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Effect of variety and planting date on the growth and yield of okra

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Abstract

A field experiment was conducted at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh to study the effect of variety and panting date on the growth and yield of okra. Three planting dates (1 February, 15 February and 2 March) and three varieties (BARI Dherosh-1, Arka Anamica and Annie Oakley) were used as treatment variables. Layout system was randomized complete block design under factorial arragement with three replications. Planting date had significant influence on yield contributing characters and yield of the three varieties tested. Significantly higher yield was obtained (9.11 t/ha) from Annie Oakley variety when shown on 15 February, compared to other dates. Higher pod yield with 15 February sowing was mainly due to increased number of pods/plant, pod size and pod weight. Annie Oakley variety enhanced plant growth and resulted greater pod weight (22.28 g) to other varieties cultivated. The highest BCR was recorded from the treatment combination of variety Annie Oakley with 15 February planting date. Results of the study revealed that 15 February sowing would be profitable for variety Annie Oakley cultivation under Mymensingh condition.

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Introduction

Okra (*Abelmoschus esculentus* L.) is an important vegetable crop grown throughout the tropical world including Bangladesh. Okra is cultivated for its immature pods to be consumed as fresh and canned food as well as for seed purpose. Okra can be grown almost round the year but its production is mainly concentrated during summer season in Bangladesh. Okra is popular as vegetables among all classes of people in Bangladesh and elsewhere in the world. It is good source of vitamins A, B, C and also rich in protein, carbohydrates and fats (Adiroubane and Letachoumanane, 1992). Fruits of okra are very rich in calcium (90 mg/100 g fresh wt.) and provide a valuable supplementary nutrition in human diet (Markose and Peter, 1990). In Bangladesh, supply of vegetables is plenty in winter season, but is low in summer season. Of the total vegetable production, around 38% is produced during Kharif season (Anon., 2010). Total production of okra was 42,366 MT produced from 10,204 ha of land in the year 2009-2010 and the average yield was 3.92 t/ha (BBS, 2010), which is very low compared to that of other developed countries where the yield was as high as 14.0-15.0 t/ha (Jamaguch, 2009). Okra production is greatly influenced by agronomic practices among them; spacing is one of the important factors that greatly influence the growth and yield of okra (Grindal, 1980). Early planting gives the longest growth cycle (Izquierdo *et al.,* 2003). Therefore, emphasis must be given to increase the per hectare yield of okra by adopting proper spacing. Early okra planting may face cool conditions and late planting may suffer from high virus infestation (Sastri *et al.,* 2004). Yellow mosaic virus disease is the most serious problem for okra cultivation. All locally grown recommended varieties of okra are susceptible to this disease (Sastri and Singh, 1994). Arka Anamica and Annie Oakley are two new varieties in Bangladesh. But their performance has not been studied in Bangladesh conditions in respect of growth and yield (Kamal and Islam, 2007). There is scope of increasing okra yield per unit area with appropriate selection of cultivar and use of proper spacing. Under Bangladesh conditions few studies have been conducted to investigate the effects of variety and spacing. The present study was, therefore, undertaken to investigate the effect of planting date on the growth and yield contributing characters and yield of three varieties of okra under Mymensingh condition.

Materials and methods

Location of the experiment

The experiment was conducted at the Horticulture Farm, Bangladesh Agricultural University Mymensingh. The experiment was carried out in a high land belonging to the old Brahmaputra Flood plain Alluvial tract and under the Agro-ecological Zone 9.

Planting materials and treatments

Three varieties were used in the experiment namely BARI Dherosh-1, Arka Anamica and Annie Oakley.The treatments consisted of three varieties BARI Dherosh-1, Arka Anamica and Annie Oakley and three planting date 1 February, 15 February and 2 March.

Design and data analysis

The experiment was laid out in Randomized Complete Block Design (RCBD) under factorial arrangement with three replications. Unit plot size was 3.6 m x 3.6 m. The collected data were analyzed with the help of a computer package programme MSTAT- C and means were separated by using LSD test. Economic analysis was also done.

Cultivation

Seeds of BARI Dherosh-1, Arka Anamica and Annie Oakley were sown on 15 February 2011, maintaining 45 cm plant to plant and 60 cm line to line distance. The entire quantity of cowdung (2ton/ha) was applied just after opening the land. Full doses of Tsp (40kg/ha) and cowdung (2 ton/ha) were applied to the soil at the final land preparation. Urea (60kg/ha) and MoP (60kg/ha) were applied as side dressing in 3 equal installments.To control Lady's finger shoot and fruit borer, Axis @ 5 ml/l was sprayed at an interval of 15 days. After fruit setting, Diathene M-45 @ 0.02% was sprayed at an interval of 7 days for

controlling diseases. Harvesting was done at 3 days interval when they attained edible stage. Harvesting was started from 20 March and continued up to May, 2011.

Data collection

Ten plants were selected randomly from each plot for collection of data. The following yield and yield contributing characters were considered for data collection.

Growth parameters

Height of ten selected plants from each plot at different days after sowing and at last edible pod harvest was measured in centimeter (cm) with a measuring scale from the ground level to the tip of the longest stem. Finally average height of ten selected plants from each plot was measured in centimeter (cm).

Different dates of first flowering were recorded from individual plot. Observation was made from the date of seed sowing. It was considered with the anthesis of flower.

The number of nodes of which first flower appeared was recorded by counting the ten individual plants from each plot. Observation was made from the date of seed sowing.

Number of branches/plant of selected plants from each plot at different days after sowing was recorded. Total number of branches at the last pod harvest was recorded and their average was calculated.

Pod maturity dates of selected plants from each plot were recorded and their average was calculated.

The number of pods of selected plants from each plot was recorded. It was recorded by the following formula:

$$\text{Number of pods/plant} = \frac{\text{Total no. of pods from 10 sample plants}}{10}$$

Size and weight of pod

Average weight of pod was measured in gram (g) of selected plants from each plot. Mean weight of 20 randomly selected pods at edible stage from each plot were measured in gram (g). It was recorded by the following formula:

$$\text{Weight of pod (g)} = \frac{\text{Total weight of pods from 10 sample plants}}{\text{Total no. of pods from 10 sample plants}}$$

The length of pods was measured with a measuring scale (Model Swordfish, China) from the neck of the pod to the bottom of 20 randomly selected pods from each plot and average was taken in centimeter (cm).

The diameter of pod was measured at the middle portion of 20 selected pods from each plot with a slide calipers (model Mitutoyo, Japan) and their average was taken in centimeter (cm).

Yield

Pod yield/hectare was calculated out in metric ton (MT) by converting the mean pod yield/plot using the following formula:

$$\text{Pod yield/hectare} = \frac{\text{Pods yield/plot x 1000}}{\text{Area of plot (m2)x 1000}}$$

Total cost and gross income/hectare were calculated from individual plot using the following formula:

$$\text{Benefit cost ratio} = \frac{\text{Gross income}}{\text{Total cost of production}}$$

Results and discussion

Plant height

Plant height varied significantly among the varieties (Table 1). Muhammad *et al.* (2001) reported similar results in case of variety Arka Anamica. Significantly variation was found among the different planting date in respect of plant height after different days of sowing (Table 2). The possible reason could be that in February 1 planting plants received proper environment, water and other natural resources that results in better growth. The results of the present study are at par with Dinesh *et al.* (2007). They also reported that plat height in okra increased in February 21 planting and early (January 15) or late (March 25) planting, reduced the plant height. Plant

height of okra variety namely Annie Oakley and Arka Anamica was higher at optimum planting date (mid February). The possible reason could be that in that time plant received more sunlight and photosynthesis was more compare to late planting.

Table 1. Effect of variety on plant height.

Character	Height of plant (cm) at				Plant height at last edible pod harvest (cm)
	35 DAS	50 DAS	65 DAS	80 DAS	
V_1	13.67	107.00	35.89	43.32	107.00
V_2	16.01	121.96	38.80	47.52	121.96
V_3	13.90	114.00	37.10	42.16	114.00
LSD (0.05)	0.19	1.09	0.57	0.64	1.09
Level of significance	**	**	**	**	**

DAS= Days after sowing, ** indicates significant at 1 % level of probability, V_1= BARI Dherosh-1,V_2= Arka Anamica, V_3= Annie Oakley .

Days for first flowering

Days for first flowering varied significantly among the different varieties (Table 3). The variety Annie Oakley produced early flower (36.57 days) and delayed flowering (39.24 days) were observed in variety Arka Anamica. Singh *et al.* (1996) found variation among the varieties for flowering and found that variety Arka Anamica required longer time (40.45 days) for first flowering. Days for first flowering varied significantly among the different planting date in respect of days for first flowering (Table 4). Planting in March 2 produced early flowers (36.67 days) and delayed flowering (38.39 days) were recorded in February 2 planting. Amjad *et al.* (2001) found significant effect of planting date on the days taken to first flowering. They also found that late planting gave early flowering compared to other planting date. Annie Oakley was a hybrid variety. Due to varietal characteristics Annie Oakley gives early flower compare to another variety Arka Anamica. On the other hand, in case of late planting physiological change is rapid and facilitated early flowering.

Table 2. Effect of planting date on plant height.

Character					Plant height at last edible pod harvest (cm)
	35 DAS	50 DAS	65 DAS	80 DAS	
P_1	14.14	24.40	35.31	42.17	111.99
P_2	15.70	36.37	43.01	50.56	139.00
P_3	13.73	23.84	33.47	40.28	91.97
LSD (0.05)	0.19	0.38	0.56	0.63	1.09
Level of significance	**	**	**	**	**

DAS= Days after sowing, ** indicates significant at 1 % level of probability, NS indicates non significant P_1= Planting time 1 February, P_2= Planting time 15 February, P_3= Planting time 2 March.

Nodes at first flowering

Nodes at first flowering varied significantly among the varieties (Table 3). The variety Annie Oakley produced flower at 4.43 number of node and at 3.84 number of node produced flower in variety BARI Dherosh-1. Sood *et al.* (2005) recorded that appearing of first flower at different number of node varied among the varieties. Significant variation was

found among the different planting date in respect of nodes at first flowering (Table 4). The planting in February 15 produced flower at 4.18 number of node and at 3.33 number of node produced flower in March 2 planting. These results agreed with the findings of Gondane and Bhatia (2005). BARI Dherosh-1 was low height compare than another variety. It gives flower at lower node. The possible reason could be that BARI Dherosh-1 gives flower at lower node due to its varietal characteristics.

Table 3. Effect of variety on days for first flowering, nodes at first flowering and number of branches/plant.

Character	Days for first flowering	Nodes at first flowering	Number of branches/plant				Number of branches at last edible pod harvest
			35 DAS	50 DAS	65 DAS	80 DAS	
V_1	37.58	3.48	1.13	1.40	1.67	1.86	1.99
V_2	39.24	4.15	1.43	1.73	2.00	2.47	2.61
V_3	36.57	3.56	1.90	2.12	2.30	2.77	2.86
LSD (0.05)	0.27	0.03	0.03	0.03	0.03	0.03	0.02
Level of significance	**	**	**	**	**	**	**

DAS= Days after sowing, ** indicates significant at 1 % level of probability, V_1= BARI Dherosh-1,V_2= Arka Anamica, V_3= Annie Oakley.

Table 4. Effect of planting date on days for first flowering, nodes at first flowering and number of branches/plant.

Character	Days for first flowering	Nodes at first flowering	Number of branches/plant				Number of branches at last edible pod harvest
			35 DAS	50 DAS	65 DAS	80 DAS	
P_1	38.33	3.68	1.36	1.64	1.80	2.03	2.18
P_2	38.39	4.18	1.47	1.67	1.93	2.43	2.67
P_3	36.67	3.33	1.63	1.94	2.23	2.62	2.61
LSD (0.05)	0.26	0.03	0.03	0.03	0.03	0.03	0.02
Level of significance	**	**	**	**	**	**	**

DAS= Days after sowing, ** indicates significant at 1 % level of probability, NS indicates non significant P_1= Planting time 1 February, P_2= Planting time 15 February, P_3= Planting time 2 March.

Number of branches/plant

Number of branches/plant varied significantly among the varieties (Table 3). Panda and Singh *et al.* (2008) reported that branch production changed due to changed in both environment and varieties. Significant variation was found among the different planting date in respect of number of branches/plant (Table 4). Muoneke and Udeogalanya (1991) reported that number of branches/plant increased in late planting compared to early planting which are at par my results. The environment as well as natural resources such as soil, water etc. was favorable for growth and development of variety Annie Oakley. For

this reason Annie Oakley variety produced more branches compared to another variety.

Days required for first harvest of pod

Days required for first harvest of pod from date of sowing varied significantly among the varieties (Table 5). Maturity of pod was earlier (42.79 days) in variety Annie Oakley. On the other hand 45.26 days required for first pod maturity in variety Arka Anamica. Singh *et al.* (1996) found that the variety Arka Anamica required longer time (46.45 days) to mature pod compared to other tested variety which is at par with the present findings. Significant variation was found among the different planting date in respect of days required for first harvest of pod (Table 5). Pod mature was earlier (42.62 days) in March 2 planting and delayed pod maturity (44.59 days) was observed in February 1 planting. Pods harvested earlier in case of variety Annie Oakley. The possible reason could be that the growth and development of Annie Oakley variety is good at that condition and plats produced pods earlier compared to another variety.

Table 5. Effect of variety on days required for first harvest of pod, number of pods/plant, average weight of pods, Pod length, Pod diameter and Benefit cost ratio.

Character	Days required for first harvest of pod	Number of pods/ plant	Weight of pod (g)	Pod length (cm)	Pod diameter (cm)	Benefit cost ratio
V_1	43.56	8.25	14.90	12.68	1.59	2.56
V_2	45.26	9.94	18.94	14.39	1.77	3.57
V_3	42.79	10.97	22.28	15.13	1.96	3.96
LSD (0.05)	0.23	0.08	0.15	0.09	0.04	0.03
Level of significance	**	**	**	**	**	**

** indicates significant at 1 % level of probability, V_1= BARI Dherosh-1, V_2= Arka Anamica, V_3= Annie Oakley.

Number of pods/plant

Number of pods/plant varied significantly among the varieties (Table 5). The highest number of pods/plant (10.96) was recorded in the variety Annie Oakley. On the other hand the lowest number of pods/plant (8.25) was recorded in the variety BARI Dherosh-1. The results of the present study are similar with the findings of Shridhar (1996) who found that the variety Annie Oakley produced maximum number of fruits/plant (12.0). Similar results were also reported by Singh *et al.* (1996) in case of the variety Annie Oakley. Significant variation was found among the different planting date in respect of number of pods/plant (Table 6). February 15 planting produced the highest number of pods/plant (11.10) while March 2 planting produced the lowest number of pods/plant (8.40). The highest number of pods/plant produced with February 15 planting. February 15 planting plant received more nutrients and other natural resources like light, water etc. for which resulted in more lateral growth of the plants as well as higher number of pods/plant. These findings are in close conformity with the results of the previous workers (Amjad *et al.*, 2001). They reported that number of pods/plant increased in February 15 planting compared to other planting date. Variety Annie Oakley gives more pods/plant at optimum planting date. The possible reason could be that growth is better of Annie Oakley variety and produced more branches at optimum planting date. As a result number of pods/plant increased.

Weight of pod

Weight of pod varied significantly among the varieties (Table 5). The variety Annie Oakley gave the maximum pod weight (22.19 g), whereas the minimum pod weight (14.90 g) was obtained from the variety BARI Dherosh-1. Mishra *et al.* (2001) reported

that pod weight varied significantly among different varieties of okra. Significant variation was found among the different planting date in respect of weight of pod (Table 6). The highest (21.02 g) and the lowest (17.14 g) pod weight were recorded from February 15 and March 2 planting, respectively. Individual weight of pod is higher in case of variety Annie Oakley. It is due to favorable environmental condition. Plants get more nutrients from soil and other natural resources from environment which facilitated proper development of pods.

Table 6. Effect of planting date on days required for first harvest of pod, number of pods/plant, Weight of pods, Pod length, Pod diameter and Benefit cost ratio.

Character	Days required for first harvest of pod	Number of pods/plant	Weight of pod (g)	Pod length (cm)	Pod diameter (cm)	Benefit cost ratio
P_1	44.59	9.66	17.94	14.91	1.91	4.19
P_2	44.39	11.10	21.02	15.28	2.01	4.01
P_3	42.62	8.40	17.14	12.02	1.40	1.90
LSD (0.05)	0.23	0.08	0.15	0.09	0.04	0.03
Level of significance	**	**	**	**	**	**

** indicates significant at 1 % level of probability, NS indicates non significant P_1= Planting time 1 February, P_2= Planting time 15 February, P_3= Planting time 2 March.

Pod length

Pod length varied significantly among the varieties (Table 5). The longest length of pods (15.13 cm) and the shortest length of pods (12.68 cm) were recorded from the variety Annie Oakley and BARI Dherosh-1, respectively. Pod length increased with changed of varieties Mishra *et al.* (2001) reported that variety Annie Oakley gave larger pod length compared to an other Indian variety namely Arka Anamica. Significant variation was found among the different planting date in respect of pod length (Table 6). The results revealed that the maximum pod length (15.28 cm) was found from 15 February planting, while the minimum pod length (12.02 cm) was found from 2 March planting. Amjad *et al.* (2001) found that pod length varied significantly among different planting date used. They also found that maximum pod length was obtained from 15 February planting in case of variety Annie Oakley. Pod length is higher in case of variety Annie Oakley. The possible reason could be that favorable environmental condition. Plants get more nutrients from soil and other natural resources from environment which facilitated for development of pods length.

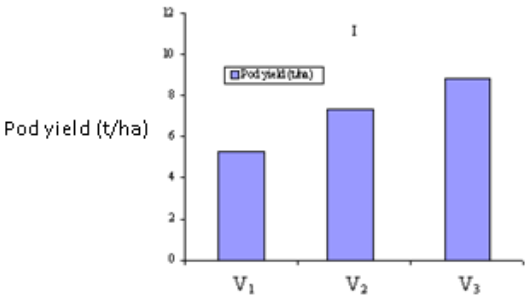

Fig. 1. Effect of variety on pod yield (t/ha) of okra, (Vertical bar represents LSD values at 0.05) V_1: BARI Dherosh-1, V_2: Arka Anamica, V_3: Annie Oakley.

Pod diameter

Pod diameter varied significantly among the varieties varieties (Table 5). The maximum diameter of pod (1.96 cm) and the minimum diameter of pod (1.59 cm) were obtained from variety Annie Oakley and BARI Dherosh-1, respectively. Mishra *et al.* (2001) reported that variety Annie Oakley gave larger pod diameter compared to an other Indian variety namely

Arka Anamica. Pod diameter varied significantly among the different planting date (Table 6). The maximum diameter of pod (2.01 cm) was obtained from 15 February planting, while the minimum diameter of pod (1.40 cm) was obtained from 2 March planting. Gupta and Srinivas (1981) reported that breadth of pod was increased gradually in 23 February planting. Pod diameter is higher in case of variety Annie Oakley. The possible reason could be that favorable environmental condition. Plants get more nutrients from soil and other natural resources from environment at optimum planting date which facilitated for development of pods diameter.

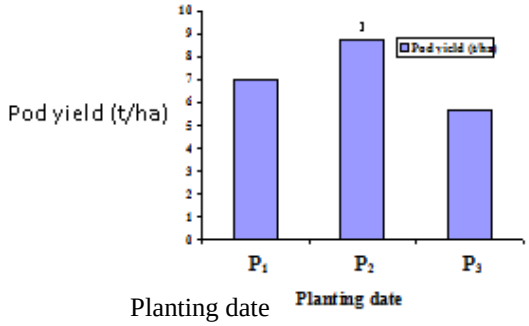

Fig. 2. Effect of planting date on pod yield (t/ha) of okra. (Vertical bar represents LSD values at 0.05) P_1: Planting time 1 February, P_2: Planting time15 February and P_3: planting 2 March.

Pod yield/hectare

Significant variation was found in respect of pod yield per hectare among the varieties (Fig. 1). The highest (9.11 t) and the lowest (4.60 t) pod yield/hectare were obtained from okra variety Annie Oakley and BARI Dherosh-1, respectively. Martin and Rhodes (1999) reported that pod yield varied among the varieties. Pod yield per hectare varied significantly among the different planting date (Fig. 2). The highest (8.76 t) and the lowest (5.20 t) pod yield/hectare were recorded from 15 February and 2 March planting, respectively. The highest pod yield per hectare with 21 February planting had already been reported by the previous workers (Gadakh *et al.,* 1990). The highest pod yield/hectare was obtained from variety Annie Oakley. The possible reason could be that number of pods/plant as well as per plot was higher in case of variety Annie Oakley. All conditions for growth and development of okra variety Annie Oakley was favorable. As a result plants produced more pods/plant. So total pods yield is higher in case of variety Annie Oakley.

Benefit cost ratio

Benefit cost ratio varied significantly among the varieties (Table 5). The highest (3.96) and the lowest (2.56) benefit cost ratio/hectare were obtained from variety Annie Oakley and BARI Dherosh-1, respectively. Singh *et al.* (2008) found that benefit cost ratio higher in variety Annie Oakley compared to other Indian variety namely Arka Anamica, Pusa Sawani, Awgu Early, respectively. Significant variation was found among the different planting date in respect of benefit cost ratio (Table 6). The highest (4.19) and the lowest (1.90) benefit cost ratio/hectare were obtained from 15 February and 2 March, respectively. Benefit cost ratio is higher in cultivation of Annie Oakley variety. Because cost of cultivation of variety Annie Oakley is easy and cheap compare to other variety. But income from cultivation of variety Annie Oakley is more

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