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Effect of Genotypes and De-Topping on Growth and Yield of Okra

Masuma Zahan Akhi[1], Md. Shahidul Islam[1*], Biswojit Debnath[1], Jannatul Ferdousi[1], Dwipok Deb Nath[1]

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ABSTRACT

A field experiment was conducted at the experimental field of the Department of Horticulture in Sylhet Agricultural University to evaluate the growth and yield performance of three okra genotypes (viz. BARI Dherosh-1, BARI Dherosh-2 & RAJ F1) under special management practices (viz. de-topping & non de-topping) from March to July 2022. The two factor experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. BARI Dherosh-1 showed vigorous growth nature having maximum yield and yield contributing characters viz. the highest plant height (20.46 cm) at 30 DAS (Days After Sowing) and at 1st harvest (108.23 cm), early flowering (51.33 days), the maximum number of leaves per plant (4.71), number of branches (2.96), number of pods per plant (43.80), the highest individual pod weight (20.96 g), pod yield per plant (916.75 g) as well as per hectare yield (30.53 t) than the other two genotypes. Contrary, the lowest individual pod weight (18.80 g), pod yield per plant (638.72 g), and per hectare yield (21.28 t) were produced by genotype RAJ F1. Due to removing apical parts at 30 DAS, the shortest plants were observed in the de-topping system (85.69 cm). Again, Individual pod weight (20.87 g), pod yield per plant (887.95 g), and per hectare yield (29.57 t) were higher in non de-topping system than the de-topping system. Considering the interaction effect, BARI Dherosh-2 performed better under non de-topping system having the highest pod breadth (2.05 cm) and pod yield per plant (1007.86 g) and per hectare yield (33.56 t). Actually, de-topping at 30 DAS had no beneficial effect on yield or yield contributing characters. So, BARI Dherosh-2 might be recommended for the Sylhet region to ensure maximum benefit without de-topping.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench), a member of Malvaceae family, popularly known as "lady's finger" or "Dherosh' or 'Bhendi' is an important green fruit vegetable in the world (Rashid, 1999; Ashraf *et al.*, 2020). It is considered to be originated in Tropical Africa and native to North Eastern Africa especially Ethiopia and Sudan but now extensively cultivated throughout the tropical, subtropical, and warmer parts of the temperate regions (Oyelade *et al.*, 2003; Shahid *et al.*, 2013; Maurya *et al.*, 2013). Though, okra is a perennial herbaceous vegetable, but it is mostly cultivated as an annual crop for delicious, tasty and gelatinous tender green pods which can be consumed in fresh, cooked, dried, or in processed form (Ali *et al.*, 2021). Okra is considered as a diet food than staple due to having digestible fiber, fat-free contents, low calories, vitamins A, C and B complex, protein, calcium, potassium, phosphorus, iron etc. (National Research Council, 2006; Saha *et al.*, 2016). It is also a rich source of mucilage which acts as blood volume expander and remove toxins from the liver (Gemede *et al.*, 2015).

In Bangladesh, vegetables are abundant in winter season. Contrary, summer is the scarce season for vegetables production and supply due to low productivity, adverse climatic condition like high temperature, humidity, rainfall, flood, cyclones, severe disease and pest infestation etc. (Hazra, 2008; Chanda *et al.*, 2020). Due to shortage of vegetable supply, the price remains high which contributed to the malnutrition of poor people during this season. As okra is a major summer vegetable and contain different health promoting substance, cultivation of okra may be an option to increase the supply and reduce nutritional deficiency. Among the summer vegetables, okra occupied only 5.04% of cultivable lands and produced around 928 metric tons from 473 acres of land (BBS, 2021). As it has the multidimensional impacts on human diet, it is compulsory to enhance the production of okra through selecting suitable genotypes and proper management practices (Saha *et al.*, 2016).

Choosing an appropriate genotype in any vegetable crop is important to meet minimal criteria for many traits that are potentially valued in the markets (Priyanka *et al.*, 2018). Superiority for morphological traits, yield and yield attributes of a genotype is the basis of successful crop production as well as economic sustainability (Reddy *et al.*, 2014). In Bangladesh, a lot of okra genotypes are available in the market. So, farmers can choose any one from these genotypes without knowing the quality but only trust the traders. Sometimes due to selecting inferior genotypes they face the production and yield challenges (Ashraf *et al.*, 2020).

That's why it is essential to identify high yielding genotypes to maximize okra yield. Again, Yield and yield attributes of any crop is influenced by proper management practices. De-topping is a part of management practices which arrests the apical growth and boosts the lateral branches as well as can improve the yield contributing

[1] Department of Horticulture, Sylhet Agricultural University, Sylhet, Bangladesh
[*] Crresponding author's e-mail: shahidulhrt@gmail.com

characteristics of okra (Firoz *et al.*, 2010). This technique has been proven to offer advantages to increase yield in many crops viz. eggplant (Buczkowska, 2010), jute (Das *et al.*, 2014), pepper (Adenle-Saheed *et al.*, 2016), cotton (Aydin and Arslan, 2018), and tomato (Ayarna *et al.*, 2019). Sylhet is one of the special Agro Ecological Zones in Bangladesh due to its acidic soil with pH ranges from 4.5 to 6.5. Generally, plants grown in acidic soil differs in growth habit than normal soil (Saha *et al.*, 2016).

In Sylhet District, total production of okra is only about 267.13 metric tons from 248 acre of land (BBS, 2021). This is not enough to meet up the present demand. Considering this facts the present investigation was undertaken to evaluate the performance of okra genotypes based on yield and yield attributes under special management practices like de-topping and non de-topping system for selecting suitable one(s) for this region.

METHODS

The experiment was conducted at the experimental field of the Department of Horticulture in Sylhet Agricultural University (SAU), Sylhet, from March to July, 2022. The experimental site was located on the north-east corner of the Bangladesh lying between $23^0$57' to $25^0$13' and $90^0$56'to $92^0$21' North latitude and East longitude, respectively. Basically, this falls under the Eastern Surma-Kusiyara Flood Plain (Agro-ecological Zone-20) (UNDP and FAO, 1988). Soil of this region is clay loam type with acidic in nature and pH is around 4.83 (Saha *et al.*, 2016). Frequent heavy rainfall and high temperature during Kharif season with high sunshine intensity and cloudy weather are the common scenario of this region. There were three genotypes viz. BARI Dherosh-1, BARI Dherosh-2 and RAJ F1 and two management practices viz. de-topping and non de-topping. The two factor field experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications.

There were total 12 experimental plots and unit plot size was 3.2 m × 1.0 m. 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. Before sowing seeds were soaked in water for overnight. 2-3 seeds were placed in each pit for germination. Around seven days after germination excess seedlings were removed only allowing the healthy one in each pit. Cowdung, urea, TSP, MoP were applied to the plots @ 3 t, 150 kg, 100 kg and 150 kg ha-1, respectively (BARC, 2005).

Total amount of cowdung, TSP, MoP and one third of urea were applied as basal doses during the final land preparation. Remaining urea was applied in two installments as top dressing at 25 DAS and 40 DAS. De-topping was done at 30 DAS with clean and sharp knife. Only apical portion of the main shoot was removed. Weeding and mulching were done to keep the plots free from weeds and to conserve the soil moisture as and when necessary. The plots were watered when necessary to keep the field moist for better growth and development. Data on growth and yield parameters such as plant height, days to first flowering, days to first harvest, total number of fruits per plant, fruit size (cm), individual fruit weight (g), yield per plant (g) and per hectare yield (t) were collected. The data were subjected to analysis of variance (ANOVA) using the MSTAT-C software and the means were separated according to Duncan's Multiple Range Test (DMRT).

RESULTS

Effect of genotypes on growth, yield and yield attributes of okra

Growth, yield and yield contributing attributes were significantly influenced by the okra genotypes (Table 1). At 30 DAS the tallest plant (20.46 cm) and the maximum number of leaves per plant (4.71) were produced by BARI Dherosh-1. Contrary, the shortest plant (18.88 cm) and minimum number of leaves per plant (4.18) were produced by the genotype RAJ F1. Again, at 1st harvest the tallest plants were identified in the genotype BARI Dherosh-1 (108.23 cm) followed by BARI Dherosh-2 (92.05 cm) and RAJ F1 (74.86 cm) genotypes. These results revealed that BARI Dherosh-1 was more vigorous in nature than the two genotypes.

Early flowering was noticed in the genotype BARI Dherosh-1(51.33 days), which was statistically similar with the genotype BARI Dherosh-2 (52.50 days) and late flowering was noticed in RAJ F1 (55.50 days) genotype. Days to 1st harvest of BARI Dherosh-2 (59.33) was significantly lower than the genotypes RAJ F1 (63.50) but par with the genotype BARI Dherosh-1 (59.83). During 1st harvesting BARI Dherosh-1 had the maximum number of branches (2.96) then BARI Dherosh-2 (2.46) and RAJ F1 (2.46). Again, BARI Dherosh-1 produced maximum number of pods per plant (43.80) than the reaming two genotypes. The highest pod length (16.80 cm) was found in BARI Dherosh-1 which was similar with BARI Dherosh-2 (16.64 cm).

On the other hand the highest pod breadth was found in BARI Dherosh-2 (2.02 cm), which was par with BARI Dherosh-1 (1.97 cm) and the lowest pod length and breadth were identified in RAJ F1 (14.70 cm and 1.88 cm respectively). In case of yield parameters, the highest individual pod weight, pod yield per plant and the maximum per hectare yield were produced by BARI Dherosh-1 (20.96 g, 916.75 g and 30.53 t, respectively) followed by BARI Dherosh-2 (19.95 g, 785.09g and 26.15 t, respectively). Contrary, the lowest individual pod weight, pod yield per plant and the minimum per hectare yield were produced by RAJ F1 (18.80 g, 638.72g and 21.28 t, respectively).

Here, significant variations among these genotypes for all the traits might be due to their different genetic makeup. All these findings indicated that vigorous growth of BARI Dherosh-1 might ensure the maximum yield and yield attributes than the remaining two genotypes. The reasons behind this might be its potential heredity as well as taking more benefits from the environmental factors by

proper utilizing the natural resources, absorbing water and nutrients from soil for ensuring maximum photosynthetic rate and metabolism. (Islam *et al.*, 2000) also observed the similar vigorous nature of BARI Dherosh-1 when working with three okra varieties under four sowing dates. Similar variation among different okra genotypes for yield and yield attributes were observed in previous studies of (Saha *et al.*, 2016) and (Rahman *et al.*, 2020).

Table 1: Effect of genotypes on growth, yield and yield attributes of okra

Geno types	Plant height at 30 DAS (cm)	No. of leaves/ plant at 30 DAS	Plant height at 1st harvest (cm)	Days to flower	Days to harv est	No. of branc hes at last harvest	No of pods/ Plant	Pod length (cm)	Pod brea dth (cm)	Indivi dual pod weight (g)	Pod yield/ plant (g)	Yield (t/ha)
V1	20.46^{a}	4.71^{a}	108.23^{a}	51.33^{b}	51.33^{b}	2.96^{a}	43.80^{a}	16.80^{a}	1.97^{a}	20.96^{a}	916.75^{a}	30.53^{a}
V2	20.43^{a}	4.50^{ab}	92.05^{b}	52.50^{b}	59.33^{b}	2.46^{b}	38.76^{ab}	16.64^{a}	2.02^{a}	19.95^{ab}	785.09^{ab}	26.15^{ab}
V3	18.88^{b}	4.18^{b}	74.86^{c}	55.50^{a}	63.50^{a}	2.46^{b}	31.24^{b}	14.70^{b}	1.88^{b}	18.80^{ab}	638.72^{b}	21.28^{b}
F-test	*	*	**	*	*	*	*	**	*	*	*	*
CV	4.17	6.54	17.55	4.37	3.52	10.9	16.16	5.08	3.39	3.21	19.45	19.47

* indicates significant at 1% level of probability;
V1= BARI Dherosh-1, V2= BARI Dherosh-2, V3= RAJ F1.

Effect of de-topping system on growth, yield and yield attributes of okra

Effect of de-topping system on growth and yield parameters was presented in table 2. Significant variation was observed between the two crop management practices viz. de-topping and non de-topping system for most of the parameters except plant height at 30 DAS, number of leaves at 30 DAS, number of branches at last harvest as well as pod breadth. Actually, de-topping was done at 30 DAS, that's why there was no significant variation for plant height as well as number of leaves at 30 DAS among these two systems. Number of pods per plant in de-topping system was lower due to delay flowering. Plant height at 1st harvest in non de-topping system (97.73 cm) was significantly higher than those of all the de-topping system (85.69 cm).

The reason behind these might be due to removal of top part of shoot, plant growth accelerated horizontally rather than vertically and formed a bushy structure. Basically, this phenomenon is related to the apical dominance. At de-topping system, removal of top portion reduced the auxin content in the apical parts of the plants which retarded the increase of plant height. Considering reproductive growth parameters, early flowering (47.44 days) and early harvesting (56.11 days) were found in non de-topping system than these de-topping system (58.77 days and 65.66 days, respectively). This might be happened due to taking more time for vegetative growth after removal of apical portion in de-topping system. On the other hand, comparatively longer pods (16.61 cm) but shorter in diameter (1.93 cm) were harvested from the de-topping system than the non de-topping system (15.48 cm and 1.98 cm, respectively). Finally, Individual pod weight (20.87 g), pod yield per plant (887.95 g) and per hectare yield (29.57 t) was higher in non de-topping system than the de-topping system (18.97 g, 672.42 g and 22.40 t, respectively).

This might be due to delay flowering and fruiting, delay 1st harvesting as well as shorter harvesting period of okra under de-topping system. (Aikins *et al.,* 2017) observed the effect of removal of apical portion of okra at varied days after sowing and proved that de-topping after 21-28 DAS had no significant effect on the yield and yield contributing characters. (Ali *et al.* 2021) found that apical pinching at 3rd node stage was more effective than early or late pinching. (Firoz *et al.* 2010) also showed that de-topping at 3 leaf stage was more beneficial than 9 leaf stage. (Bagasol *et al.* 2019) and (Gopal *et al.* 2016) also noticed that topping beyond 20 Days After Emergence caused considerable economic lose.

Table 2: Effect of de-topping system on growth, yield and yield attributes of okra

De-topping system	Plant height at 30 DAS (cm)	No. of leaves/ plant at 30 DAS	Plant height at 1st harvest (cm)	Days to flo wer	Days to harv est	No. of branc hes at last harvest	No of pods/ Plant	Pod length (cm)	Pod brea dth (cm)	Indivi dual pod weight (g)	Pod yield/ plant (g)	Yield (t/ha)
T1	20.22	4.34	85.69	58.77	65.66	2.76	35.07	16.61	1.93	18.97	672.42	22.40
T2	19.63	4.58	97.73	47.44	56.11	2.49	40.79	15.48	1.98	20.87	887.95	29.57
F-test	NS	NS	**	**	**	NS	NS	*	NS	*	*	*
CV	4.17	6.54	17.55	4.37	3.52	10.90	16.16	5.08	3.39	3.21	19.45	19.47

NS indicates non-significant, * indicates significant at 5% level of probability, ** indicates significant at 1% level of probability; T1= De-topping, T2= Non de-topping.

Interaction Effect

Interaction effect between genotypes and de-topping system on growth, yield and yield attributes of okra was presented in Table 3. Most of the parameters were not significantly affected due to interaction effect between genotypes and de-topping system except plant height at 1st harvest and number of pods per plant. During 1st harvesting the tallest plants were found in BARI Dherosh-1 in case of non de-topping system (108.56 cm) than de-topping system (107.90). Contrary, the smallest plants were produced by RAJ F1 (65.53 cm) genotype when planted in de-topping system. Maximum number of pods per plant (48.35) was harvested from the genotype BARI Dherosh-2 when cultivated under non de-topping system which was statistically similar with the genotype BARI Dherosh-1 grown under both de-topping (45.66) and non de-topping system (41.94) system. On the other hand the lowest number of pods per plant (29.16) was harvested from BARI Dherosh-2 when grown under de-topping system. Non de-topping system result in almost similar or better performance from de-topping system in term of pods per plant might be due to the in appropriate time of de-topping. (Ali *et al.*, 2021) reported de-topping at 2nd and 3rd node stage significantly increased the pods number per plant compared to 1st node stage while working with four different genotypes. De-topping at proper time result in more lateral branches and vegetative growth, therefore higher photosynthetic efficiency which have beneficial effect on reproductive growth (Ali *et al.*, 2021; Aikins *et al.*, 2017).

Table 3: Interaction effect between genotypes and de-topping system on growth, yield and yield attributes of okra

Genotypes × De-topping system	Plant height at 28 DAS (cm)	No. of leaves/ plant at 28 DAS	Plant height at 1st harvest (cm)	Days to flower	Days to harvest	No. of branches at last harvest	No of pods/ Plant	Pod length (cm)	Pod breadth (cm)	Individual pod weight (g)	Pod yield/ plant (g)	Yield (t/ha)
V1T1	20.66	4.43	107.90^{a}	56.00	64.33	2.93	45.66^{a}	17.66	1.99	19.79	904.62	30.13
V1T2	20.26	5.00	108.56^{a}	46.66	55.33	2.98	41.94^{ab}	15.94	1.95	22.13	828.88	30.93
V2T1	20.86	4.50	83.66^{c}	57.00	64.00	2.62	29.16^{c}	17.56	1.99	19.04	562.32	18.73
V2T2	20.00	4.50	100.43^{b}	48.00	54.66	2.29	48.35^{a}	15.72	2.05	20.87	1007.86	33.56
V3T1	19.13	4.10	65.53^{d}	63.33	68.66	2.72	30.41^{c}	14.61	1.80	18.08	550.31	18.33
V3T2	18.63	4.26	84.20^{c}	47.66	58.33	2.20	32.08^{bc}	14.79	1.96	19.61	727.13	24.23
F-test	NS	NS	**	NS	NS	NS	*	NS	NS	NS	NS	NS
CV	4.17	6.54	17.55	4.37	3.52	10.90	16.16	5.08	3.39	3.21	19.45	19.47

NS indicates non-significant, * indicates significant at 5% level of probability, ** indicates significant at 1% level of probability. V1= BARI Dherosh-1, V2= BARI Dherosh-2, V3= RAJ F1 and T1= De-topping, T2= Non de-topping.

CONCLUSION

Based on the results of the present study it could be concluded that vigorous growth nature of BARI Dherosh-2 might ensure the maximum yield and yield attributes than BARI Dherosh-1 and RAJ F1. Again de-topping at 30 DAS could lead to economic loss than the non de-topping system due to decreased growth, yield and yield attributes. Therefore, BARI Dherosh-2 can be recommended to cultivate in Sylhet region under non de-topping system. In future, further research work can be taken under different time of de-topping with BARI Dherosh-2.

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