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Research Article

Evaluation of okra (*Abelmoschus esculentus* L. Moench) genotypes for important quantitative characters

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ABSTRACT
An experiment was carried out during *kharif* 2017 at Zonal Research Station, Chianki using sixteen promising genotypes of okra with three replications in randomized block design. Observations on ten important quantitative characters were recorded. Analyzed data revealed that all characters showed significant effect. The genotype Ajeet-121 gave significantly highest yield with the yield of 135.12 q/ha followed by NS-862 and Super green with the yield of 134.75 q/ha and 134.02 q/ha, respectively. Average fruit weight (15.33 g) and yield of fruits per plant (245.67 g/plant) were recorded significantly highest in the genotype Ajeet-121. On the basis of these observations, it may be concluded that the genotype Ajeet-121 was found most suitable okra genotype for *kharif* cultivation in the western plateau region (sub zone-V) of Jharkhand.
Keywords: *Okra, Genotype, Evaluation, Quantitative characters*

INTRODUCTION
Okra (*Abelmoschus esculentus* L. Moench) belongs to the family Malvaceae having a chromosome number 2n = 2x = 130. Nutritive value of okra varies in different cultivars, which depends on the agro–climatic conditions. It contains protein, carbohydrate, vitamin C and other nutritive components which play a vital role in human diet (Kahlon *et al.,* 2007). Besides this, tender green pods of okra are important sources of vitamins A, B_1, B_3, B_6 and K, folic acid, potassium, magnesium, calcium and trace elements such as copper, manganese, iron, zinc, nickel, and iodine (Lee *et al.,* 2000), which are often lacking in the diet of people in most developing countries. The tender green pods are highly nutritious vegetable, containing 86.1% moisture, 9.7% carbohydrate, 2.2% protein, 0.2% fat, 1.0% fiber and 0.8% ash etc. (Saifullah and Rabbani, 2009). The tender green pods are also popular in most tropical and sub-tropical region of the world due to their medicinal values as they contain very high levels of antioxidants compounds including β-carotene, xanthin, lutein etc. (Rahman *et al.,* 2012). Okra commonly known as "lady's finger" and Bhindi in India is primarily suitable for cultivation as a garden crop as well as on large commercial farms. Okra is a popular vegetable grown almost all states of the country for its tender green fruits, which are cooked and commonly consumed as boiled vegetables and used in several recipe in Indian cousin (Chattopadhyay *et al.,* 2011). The crop performs very well in hot weather, especially in the regions with warm nights (Ndunguru and Rajabu, 2004). It is heat and drought-tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture (Gundane *et al.,* 1995) but chilling temperature and frost and foggy weather can damage the crops; however, *kharif season* is the main growing season. In recent years, public sector and a number of private seed companies in India have been able to develop a good number of commercial cultivars, which are not suitable to all the regions of the country. They are varying in various characters from one region to another. Now today a large numbers of okra varieties/genotypes are available in the market which creates confusion among the farmers to select suitable one, all these are not adapted and suited to all the regions. No specific recommendations of variety all over the country in different agro-climatic zone. Farmers are facing problems in selecting genotypes for a particular area for commercial cultivation.

Considering the above mentioned facts, there is a need to compare some of the available genotypes to select high yielding, better adaptable genotypes for commercial cultivation. There is also lacking of suitable genotypes of okra for western plateau region of Jharkhand. Therefore, the present investigation was undertaken to identify superior and promising okra varieties/genotypes in respect to green fruit yield and other quantitative characters under western plateau condition of Jharkhand.

MATERIALS AND METHODS

An experiment was carried out at Zonal Research Station, Chianki of Birsa Agricultural University, Ranchi, Jharkhand, India during rainy season, 2017. This research station represents western plateau region of Jharkhand and geographically situated at an altitude of 222 meters above mean sea level. This region (sub-zone-V of Jharkhand) falls under sub-tropical climate with annual mean rainfall of 1179.3 mm and lies between 22.5° to 24.5° N latitude and 23.2° to 25.6° E longitude (Sah *et al.,* 2008). The experimental materials were comprised of sixteen promising genotypes/cultivars *viz.,* Ankur-41, Super green, NS-862, Ajeet-121, Tiger green, Pusa sawani, Local-1, BAU-1, BAU-2-2, BAU-2-3, BAU-2-4, BAU-3-3, BAU-3-4, BAU-4-1, BAU-5-1 and BAU-5-2. Field trial was laid out in randomized block design with three replications. Standard package of practices were followed to grow normal crops with the plot size 1.5 X 5.0 =7.5 m^2. Sowing was done in spacing of 50 cm X 25 cm with two seeds per hill on 20th July, 2017. After germination excess plants were thinned out to maintain one plant at desired distance. During data recording and observations, 5 plants were randomly selected from each plot and observations were recorded on ten important quantitative characters *viz.,* plant height (cm), number of primary branches per plant, stem diameter (cm), days to first flowering, fruit length (cm), fruit diameter (cm), number of fruits per plant, average fruit weight (g), green fruit yield per plant (g) and green fruit yield per hectare (q) were recorded. Mean data of all characters were subjected to suitable statistical analysis as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Statistically analyzed mean data of the experiment revealed that all characters under observation gave significant effect. Growth and flowering characters depicted in table 1 whereas, fruit characters and green fruit yield depicted in table 2. The plant height is usually a good index of plant vigour which may contribute towards higher productivity (Pandey *et al.,* 2017). The mean values of plant height of different genotypes showed significant variations, ranged from 109.67 cm (NS-862) to 162.33 cm (Local-1). The national check variety Pusa Sawani (151.67 cm), Tiger green (151.0 cm), BAU-2-2 (159.33 cm) and BAU-2-4 (154.67 cm) were statistically at par with the local check variety Local-1. Increase in plant height might be due to longer intermodal length in tall genotype (Local-1) and smaller in dwarf genotype (NS-862). Similar observations were also reported by other workers with significant variations among the plant height of okra genotypes (Saifullah *et al.,* 2009, Pandey *et al.,* 2017).

The mean values for number of primary branches per plant revealed significant differences among the genotypes with the range of 1.40 in BAU-1 to 2.60 in BAU-3-4. Five genotypes *viz.,* Ajeet-121 (2.37), Pusa Sawani (2.30), BAU-2-3 (2.27), BAU-3-3 (2.47) and BAU-5-2 (2.23) were found statistically similar to the genotype BAU-3-4 and all these genotypes were performing better in comparison to local checks i.e. Local-1(2.17). Rest of the variety was found intermediate range for this character. The highest number of primary branches per plant might be due to the genetic makeup of the genotype and environmental effect might be the cause of this variation. Which are prevailed during the crop growth period (Pandey *et al.,* 2017). Variation in number of primary branches in different genotypes of okra was also reported by Shivaramegowda *et al*. (2016) and Tiwari (2001).

Diameter of stem is also an important index of vigorous growth of the plants which leads to get higher productivity. The mean values of stem diameter revealed significant differences among the genotypes with the range of 1.43 cm in NS-862 to 2.40 cm in Super green. Six other genotypes *viz.,* Ajeet-121 (2.27 cm), BAU-2-2 (2.13 cm), BAU-2-3 (2.37 cm), BAU-3-4 (2.23 cm), BAU-5-1 (2.23 cm) and BAU-5-2 (2.20 cm) which were statistically similar to the superior genotype Super green and all these six genotypes were performing better as compared to both the checks Pusa Sawani (1.93 cm) and Local- 1 (1.80 cm). Rests of the entries were performing with in intermediate results. Variation in stem diameter of okra genotypes were also observed by other research workers at different places (Shivaramegowda *et al.,* 2016; Pandey *et al.,* 2017).

Days to flowering is an important characters of okra as earlier flowering resulted early picking of marketable green fruits which generally fetching higher prices in the market. The mean values of first flowering was observed as significant variations among the genotypes of okra for first flowering after date of sowing (DAS) with range of 40.0 DAS in Tiger green to 46.67 DAS in BAU-1. The genotypes Ajeet-121 (41.33 DAS) and BAU-3-3 (41.67 DAS) were observed as statistically similar to the earliest flowering genotype Ajeet-121 and these genotypes were found earliest even national checks (Pusa Sawani) and local checks (Local-1) which were comparatively flowering late with the mean values of 44.00 DAS and 43.67 DAS, respectively. Early flowering might be due to the better adaptability and

genetic performance of the genotypes (Pandey *et al.,* 2017). This result was inconsonance with the result of Mahapatra *et al*. (2007) and Binalfew and Alemu (2016).

Fruit characteristics of any vegetable crops are important parameters to select a variety/genotype for its wider acceptability among the farming community as fruit shape, size, colour, tenderness, firmness etc. are very much appealing to the consumers in the market. Okra is also a popular vegetable crop and its green tender fruits with long straight firm fruits like by the consumers. So, fruit length and diameter are considerable traits during the genotypic evaluation process. As far as fruit length is concern, mean values of tender fruit length revealed that significant variations among the genotypes with the range of 10.70 cm to 13.30 cm. Significantly highest fruit length was recorded in the genotypes NS-862 (13.30 cm) and BAU-5-2(13.30 cm) followed by Super green (12.30 cm), Pusa Sawani (12.70 cm), Local-1 (12.30 cm), BAU-1 (13.00 cm), BAU-2-2 (13.00 cm), and BAU-3-3 (12.70 cm) which were statistically at par. This result might be due to the genetic makeup as well as environmental influence on the genotypes as reported by earlier workers (Pandey *et al.,* 2017; Singh *et al.,* 2017). The mean values of fruit diameter at tender stage were also revealed significant differences among the genotypes with the range of 1.33 cm (BAU-5-2) to 1.63 cm (BAU-1). Most of the genotypes showed statistically similar to the better performing genotypes except, Super green (1.37 cm), Pusa sawani (1.43 cm) and BAU-5-2 (1.33 cm). This result was in accordance with the result of Mahapatra *et al.,* (2007) and Pandey *et al.,* (2017).

Average fruit weight and number of fruit per plant are an important yield attributing characters in okra. The data recorded on average fruit weight revealed that significant variations among the genotypes with the range of 13.00 cm (BAU-2-3 and BAU-3-4) to 15.33 cm (Ajeet-121 and Pusa sawani). Most of the genotypes were observed as statistically similar to the better performing genotypes except, BAU-1 (13.33 cm), BAU-2-3 (13.00 cm) and BAU-3-4 (13.00 cm), which were found significantly lower values. This result might be due to higher fruit length and diameter as well as their genetic response to the environmental conditions (Muhammad *et al.,* 2001). Several other workers also reported similar results (Singh and Jain, 2006; Sarkar and Chattopadhayay, 2004; Mehta *et al.,* 2006; Koundinya *et al.,* 2013).

As far as number of fruits per plant is concern, the mean values of the data revealed significant variation among the genotypes with the range of 12.00 fruits per plant in Local-1 to 18.67 fruits per plant in BAU-2-3. There was no significant difference between the best performing genotype BAU-2-3 (18.67 fruits/plant) and Super green (17.00 fruits/plant). Rest of the genotype was observed in intermediate range of number of fruits per plant. Variation in number of fruits per plant might be due to the greater plant height, more number of branches per plant may get more space for fruit development (Pandey *et al.,* 2017) and similar reports also quoted by Singh and Jain (2002).

The mean values of data recorded on green fruit yield per plant exhibited significant variations among the genotypes with the range of 168.33 g/plant (Local-1) to 245.67 g/plant (Ajeet-121). Most of the genotypes observed that statistically similar to the best performing genotype Ajeet-121 (245.67 g/plant) except, Local-1 (168.33 g/plant) and BAU-3-3 (195.33 g/plant). Variations among the genotypes for yield per plant might be due to the number of fruits/plant, average fruit weight, fruit length and diameter, seed content of the fruits and less incidence of yellow vein mosaic virus. These results are in accordance with the result of Pandey *et al*. (2017), Mahapatra *et al*. (2007) and Singh and Jain (2002).

Ultimate goal of any crop plants cultivation is to get higher yield per hectare. Similarly, in okra green tender fruit yield per hectare is also most ultimate target of any growers. The mean values of green fruit yield per hectare exhibited significant variations among the genotypes with the range of 92.58 q/ha (Local-1) to 135.12 q/ha (Ajeet-121). Most of the genotypes were found statistically similar with respect to the yield per hectare except, Local-1 (92.58 q/ha) and BAU 3-4 (107.43 q/ha). The genotype Ajeet-121 gave significantly highest yield with value of 135.12 q/ha followed by NS 862 (134.75 q/ha) and Super green (134.02 q/ha).

The superior performance of these genotypes for pod yield was due to their higher ranking for number of pods per plant, weight of pods per plant, number of branches per plant, pod length, plant height and less infection of yellow vein mosaic virus, which caused greater assimilation of photosynthates. The inherent yield potential of these genotypes was also responsible for higher production of pods (Pandey *et al.,* 2017). The genotypes received better adaptability to the environment and get the congenial conditions for the better growth and development of the plant as well as for flowering and fruiting. These findings were also in accordance with the (Tiwari, 2001; Singh and Jain, 2006) that have reported better adaptation of the genotypes with environment and also get the variation among the genotypes for different characters. These observations were also confirming the finding of (Muhammad *et al.,* 2001) who has reported that plant height and number of green pods had the direct effect on total fruit yield.

Table 1: Growth and flowering characters of okra genotypes during *kharif* 2017

Genotypes	Plant Height (cm)	No. of Primary Branches /plant	Stem Diameter (cm)	Days to First Flowering
Ankur-41	112.67	1.60	1.70	42.00
Super green	124.33	1.47	2.40	44.33
NS-862	109.67	2.20	1.43	45.67
Ajeet-121	126.67	2.37	2.27	41.33
Tiger green	151.00	1.53	1.77	40.00
Pusa Sawani (NC)	151.67	2.30	1.93	44.00
Local-1(LC)	162.33	2.17	1.80	43.67
BAU-1	127.67	1.40	2.00	46.67
BAU-2-2	159.33	1.53	2.13	44.67
BAU-2-3	120.33	2.27	2.37	46.67
BAU-2-4	154.67	1.67	1.47	43.67
BAU-3-3	137.33	2.47	1.72	41.67
BAU-3-4	143.33	2.60	2.23	44.00
BAU-4-1	128.00	1.60	1.67	43.00
BAU-5-1	148.33	1.87	2.23	46.33
BAU-5-2	129.00	2.23	2.20	43.33
CD (5%)	12.43	0.37	0.27	1.99
SE(d)	6.059	0.178	0.133	0.968
SE(m)	4.285	0.126	0.094	0,685
CV %	5.43	11.14	8.32	2.71

Table 2: Fruit characters and fruit yield of okra genotypes during *kharif* 2017

Genotypes	Fruit Length (cm)	Fruit Diameter (cm)	Average Weight of Fruits (g)	No of Fruits /Plant	Green Fruit Yield /Plant (g)	Green Fruit Yield /ha (q)
Ankur-41	11.3	1.47	15.00	15.33	229.67	126.32
Super green	12.3	1.37	14.33	17.00	243.67	134.02
NS-862	13.3	1.60	15.00	16.33	245.00	134.75
Ajeet-121	12.0	1.60	15.33	16.00	245.67	135.12
Tiger green	10.7	1.47	14.00	16.00	224.33	123.38
Pusa Sawani (NC)	12.7	1.43	15.33	15.00	230.33	126.68
Local-1 (LC)	12.3	1.47	14.00	12.00	168.33	92.58
BAU-1	13.0	1.63	13.33	16.00	213.00	117.15
BAU-2-2	13.0	1.53	14.33	16.67	238.67	131.27
BAU-2-3	10.7	1.57	13.00	18.67	243.00	133.65
BAU-2-4	10.7	1.47	14.00	15.67	219.67	120.82
BAU-3-3	12.7	1.50	15.00	15.67	235.33	129.43
BAU-3-4	11.0	1.50	13.00	15.00	195.33	107.43
BAU-4-1	11.7	1.47	14.67	15.00	220.00	121.00
BAU-5-1	10.7	1.60	15.00	15.67	234.67	129.07
BAU-5-2	13.3	1.33	14.00	15.00	210.33	115.68
CD (5%)	1.28	0.168	1.44	1.94	38.637	21.25
SE(d)	0.623	0.082	0.703	0.943	18.827	10.355
SE(m)	0.440	0.058	0.497	0.667	13.313	7.322
CV %	6.38	6.69	6.03	7.36	10.26	10.26

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