The Agriculturists 12(2): 56-63 (2014) ISSN 2304-7321 (Online), ISSN 1729-5211 (Print)
A Scientific Journal of Krishi Foundation ***Indexed Journal***

Response of Okra (*Abelmoschus esculentus* L.) to Growth Regulators and Organic Manures

M. S. Chowdhury, Z. Hasan, K. Kabir, M. Shah Jahan and M. H. Kabir*

Department of Horticulture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh

**Corresponding author and Email: kabirsau@yahoo.com*

Received: 25 May 2014 Accepted: 13 December 2014

Abstract

A study was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University, Bangladesh during April to September, 2012 to determine the suitability of selected plant growth regulators and the proper use and effectiveness of selected organic manures and also their suitable combinations for successful okra production. The experiment consisted of two factors: factor A: growth regulators as - G_0: control (water), G_1: GA_3 (100 ppm) and G_2: Miraculan (1000 ppm) and factor B: organic manures as - OM_0: control (no manure), OM_1: vermicompost (9 t/ha) and OM_2: poultry manure (11.5 t/ha). The combined use of GA_3 and poultry manure produced the tallest plants. Both the growth regulators and organic manures enhanced early flowering. In case of growth hormone, the highest yield (16.67 t/ha) was recorded from G_1 followed by G_2 (16.49 t/ha). The highest yield (18.03 t/ha) was found from $OM_{2,}$ closely followed by OM_1 (17.59 t/h). Considering the treatment combinations, the highest yield was harvested from G_1OM_2 (19.62 t/ha), followed by G_1OM_1 (19.01 t/h), G_2OM_1 (18.42 t/h) and G_2OM_2 (18.30 t/h), respectively.

Keywords: Okra, GA_3, Miraculan, vermicompost, poultry manure

1. Introduction

Okra or bhendi (*Abelmoschus esculentus* L.), belonging to the family Malvaceae, is an important vegetable crop of the world and is cultivated in Bangladesh in summer. It is a tropical and sub-tropical plant in which tender pods are used as a vegetable. These green fruits are rich sources of vitamins; calcium, potassium and other minerals. In Bangladesh, vegetable production is not uniform round the year: plenty in winter but less in summer. Around 30% of total vegetables are produced during summer and 70% in winter (Hossain, 1992). The present consumption of vegetables in Bangladesh is 112 g/day/capita (23 g leafy vegetables, 89 g non-leafy vegetables), which is far below the minimum average requirement of 400 g/day/capita (FAO/WHO, 2003). Therefore, there is a big gap between the requirement and the supply of vegetables in Bangladesh. Successful okra production may contribute partially in solving vegetable scarcity in summer. Okra production in the country is low compared to other countries. Total production of okra was about 240 thousand tons from 7287.5 ha in 2009 and the average yield was about 3.38 t/ha (BBS, 2010).

Plant growth regulators (PGR's) are organic compounds, which in small amounts modify physiological process of plants. PGR influences plant height, number of leaves, length of the internode, number of days for first flower initiation, fruit quality, number of fruits, fruit weight, and number of fruits per plant of okra (Kokare *et al*., 2006 and Nawalkar *et al*., 2007). Gibberellin (GA) plays an essential role in many aspects of plant growth and development, such as stem elongation and flowering (Yamaguchi and Kamiya, 2000). Miraculan (triacontanol 0.05%) is also a PGR with effective metabolic activator used for enlarging fruit size, yield of different fruits and vegetable crops.

Organic manures such as farm yard manure, poultry manure, vermicompost etc. are very active and important for soil. It furnishes large portion of macro and micro nutrients, protects soil against erosion, supplies the cementing substance for desirable soil aggregate formation and loosen soil. Application of vermicompost and poultry manure subsequently increases yield attributes and yield of okra (Sameera *et al*., 2005). In addition, the product from organic manure is beneficial for health and the natural eco-system. Therefore, the present investigation was carried out to find out the suitability of selected plant growth regulators and the proper use and effectiveness of selected organic manures and also their suitable combinations for successful okra production in Bangladesh.

2. Materials and Methods

The study was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh from April to September 2012**,** to determine the response of okra to growth hormone and organic manure. BARI Dherosh 1 was used as the test crop. The experiment consisted of two factors: factor A: growth regulators (three levels) as - G_0: control (no growth regulators), G_1: GA_3 (gibrellic acid @100 ppm) and G_2: Miraculan @ 1000 ppm (Triacontanol 0.05%) and the factor B: organic manure (three levels) as - OM_0: control (no manuring), OM_1: vermicompost (9 t ha^{-1}) and OM_2: poultry manure (11.5 t ha^{-1}). No chemical fertilizer was applied in the experiment.

The two factors experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The total experimental plot (114.75 m^2 with length 15.3 m and width 7.5 m) was divided into three equal blocks. Each block was then divided into 9 plots where 9 treatment combinations were allotted at random. Thus there were 27 unit plots.

Seeds were sown in the plots maintaining the distance of 50 x 40 cm. Intercultural operations were done as and when necessary. Five plants were selected for data collection. Data were recorded at 20, 40 and 60 days after sowing**.** The data recorded on different characteristics were plant height (cm), number of leaves per plant, number of internodes per plant, fresh weight of plant (g), dry matter of plant, days required for 50% flowering, number of flower buds per plant, number of pods per plant, pod length (cm), pod diameter (cm) and yield of okra. The mean values of all the recorded characteristics were evaluated and analysis of variance was performed using the 'F' (variance ratio) test. The significance of the difference among the treatment means was estimated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

3. Results and Discussion

3.1. Plant height

Plant height showed significant differences due to the influence of various growth hormones applied at 20, 40, and 60 days after sowing (DAS). The tallest plants (14.82, 72.46 and 89.24 cm) were recorded from G_1 (GA_3 @100 ppm) and at all the DAS, while the shortest plants (12.93, 64.00 and 78.57 cm) were measured from G_0 (Figure 1). Singh *et al.* (1999) reported that GA_3 increased plant height of okra. At 20, 40 and 60 DAS, the longest plants (15.65, 76.91 and 89.68 cm) were noted from OM_2 (poultry manure @11.5 t ha^{-1}) but the shortest plants (11.99, 57.99 and 78.20 cm) were found from OM_0 as control at all the DAS (Figure 2). Pavan *et al*. (2004) reported that the poultry manure increased plant height over the untreated control.

Vermicompost and poultry manure subsequently increased yield attributing characteristics of okra (Prakash and Bhadoria, 2004). The longest plants (17.32, 84.39 and 96.20 cm) were recorded from G_1OM_2 (GA_3 @100 ppm and poultry manure @11.5 t ha^{-1}) at 20, 40 and 60 DAS, respectively. On the other hand, the shortest plants (11.47, 56.50 and 72.20 cm) were recorded from G_0OM_0 (no growth hormone and no organic fertilizer) (Table 1). It was revealed that the combined use of GA_3 and poultry manure @ 11.5 t ha^{-1} produced the tallest plant under that trial.

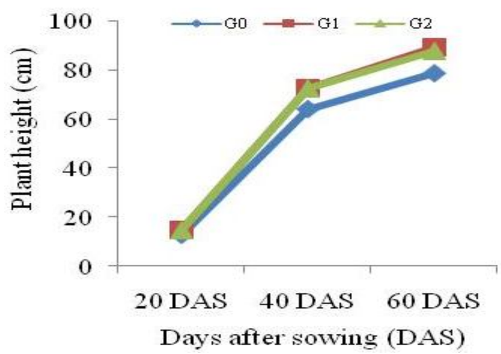

Figure 1. Effect of growth regulators on the plant height at different days after sowing of okra

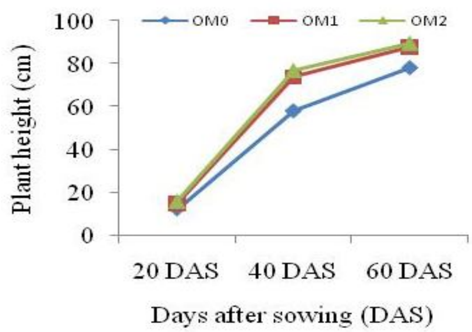

Figure 2. Effect of organic manures on the plant height at different days after sowing of okra

Table 1. Effect of growth regulators and organic manures on number of leaves and number of internodes per plant of okra

Treatment	Number of leaves per plant			Number of internodes		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
Growth regulators						
G_0	5.66 b	21.86 b	43.07 b	5.19 b	12.94 b	19.37 b
G_1	7.00 a	28.21 a	48.73 a	5.93 a	14.16 a	21.61 a
G_2	6.94 a	25.90 a	48.71 a	5.80 a	14.11 a	21.22 a
$LSD_{(0.05)}$	0.241	3.183	1.790	0.325	0.617	0.539
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
Organic manures						
OM_0	5.67 b	19.01 c	40.78 b	4.87 c	12.09 b	19.20 b
OM_1	6.88 a	26.64 b	49.10 a	5.84 b	14.33 a	21.32 a
OM_2	7.06 a	30.31 a	50.63 a	6.21 a	14.79 a	21.68 a
$LSD_{(0.05)}$	0.241	3.183	1.790	0.325	0.617	0.539
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
CV(%)	7.69	12.58	6.82	5.78	4.49	6.60

In a column the mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at the 0.05 level of significance

G_0: Control (no growth regulators/water), G_1: GA_3 (Gibberellic acid @100 ppm), G_2: Miraculan @1000 ppm (Triacontanol 0.05%), OM_0: Control (no manure), OM_1: Vermicompost @9 t ha^{-1}, OM_2: Poultry Manure @11.5 t ha^{-1}

3.2. Number of leaves per plant

The maximum numbers of leaves per plant (7.00, 28.21 and 48.73) were counted from G_1 and at all the DAS. Oppositely the minimum numbers of leaves per plant (5.66, 21.86 and 43.07) were obtained from G_0 (Table 1). Singh and Mahesh (2005) reported the highest number of leaves per plant with 75 ppm GA_3. At 20, 40 and 60 DAS, the maximum numbers of leaves per plant (7.06, 30.31 and 50.63) were found from OM_2, whereas the minimum numbers of leaves per plant (5.67, 19.01 and 40.78) were observed from OM_0 (Table 1). The maximum numbers of leaves per plant (7.67, 34.93 and 54.70) were obtained from G_1OM_2 at 20, 40 and 60 DAS, respectively. On the contrary, the minimum numbers of leaves per plant (4.83, 18.37 and 41.10) were found from G_0OM_0, (Table 2).

3.3. Number of internodes per plant

Different growth hormones showed significant differences for number of internodes per plant at 20, 40, and 60 DAS. The maximum numbers of internodes per plant (5.93, 14.16 and 21.61) were recorded from G_1 whereas at all the DAS, the minimum numbers of internodes (5.19, 12.94 and 19.37) were recorded from G_0 (Table 1). At 20, 40 and 60 DAS, the maximum numbers of internodes (6.21, 14.79 and 21.68) were recorded from OM_2. Oppositely, the minimum numbers of internodes (4.87, 12.09 and 19.20) were found from OM_0 (Table 1). The maximum numbers of internodes (6.87, 15.87 and 23.03) were recorded from G_1OM_2 at 20, 40 and 60 DAS, respectively whereas the minimum numbers of internodes (4.67, 11.87 and 18.27) were recorded from G_0OM_0, respectively (Table 2).

Table 2. Interaction effect of growth regulators and organic manures on plant height, number of leaves and number of internodes per plant of okra

Treatment	Plant height (cm) at			Number of leaves per plant at			Number of internodes at		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
G_0OM_0	11.47 ef	56.50 e	72.20 f	4.83 e	18.37 e	41.10 cd	4.67 e	11.87 e	18.27 e
G_0OM_1	13.11 de	65.79 d	81.09 e	5.99 cd	21.97 cde	42.70 bc	5.27 d	13.20 d	19.83 d
G_0OM_2	14.21 cd	69.72 cd	82.42 de	6.17 cd	25.23 bcd	45.40 b	5.63 cd	13.77 cd	20.00 d
G_1OM_0	10.79 f	51.67 e	77.75 ef	5.83 d	18.63 e	38.70 d	4.43 e	11.17 e	19.20 d
G_1OM_1	16.36 ab	80.37 ab	93.75 ab	7.49 ab	31.07 ab	52.80 a	6.50 ab	15.30 ab	22.60 ab
G_1OM_2	17.32 a	84.39 a	96.20 a	7.67 a	34.93 a	54.70 a	6.87 a	15.87 a	23.03 a
G_2OM_0	13.70 cd	65.81 d	84.64 cde	6.33 c	20.03 de	42.53 bc	5.50 d	13.23 d	20.13 d
G_2OM_1	14.27 cd	74.93 bc	88.19 bcd	7.16 b	26.90 bc	51.80 a	5.77 cd	14.50 bc	21.53 c
G_2OM_2	15.42 bc	76.64 abc	90.41 abc	7.33 ab	30.77 ab	51.80 a	6.13 bc	14.73 bc	22.00 bc
$LSD_{(0.05)}$	1.684	7.516	6.481	0.417	5.514	3.100	0.564	1.068	0.934
Level of significance	0.01	0.01	0.05	0.05	0.05	0.01	0.01	0.01	0.01
CV(%)	6.91	6.24	4.40	7.69	12.58	6.82	5.78	4.49	6.60[[

In a column the mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at the 0.05 level of significance

G_0: Control (no growth regulators/water), G_1: GA_3 (Gibberellic acid @100 ppm), G_2: Miraculan @1000 ppm (Triacontanol 0.05%), OM_0: Control (no manure), OM_1: Vermicompost @9 t ha^{-1}, OM_2: Poultry Manure @11.5 t ha^{-1}

3.4. Fresh weight of plant

The highest fresh weight of plant (84.70 g) was obtained from G_1 which was statistically similar (82.93) to that form G_2, whereas the lowest weight (74.38) was found from G_0 (Table 3). The highest fresh weight of plant (88.28) was recorded from OM_2 whereas, the lowest (69.93) was found from OM_0 (Table 3). The highest fresh weight of plant (97.00) was recorded from G_1OM_2, whereas the lowest weight (65.99 g) was recorded from G_0OM_0 (Table 4).

3.5. Dry weight of plant

The highest dry weight of plant (11.09 g) was found from G_1, again the lowest (9.53) was obtained from G_0 (Table 3). Vijayaraghavan (1999) reported that 50 ppm gibberellic acid produced the maximum total dry matter than the control. The highest dry weight of plant (11.45) was observed from OM_2, while the lowest (8.98) found from OM_0 (Table 3). The highest dry weight of plant (12.54) was obtained from G_1OM_2, but the lowest (8.43 g) was recorded from G_0OM_0 (Table 4).

3.6. Days to 50% flowering

The highest days required for 50% flowering (47.11) was recorded from G_0, while the lowest (43.22) was found from G_1 (Table 3). Katung *et al*. (2007) reported that GA_3 influenced the number of days to 50% flowering. The highest days required for 50% flowering (47.44) was obtained from OM_0 while, the lowest (43.22) was recorded from OM_1 (Table 3). The highest days required for 50% flowering (50.00) was obtained from G_0OM_0, again the lowest (40.00) was found from G_2OM_1 (Table 4).

3.7. Number of flower buds per plant

The maximum number of flower buds per plant (43.86) was recorded from G_2 which was statistically similar with G_1 (42.98). On the other hand, the minimum (36.18) was recorded from G_0 (Table 3). The maximum number of flower buds (43.13) was observed from OM_1 which was similar to OM_2 (42.66), while the minimum (37.22) was obtained from OM_0 (Table 3). The maximum number of flower buds (45.53) was observed from G_1OM_2. On the other hand, the minimum (33.43) was found from G_0OM_0 (Table 4).

3.8 Number of pods per plant

Significant variation was recorded for the number of pods per plant due to the application of different growth hormones. The maximum number of pods per plant (33.77) was recorded from G_1 whereas the minimum (24.30) was observed from G_0 (Table 3). Vijayaraghavan (1999) reported that 50 ppm gibberellic acid produced the highest number of fruits per plant. The maximum number of pods per plant (33.87) was found from OM_2, whereas the minimum (23.12) was recorded from OM_0 (Table 3). The maximum numbers of pods per plant (39.60) were found from G_1OM_2, and again the minimum (20.70) were observed from G_0OM_0 (Table 4).

3.9. Pod length

The longest pods (17.66 cm) were observed in G_1 treated crops and the shortest pods (15.33 cm) were found from G_0 (Table 3). The longest pods (17.72) were observed from OM_2 whereas the shortest pods (15.67) were recorded from OM_0 (Table 3). The longest pods (18.67) were recorded from G_1OM_2, while the shortest ones (13.83 cm) were recorded from G_0OM_0 (Table 4).

3.10. Pod diameter

Significant variation was recorded in pod diameter as an effect of growth hormones. The highest pod diameter (1.77 cm) was recorded from G_1 whereas the lowest diameter (1.33) was recorded from G_0 (Table 3). The highest pod diameter (1.84) was recorded from OM_2 whereas the lowest diameter (1.22) was found from OM_0 (Table 3). The highest pod diameter (2.11) was recorded from G_1OM_2 whereas the lowest pod diameter (1.04 cm) was obtained from G_0OM_0 (Table 4).

Table 3. Effect of growth hormones and organic manures on the fresh weight, dry weight, yield contributing traits and yield of okra

Treatment	Fresh weight per plant (g)	Dry weight per plant (g)	Days required for 50% flowering	Flower buds per plant (No.)	Pods per plant (No.)	Pod length (cm)	Pod diameter (cm)	Yield (t/ha)
Growth regulators								
G_0	74.38 b	9.53 b	47.11 a	36.18 b	24.30 c	15.33 b	1.33 b	14.08 b
G_1	84.70 a	11.09 a	43.22 b	42.98 a	33.77 a	17.66 a	1.77 a	16.67 a
G_2	82.93 a	10.79 a	43.89 b	43.86 a	31.57 b	17.61 a	1.70 a	16.49 a
$LSD_{(0.05)}$	4.180	0.548	2.283	1.139	1.870	0.697	0.089	0.895
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Organic manures								
OM_0	69.93 c	8.98 b	47.44 a	37.22 b	23.12 b	15.67 b	1.22 c	11.62 b
OM_1	83.80 b	10.99 a	43.22 b	43.13 a	32.64 a	17.22 a	1.74 b	17.59 a
OM_2	88.28 a	11.45 a	43.56 b	42.66 a	33.87 a	17.72 a	1.84 a	18.03 a
$LSD_{(0.05)}$	4.180	0.548	2.283	1.139	1.870	0.697	0.089	0.895
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CV(%)	5.19	5.24	5.11	7.78	6.26	4.14	5.46	5.69

In a column the mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at the 0.05 level of significance

Table 4. Interaction effect of growth regulators and organic manures on fresh weight, dry weight, yield contributing characteristics and yield of okra

Treatment	Fresh weight per plant (g)	Dry weight per plant (g)	Days required for 50% flowering	Flower buds per plant (No.)	Pods per plant (No.)	Pod length (cm)	Pod diameter (cm)	Yield (t/ha)
G_0OM_0	65.99 e	8.43 e	50.00 a	33.43 d	20.70 e	13.83 d	1.04 e	10.73 d
G_0OM_1	76.39 d	9.80 d	45.67 b	38.07 c	25.97 d	15.99 c	1.43 d	15.33 b
G_0OM_2	80.76 cd	10.37 cd	45.67 b	37.03 c	26.23 d	16.17 c	1.54 d	16.17 b
G_1OM_0	64.80 e	8.77 e	41.67 bc	38.07 c	23.63 de	16.83 bc	1.18 e	11.37 cd
G_1OM_1	92.31 ab	11.96 ab	44.00 bc	45.33 a	38.07 ab	17.49 ab	2.01 ab	19.01 a
G_1OM_2	97.00 a	12.54 a	44.00 bc	45.53 a	39.60 a	18.67 a	2.11 a	19.62 a
G_2OM_0	79.00 d	9.73 d	50.67 a	40.17 b	25.03 d	16.33 bc	1.43 d	12.75 c
G_2OM_1	82.71 cd	11.21 bc	40.00 c	46.00 a	33.90 c	18.17 a	1.79 c	18.42 a
G_2OM_2	87.08 bc	11.44 b	41.00 c	45.40 a	35.77 bc	18.33 a	1.87 bc	18.30 a
$LSD_{(0.05)}$	7.241	0.950	3.954	1.973	3.239	1.208	0.155	1.550
Level of significance	0.01	0.05	0.01	0.05	0.01	0.05	0.01	0.05
CV(%)	5.19	5.24	5.11	7.78	6.26	4.14	5.46	5.69

In a column the mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at the 0.05 level of significance.

G_0: Control (no growth regulators/water), G_1: GA_3 (Gibberellic acid @100 ppm), G_2: Miraculan @1000 ppm (Triacontanol 0.05%), OM_0: Control (no manure), OM_1: Vermicompost @9 t ha^{-1}, OM_2: Poultry Manure @11.5 t ha^{-1}

3.11. Pod yield

Different growth hormones induced significant variations in pod yield per hectare. The highest yield (16.67 t) was observed from G_1 whereas the lowest (14.08) was attained from G_0 (Table 3). The results is in agreement with the findings of Vijayaraghavan (1999) who reported that 50 ppm gibberellic acid produced the highest fruit yield of 15.7 t/ha and the control yield was 8.07 t/ha. Surendra *et al*. (2006) also reported that GA_3 @25 and 50 ppm gave the highest fruit yields (15.81 and 18.69 t/ha, respectively). The highest yield (18.03) was recorded from OM_2, while the lowest (11.62) was found in OM_0 (Table 3). Ushakumari *et al*. (1999) reported that vermicompost applied as an organic source @12 t/ha + the full recommended dose of inorganic fertilizers resulted the highest yield (5.66 t/ha). Pavan *et al*. (2004) reported that involving 50% N as urea + 50% N as poultry manure recorded the highest yield (90.61 q/ha). The highest yield (19.62) was recorded from G_1OM_2, while the lowest yield per hectare (10.73 t) was observed from G_0OM_0 (Table 4).

4. Conclusions

From the findings of the present study, it is revealed that okra plants responded well to growth regulators (GA_3 and Miraculan) and organic manures (vermicompost and poultry manure). Therefore, farmers may use any one of the growth regulators along with vermicompost or poultry manure to increase the okra yield.

References

FAO/WHO. 2003. Food and Agriculture Organization of the United Nations. Diet, nutrition and the prevention of chronic diseases. Report of a Joint FAO/WHO Expert Consultation. WHO Technical Report Series 916. Geneva, World Health Organization.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research, 2nd end., John Wiley and Sons, Singapore, 28-192 pp.

Hossain, S. M. 1992. Status, constrains and strategies of vegetable research. In: Katherine and Eli. L (eds.). Vegetable production and marketing. Proceedings of a national review and planning Workshop held at BARI, Gazipur, Bangladesh. 26-29 January. l992, 31 p.

Katung, M. D., Olarewaju, J. D. and Mohammed, S. G. 2007. Seasonal response of okra (*Abelmoschus esculentus* L.) varieties to gibberellic acid. *Advances in Horticultural Science,* 21(1): 14-18.

Kokare, R. T., Bhalerao, R. K., Prabu, T., Chavan, S. K., Bansode, A. B. and Kachare, G. S. 2006. Effect of plant growth regulators on growth, yield and quality of okra (*Abelmoschusesculentus* L.). *Agricultural Science Digest*, 26(3): 178-181.

Monthly Bulletin, BBS, February. 2010. Monthly Statistical Bulletin of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning. Government of the People's Republic of Bangladesh, Dhaka, 44 p.

Nawalkar, L. R., Khiratkar, S. D., Badge, S. A., Chopde, N. K. and Dadgal, S. S. 2007. Effect of biofertilizers and growth regulator with reduced doses of NPK on growth and yield of okra. *Journal of Soils and Crops*, 17(1): 145-149.

Pavan, Y., Singh, P., Yadav, R. L. and Ram, L. 2004. Organic manures and nitrogen levels on okra cv. Varsha Uphar. *Haryana Journal of Horticultural Sciences*, 33(1/2): 124-126.

Prakash, Y. S. and Bhadoria, P. B. S. 2004. Relative efficacy of different organic manures on the performance of okra (*Abelmoschus esculentus* L.) grown in Lateritic soil. *Tropical Agriculture*, 81(4): 197-203.

Sameera, D. L., Shankaraiah, V. and Srihari, D. 2005. Effect of packaging and storage on organic manures grown okra (*Abelmoschus esculentus* L. Moench). *Journal of Research ANGRAU*, 33(4): 30-35.

Singh, R. K. and Mahesh, K. 2005. Response of summer season okra to plant growth regulators and foliar application of nitrogen. *Haryana Journal of Horticultural Sciences,* 34(1/2): 187-188.

Singh, R. K., Singh, G. P. and Singh, V. K. 1999. Effect of plant growth regulators and green fruit pickings on the seed production of Bhindi (*Abelmoschus esculentus* L.). *Journal of Applied Biology,* 9(1): 31-34.

Surendra, P., Nawalagatti, C. M., Chetti, M. B. and Hiremath, S. M. 2006. Effect of plant yield and yield components in okra. *Karnataka Journal of Agricultural Sciences,* 19(2): 264-267.

Ushakumari, K., Prabhakumari, P. and Padmaja, P. 1999. Efficiency of vermicompost on growth and yield of summer crop okra (*Abelmoschus esculentus* Moench). *Journal of Tropical Agriculture*, 37(1/2): 87-88.

Vijayaraghavan, H. 1999. Effect of seed treatment with plant growth regulators on bhendi (*Abelmoschus esculentus* L.,) grown under sodic soil conditions. *Madras Agricultural Journal*, 86(4/6): 247-249.

Yamaguchi, S. and Kamiya, Y. 2000. Gibberellin biosynthesis: its regulation by endogenous and environmental signals. *Plant Cell Physiology*, 41(3): 251-257.