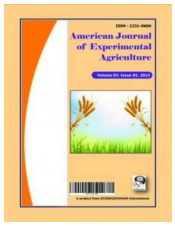

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Cultivars Response to Morphological and Yield Attributes of Okra at Sylhet Region

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Authors' contributions

This work was carried out in collaboration between all authors. Author SRS designed the study, collected data, interpreted and wrote the first draft of the manuscript. Authors MMH and RR performed the statistical analysis. Author AFMSI supervised the experiment, reviewed all drafts of the manuscript. Author MMR supervised the study and corrected the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted at the field laboratory of Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University from May to October 2013 with a view to select the superior Okra cultivar (s). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. A total of 8 cultivars viz. BARI Dherosh-1 (control), Orka Onamika, Bankim, Durga, JO (Japanese Okra)-1, JO-2, JO-3 and JO-4 were evaluated in relation to morphological and yield attributes in acidic soil conditions. Significant variations were observed in almost all parameters. Results revealed that high yielding cultivar Bankim exhibited taller plant at final harvest, produced early flowers with maximum fruit setting (%) and fruit length. The cultivar JO-3 produced maximum number of branches and leaves at final harvest. Local check cultivar showed highest internodes number and length along with maximum number of flowers and 100 seed weight. The cultivars JO-1 and JO-4 showed highest individual fruit weight and maximum fruit

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diameter, respectively. The cultivars Bankim was proved to be promising cultivars in acid soil conditions of Sylhet considering overall performance of morphological and yield attributes.

Keywords: Okra cultivars; morphological features; yield attributes; Sylhet region.

1. INTRODUCTION

Being an important vegetable, Okra (*Abelmoschus esculentus* L.) is widely grown throughout the tropics [1,2] belongs to family Malvaceae and originated from tropical Africa or Asia. In Bangladesh, Okra is one of the popular summer vegetables. Young aged Okra used as salads and for its delicious taste it is also consumed in different dimensions such as soups and stews, fresh or dried, fried or boiled [3]. The fruits of Okra contain rich amount of vitamins, calcium, potassium and other minerals [4,5]. On the other hand, fruits of Okra also contain iodine as one of the important compositions, which makes the crop more valuable in a country like Bangladesh. Besides nutritional value Okra has medicinal value as well [6]. Okra is said to be very useful against genito-urinary disorders, constipation, spermatorrhoea and chronic dysentery [7]. Its medicinal value has also been reported in curing ulcers and relief from hemorrhoids [8]. Total production of Okra was about 43000 metric tons produced from 26000 acres of land throughout Bangladesh and the average yield was 4.1 t ha^{-1} in the year 2010-2011 [9], which is much lower in compare with the yield ranges from 7-12 t ha^{-1} in the developed countries [10]. For the multidimensional impacts of Okra it is mandatory to think how the production of Okra could be increased by selecting suitable cultivar(s).

Sylhet is one of the special AEZs of Bangladesh due to its soil characters including acidity. Soil pH of the regions ranges from 4.5 to 6.5. Plants grown in acidic soil differ in nutrient uptake and physiological growth processes. The total production of Okra in Sylhet District is only about 1904 metric tons [11] from 272 ha of land. The production is too low to meet up the demand and some well studied varieties need to be selected for this region to increase the production. So the present piece of research work was undertaken to select the suitable cultivars of Okra having better morphological and yield attributes in the acidic soils.

2. MATERIALS AND METHODS

The study was conducted at the field laboratory of Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University from May to October 2013. The experimental soil belongs to the AEZ-20: Eastern Surma Kushiyara Floodplain. Soil is clay loam type with characterized by acidic (pH 4.83) in nature. The experimental region is characterized by heavy rainfall and high temperature during Kharif season with profound sunshine and cloudy weather. During the experimental period the Monthly average Rainfall (mm) and air temperature (°C) from May to September were 14.2 mm, 26.9 mm, 18.9 mm, 17.8 mm, 14 mm and 26.55°C, 29.85°C, 29.55°C, 29.6°C, 29.05°C respectively. Eight cultivars of Okra (Japanese Okra: JO-1, JO-2, JO-3 and JO-4, Indian Okra: Bankim, Durga, Orka Onamika and a local check cultivar BARI Dherosh-1) were used as experimental materials. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Eight Treatments were randomly allocated in each replication. The size of each unit plot was 2.3 m ×1.2 m. The adjacent blocks and neighboring plots were separated by 0.70 m and 0.50 m, respectively. Okra seeds were sown in lines with a spacing of 0.50 m and 0.45 m for row to row and plant to plant, respectively. Cowdung, urea, triple super phosphate (TSP), muriate of potash (MOP) were applied to the plots at the rate of 3000, 150, 100 and 150 kg ha^{-1}, respectively [12]. Total amount of Cowdung, TSP, MOP and one-third of Urea were applied as basal dose during the final land preparation. Remaining urea was applied in two installments as top dressing at 25 and 40 days after sowing (DAS). The seeds were soaked overnight in water prior to sowing. Two to three seeds were sown in each pit on 15 May 2013 in the rows. Seven days after germination the weaker seedlings were removed keeping the healthier one in each pit to grow properly. Weeding was done 4 times to keep the plots free from weeds and the soil was mulched by breaking the soil crust for easy aeration and conservation of soil moisture. The plots were watered four times at regular interval during the growth season to keep the field moist for better growth and development of plant. Data on the morphological [Seed germination (%), Plant height (cm), Number of branches, Number of leaves, Node to node distance (cm)], growth and yield [Number of days to first flowering, Number

of flowers, Number of fruits, Fruit length (cm), Fruit diameter (cm), Individual fruit weight (g), Fruit yield (t ha^{-1})] parameters were collected from the selected plants during experimental period. As for example the total number of germinated plants per plot were counted and then the germination percentage was calculated using following formula-

$$\text{Germination (\%)} = \frac{\text{Number of germinated plant per plot}}{\text{Total number of seed sowing per plot}} \times 100$$

The data were subjected to analysis of variance using the MSTAT-C [13] software and the means were separated according to Duncan's Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

3.1 Effect of Cultivars on Morphological Characters of Okra

3.1.1 Germination (%)

Cultivar response was significant in case of seed germination. The highest germination was observed in JO-1 and JO-2 (average of 97.12%) and lowest seedling emergence found in Durga (37.63%) (Table 1). While BARI Dherosh-1(68.5%) and Bankim (74.0%) showed intermediate germination. Considerable variation in seed germination as influenced by Okra cultivars was also found in some findings [14,15].

3.1.2 Plant height (cm)

Plant height increased in all the cultivars with the advancement of growth. During maturation i.e. from 80 DAS to near about final harvest, BARI Dherosh-1, Orka Onamika and Bankim produced the tallest plants. During vegetative phase, Durga produced the shortest plants while during the reproductive stage the shortest plants were found in JO-4 (Table 1). Difference in plant height among the varieties of Okra has been also reported by some researchers [15-17].

3.1.3 Branch no. plant^{-1}

The cultivar JO-3 produced the maximum branches $plant^{-1}$ at 60 and 80 DAS, and final harvest (5.54, 7.08 and 7.46, respectively) while, BARI Dherosh-1 had the maximum branches $plant^{-1}$ at 40 DAS (4.380) (Table 2). The cultivar Bankim had the minimum number of branches $plant^{-1}$ throughout the life cycle. Cultivars variation in respect of number of branches $plant^{-1}$ was also similar [15,16].

3.1.4 Leaves no. plant^{-1}

For all cultivars, the number of leaves increased with the age of plants and the maximum was found at 80 DAS and then declined. The maximum number of leaves $plant^{-1}$ was found at different cultivars at different DAS, as JO-1 (17.47) at 40 DAS, JO-4 (34.83) at 60 DAS, JO-3 (56.50) at 80 DAS and BARI Dherosh-1 (36.67) at final harvest. (Table 2). In most of the cases minimum no. of leaves $plant^{-1}$ was found in the cultivar JO-2 except at 40 DAS. These differences between the cultivars depend upon inherent character of the respective cultivars [18].

3.1.5 No. of internodes and internodal distance

Number of internodes and node to node distance is an important parameter in case of Okra because every single node bears flower which produces fruit. Maximum number of internodes

Table 1. Effect of cultivars on germination and plant height of Okra

Cultivars	Germination (%)	Plant height (cm) at different ages				
		20 DAS	40 DAS	60 DAS	80 DAS	Final harvest
BARI Dherosh-1	68.50b	6.70cde	19.07ab	74.43a	111.1a	137.9a
Orka Onamika	44.40c	7.37bc	20.13a	74.17a	108.4a	135.8a
Bankim	74.00b	7.73bc	20.70a	77.90a	109.2a	137.8a
Durga	37.63c	5.57e	12.63d	41.77cd	70.37cd	96.80bc
JO-1	97.43a	9.57a	20.20a	50.73b	73.17bc	93.67cd
JO-2	96.80a	8.50ab	18.17ab	44.73c	65.83d	84.77de
JO-3	85.13ab	7.20bcd	16.97bc	46.13bc	79.73b	107.0b
JO-4	48.10c	5.83de	15.07cd	37.70d	55.07e	74.50e
CV %	15.76	11.37	9.74	5.17	4.74	5.52

Cultivar(s) bearing similar letter are statistically similar at 5% level of probability according to DMRT

Table 2. Effect of cultivars on branch and leaf number plant^{-1} of Okra at different ages

Cultivars	No. of branches plant^{-1} at different ages				No. of leaves plant^{-1} at different ages				
	40 DAS	60 DAS	80 DAS	Final harvest	20 DAS	40 DAS	60 DAS	80 DAS	Final harvest
BARI Dherosh-1	4.38a	3.79cd	5.08c	3.29d	5.30	15.77bc	31.67bc	55.10ab	36.67a
Orka Onamika	3.00cd	3.33de	4.87c	2.91de	5.57	17.00ab	34.33a	53.97b	31.13b
Bankim	1.76f	2.06f	3.76d	2.13f	5.30	13.97d	24.61d	45.90c	21.97d
Durga	2.29ef	2.87ef	4.87c	2.67ef	4.57	11.33e	30.30c	53.65b	29.53b
JO-1	3.40bc	4.25bc	6.00b	4.00c	5.77	17.47a	31.17bc	56.23a	25.63c
JO-2	1.96f	2.79ef	4.87c	3.17de	5.47	13.90d	20.33e	37.70d	18.00e
JO-3	2.67de	5.54a	7.08a	7.46a	5.27	13.73d	32.97ab	56.50a	35.50a
JO-4	3.79ab	4.96ab	6.41ab	5.15b	4.50	14.27cd	34.83a	54.50ab	36.03a
CV %	11.90	13.05	7.89	9.08	9.66	6.34	4.80	2.30	5.49

Cultivar(s) bearing similar letter are statistically similar at 5% level of probability according to DMRT

obtained from the cultivar BARI Dherosh-1 (18.78 cm) which was closely followed by Bankim (17.11) and Orka Onamika (16.78) whereas minimum number of internodes found in Durga (13.44) (Table 3) which was almost statistically similar to the rest of the cultivars. The longest (5.63 cm) internode was found in BARI Dherosh-1 followed by Bankim (4.87 cm) and JO-4 showed the shortest internode (2.73 cm) (Table 3).

3.2 Effect of Cultivars on Yield Attributes and Yield of Okra

3.2.1 Days to first flowering

The number of days required for first flowering is one of the important inherent characters which indicate the earliness of the cultivars. The cultivar Bankim produced early flower (35.33 days) which was statistically similar to the other cultivars JO-1, JO-2 and Orka Onamika (average of 37.22 days) and the cultivar JO-3 showed delayed flowering (53.67 days) among the cultivars (Table 3). The similar variation in case of days to first flowering was also observed in several studies [16,17,19].

3.2.2 Flower no. plant^{-1}

Cultivars effect was insignificant regarding flowers number plant^{-1}. The highest number of flower (58.67) was recorded in the cultivar BARI Dherosh-1 followed by Bankim (57.8) and the lowest number of flower (28.67) was found in JO-1 (Table 3).

3.2.3 Fruit no. plant^{-1}

Number of fruits plant^{-1} was significant among the cultivars (Table 3). Bankim produced the maximum number of fruits (41.13) plant^{-1} followed by BARI Dherosh-1 (32.87). On the contrary, the minimum number of fruits (14.1) plant^{-1} was found in JO-2. Variation in number of fruits plant^{-1} was also similar in the findings [16,17].

3.2.4 Fruit setting (%)

Fruit bearing capacity i.e. fruit setting showed significant variation, as the highest fruit setting was recorded in the cultivars Bankim (69.48 %) followed by the cultivar Durga. In JO-2 and JO-3 fruit set was only about 50% which was the lowest among the cultivars (Table 3).

3.2.5 Fruit size (cm)

Fruit length and diameter varied significantly among the cultivars (Table 3). Longest fruit length (15.55 cm) was noted in Durga, while the shortest found in JO-2 (12.28 cm). Variation in fruit length among different genotypes of Okra was also recorded [15,16,20,21]. The highest fruit diameter (1.67 cm) was in JO-4 and the lowest (1.20 cm) in Durga (Table 3). Significant variation regarding fruit diameter in different genotypes of Okra was also reported [17,20].

Table 3. Effect of cultivars on growth and yield attributes of Okra

Cultivars	No. of internodes plant^{-1}	Length of internode	Days to first flowering	No. of flowers plant^{-1}	No. of fruits plant^{-1}	Fruit setting (%)	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Yield (t/ha)
BARI dherosh-1	18.78a	5.633a	40.00c	58.67	32.87ab	56.20 b	13.77b	1.33d	18.99d	9.280c
Orka Onamika	16.78ab	4.60b	37.33d	44.43	28.87ab	66.70 a	13.52b	1.40d	19.24d	9.377bc
Bankim	17.11ab	4.867b	35.33d	57.8	41.13a	69.48 a	15.41a	1.37cd	22.42b	12.56a
Durga	13.44c	3.767c	43.67b	41.53	29.0ab	68.65 a	15.55a	1.20e	22.81b	9.470bc
JO-1	15.55bc	3.633c	37.33d	34.57	18.9bc	54.04 b	12.98bc	1.57b	24.41a	11.59a
JO-2	13.78c	3.433c	37.00d	28.67	14.1 c	48.74 b	12.28c	1.60ab	20.97c	10.34b
JO-3	14.67bc	3.300c	53.67a	37.00	18.43 bc	49.17 b	15.14a	1.43c	22.68b	11.78a
JO-4	15.55bc	2.733d	43.33b	51.2	28.87 ab	56.07 b	13.08bc	1.67a	22.75a	9.857bc
CV (%)	10.29	7.61	3.04%	27.74	31.47	8.93	4.43	3.33	2.42	5.27

Cultivar(s) bearing similar letter are statistically similar at 5% level of probability according to DMRT

3.2.6 Individual fruit weight (cm)

Single fruit weight was statistically significant and ranged from 18.99 to 24.40 g (Table 3). The highest fruit weight (24.40 g) was recorded in the cultivar JO-1 and the lowest fruit weight (18.99 g) was found in BARI Dherosh-1. Fruit weight was statistically similar in case of cultivars Durga, Bankim, JO-4 and JO-3 (22.81, 22.75, 22.68 and 22.41 g respectively) and JO-2 showed medium weight (20.97 g). This variation in individual fruit weight may be due to the genetic potentiality of Okra cultivars. This result is in agreement with the findings of some researchers who reported variation in individual fruit weight of Okra [16,17].

3.2.7 Yield (t ha^{-1})

The yield is the result of complex interaction of the parameter like no. of fruit, fruit setting (%) and individual fruit weight. The highest yield (12.56 t ha^{-1}) was obtained from cultivar Bankim because both the no. of fruit (41.13) and fruit setting (69.48%) were maximum which was statistically similar to JO-3 & JO-1 (11.78 & 11.59 t ha^{-1} respectively) and the lowest (9.28 t ha^{-1}) was recorded in BARI Dherosh-1 (Table 3). Some literature showed variation in fruit yield ha^{-1} of land from 2.76 to 19.24 tones among 121 genotypes [17] and from 4.72 to 10.08 tones among cultivars [16].

4. CONCLUSION

The present study revealed that a wide range of variability exists among the collected cultivars in respect of morphological and yield contributing characters. These investigations suggest that the cultivar Bankim was very promising for better yield in acidic soil conditions of Sylhet. Bankim was found early among the cultivars and as it's per day yield was also higher. It could be used in increasing the cropping intensity specially in Sylhet region. Small sized or 2-3 days old fruits of the cultivars could be used as salads due to their softness. In future breeding programme of Okra could be performed based on these variabilities to develop a high yielding variety of good quality in the country.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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