, 40 and 60 DAS) due to complete removal of weeds throughout crop growth period by hand weeding which might have resulted in maintaining high soil fertility status by way of removing less plant nutrients through weeds might have favourable effect on yield attributes. W_2 (H.W. at 20 and 40 DAS) and W_7 (W_4 + H.W. at 40 DAS) were also found at par in respect of fruit length, fruit girth and average fruit weight. The increase in fruit length under treatments W_1, W_2 and W_7 was to the extent of 43.69, 35.15 and 31.55 fruit girth, 48.15, 36.24 and 35.98 and average fruit weight 67.14, 57.71 and 57.11 per cent respectively as compared to W_0 (control) might be due to effective control of weeds

resulting in lesser competition of weeds which might have ultimately resulted in the better utilization of nutrients and moisture available in the soil by the crop, which reflects in terms of increased yield attributes of okra. (Kumar and Choudhary, 2004). Highest green fruit yield of okra (96.48 q ha^{-1}) was recorded under weed free treatments W_1 (H.W. at 20, 40 and 60 DAS) which was at par with treatments W_2 (H.W. at 20 + 40 DAS) and W_7 (W_4 + H.W. at 40 DAS). Increase in green fruit yield of okra under treatments W_1, W_2 and W_7 over W_0 (control) to the tune of 216.95, 195.34 and 198.86 per cent, respectively. Higher green fruit yield obtained under these treatments might be due to effective control of weeds which in than of significantly increase the values of growth and yield attributes like days to 50 per cent flowering, number of fruits per plant, fruit yield per plant, fruit length, fruit girth and average fruit weight under these treatments. In addition to this the least weed population and dry weight of weeds were recorded under these treatments are also responsible for better green fruit yield. These findings are in accordance with the results reported by Patel *et al.* (2004). Fruit length, fruit girth, fruit weight, number of fruits per plant and fruit yield per plant (Table 3) were significantly increase with application of 100 per cent recommended dose of fertilizers (F_2) than 75 per cent of recommended fertilizers (F_1). Higher dose of fertilizers tends to increase the vegetative growth in terms plant height, number of leaves per plant, number of branches per plant, stem girth and number of nodes per main stem which resulted in increase photosynthate surface, consequently more production of photosynthates and carbohydrates, might have resulted in increased fruit length, fruit girth, fruit weight, number of fruits per plant. The combine effect of all these parameters finally increase the green fruit yield per plant is in agreement of results reported by(Meena *et al,*. 2008).

Table 1 : Weed population/m^2 at 40 DAS and dry weight of weeds in okra cv. Parbhani Kranti as influencedby weed management and fertility levels

Treatments	Weed population /m^2 (X + 0.5)				Dry weight of weeds (g/m^2)	
	Monocot	Dicot	Sedge	Total	At 60 DAS	At 80 DAS
Weed management						
W_0 : Unweeded control	9.95 (98.67)	6.55 (42.48)	6.38 (40.20)	13.48 (181.35)	210.80	1004.65
W_1 : Weed free (*i.e.*, Hand Weeding at 20, 40 and 60 DAS)	4.92 (23.78)	3.35 (10.78)	3.50 (11.75)	6.84 (46.31)	(82.04)* 37.87	(77.03)* 230.76
W_2 : Hand weeding at 20 and 40 DAS	4.93 (23.80)	3.37 (10.85)	3.51 (11.80)	6.85 (46.45)	(79.24) 43.76	(73.07) 270.54
W_3 : Interculturing at 20 and 40 DAS	6.64 (43.67)	5.49 (29.76)	4.55 (20.26)	9.68 (93.49)	(61.73) 80.67	(50.18) 500.50
W_4 : Pre emergence application of Pendimethalin @ 1.0 kg a.i./ha	6.73 (44.90)	5.74 (2.54)	5.54 (32.45)	10.50 (109.89)	(52.25) 100.65	(38.20) 620.87
W_5 : W_4 + Interculturing at 20 DAS	2.84 (7.60)	2.72 (6.90)	2.58 (6.15)	4.60 (20.65)	(56.89) 90.87	(46.77) 534.76
W_6 : W_4 + Interculturing at 40 DAS	6.72 (44.76)	5.57 (30.55)	4.37 (18.67)	9.71 (93.98)	(61.69) 80.76	(58.12) 420.76
W_7 : W_4 + Hand Weeding at 40 DAS	6.72 (44.65)	5.57 (30.55)	4.28 (17.86)	9.66 (93.06)	(78.91) 44.45	(72.44) 276.87
S.Em.±	1.34	0.81	0.64	1.38	2.93	16.71
C.D. at 5 %	3.80	2.30	1.82	3.91	8.32	47.45
Fertility levels (NPK kg ha^{-1})						
F_1 : 75 % of recommended dose	6.45 (41.14)	4.96 (24.10)	4.50 (19.74)	9.24 (84.95)	78.87	478.03
F_2 : 100 % recommended dose	6.50 (41.82)	5.00 (24.50)	4.53 (20.05)	9.26 (85.35)	93.59	486.89
S.Em.±	0.67	0.41	0.32	0.69	1.46	8.35
C.D. at 5 %	NS	NS	NS	NS	4.16	NS

Table 2 : Growth parameters in okra cv. Parbhani Kranti as influenced by weed management and fertility levels

Treatments	Plant height (cm) at 80 DAS	Number of leaves per plant at 80 DAS	Number of branches per plant 80 DAS	Stem girth (cm) 80 DAS	Number of nodes per main stem at 80 DAS	Days to 50 per cent flowering
Weed management						
W_0 : Unweeded control	52.41	8.08	0.75	2.30	5.22	52.20
W_1 : Weed free (*i.e.*, Hand Weeding at 20, 40 and 60 DAS)	74.46	18.08	2.10	4.50	13.08	50.70
W_2 : Hand weeding at 20 and 40 DAS	69.81	16.82	1.98	4.20	12.20	51.98
W_3 : Interculturing at 20 and 40 DAS	63.16	14.65	1.63	3.66	9.97	50.80
W_4 : Pre emergence application of Pendimethalin @ 1.0 kg a.i./ha	59.11	13.80	1.59	3.31	7.99	51.30
W_5 : W_4 + Interculturing at 20 DAS	65.27	15.33	1.67	3.81	9.98	52.10
W_6 : W_4 + Interculturing at 40 DAS	66.30	14.03	1.68	3.76	9.78	52.09
W_7 : W_4 + Hand Weeding at 40 DAS	68.71	16.80	1.95	4.18	12.15	51.95
S.Em.±	2.19	0.51	0.06	0.13	0.34	1.74
C.D. at 5 %	6.23	1.45	0.17	0.36	0.97	NS
Fertility levels (NPK kg ha^{-1})						
F_1 : 75 % of recommended dose	63.10	14.28	1.62	3.61	9.76	50.22
F_2 : 100 % recommended dose	66.71	15.11	1.72	3.82	10.33	53.06
S.Em.±	1.10	0.26	0.03	0.06	0.17	0.87
C.D. at 5 %	3.11	0.73	0.08	0.18	0.49	2.47

Table 3: Yield parameters and yield in okra cv. Parbhani Kranti as influenced by weed management and fertility levels

Treatments	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of fruits per plant	Fruit yield per plant (g)	Green fruit yield (q ha^{-1})
Weed management						
W_0 : Unweeded control	10.30	3.78	8.37	3.09	58.94	30.44
W_1 : Weed free (*i.e.*, Hand Weeding at 20, 40 and 60 DAS)	14.80	5.60	13.99	8.12	160.24	96.48
W_2 : Hand weeding at 20 and 40 DAS	13.92	5.15	13.20	7.55	151.36	89.90
W_3 : Interculturing at 20 and 40 DAS	12.70	4.99	12.08	6.23	143.73	84.25
W_4 : Pre emergence application of Pendimethalin @ 1.0 kg a.i./ha	11.80	4.70	9.12	5.60	96.89	49.55

W_5 : W_4 + Interculturing at 20 DAS	13.00	4.90	9.65	5.90	108.13	57.88
W_6 : W_4 + Interculturing at 40 DAS	12.89	4.98	10.02	6.10	112.64	61.22
W_7 : W_4 + Hand Weeding at 40 DAS	13.55	5.14	13.15	7.51	151.10	89.45
S.Em.±	0.45	0.17	0.38	0.22	4.25	2.53
C.D. at 5 %	1.28	0.48	1.07	0.62	12.07	7.19
Fertility levels (NPK kg ha^{-1})						
F_1 : 75 % of recommended dose	12.38	4.77	10.88	6.07	119.39	66.11
F_2 : 100 % recommended dose	13.36	5.04	11.51	6.42	126.37	71.43
S.Em.±	0.23	0.08	0.19	0.11	2.12	1.27
C.D. at 5 %	0.64	0.24	0.53	0.31	6.03	3.60

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