ASSESSMENT OF GROWTH, FLOWERING, YIELD AND QUALITY PARAMETERS OF DIFFERENT OKRA (*Abelmoschus esculentus* L.) GENOTYPES

Abstract

The present investigation was carried out at New Orchard, Main Agricultural Research Station, UAS, Raichur, during late *Kharif* 2021-22 using thirty-one genotypes and laid out in Randomized Block Design (RBD) with three replications. The result of the study revealed that, there was significant differences ($p < 0.05$) among the genotypes for all the traits studied. Genotype OPL-2127 recorded the highest plant height (130.69 cm), stem girth (20.45 mm), number of leaves per plant (27.29), leaf area index (3.62), number of nodes per plant (16.04), chlorophyll content (64.26 SPAD readings), fruit length (18.69 cm), number of fruits per plant (16.10), harvesting period (63.50 days), fruit yield per plant (293.53 g), fruit yield per hectare (16.4 t) and it is found to be superior over the other okra genotypes under the study. The highest fruit girth (41.36 mm) and ten fruits weight (230.10 g) was noted in the genotypes OPL-2108 and OPL-2125, respectively. The genotypes OPL-2102 and OPL-2119 recorded the minimum number of days for first flower appearance (34.50) and days to 50 per cent flowering (38.00), respectively which indicates the earliness of the genotypes. OPL-2023 recorded the highest shelf-life (5.50 days) and fibre content (16.09 %).

Key words: Okra genotypes, QUALITY PARAMETERS, FLOWERING, growth

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) also known as lady's finger and bhendi, is an important spring-summer and rainy season vegetable crop cultivated in tropical and sub-tropical parts of the world. It can also be cultivated throughout the year where winter is mild. India is the largest producer of okra in the world with an annual production of 6.87 million tonnes from an area of 550 thousand hectares in 2019-20 **(NHB-2019)**. Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam are the major okra growing states.

It is an annual herbaceous plant and belongs to the family Malvaceae under the order Malvales, having a chromosome number of 2n=130 and is considered to be an amphidiploid. Okra being an often cross-pollinated crop and being cultivated for its fruits and has multiple uses. Tender fruits are used as a vegetable and eaten boiled or in culinary preparations as sliced and fried pieces. Okra fruits are sliced and sun-dried or canned and dehydrated for off-season use. The ripe seeds are roasted, grinded and used as a substitute for coffee. Fruits contains protein (2.10 %), fat (0.2 %), carbohydrate (8.2 %), fibre (1.70 %), ash (0.8 %), vitamin C (30 mg/100g), calcium (84.00 mg/100g) and iron (1.20 mg/100g). Seeds contains 13 to 22 per cent edible oil and 20 to 24 per cent protein and used for refined edible oil **(Saifullah and Rabbani, 2009).** It is also an excellent source of iodine (2.33-6.33 µg/100 g).

There are many genotype(s)/cultivar(s) of okra having diverse characters in different parts of the country. The detailed morphological and genetical characters of okra genotypes are necessary to know. Evaluation of potentialities of the existing genotypes is essential because it depicts the genetic diversity of the base materials on which depends the promise for further improvement. Therefore, the present investigation was carried out to evaluate the okra genotypes for growth, yield and quality parameters.

1. MATERIAL AND METHODS

The present investigation was carried out at New Orchard, Department of Horticulture, Main Agricultural Research Station, University of Agricultural Sciences, Raichur during late *Kharif* (2021-22) and the laboratory studies were carried out in the laboratory of Department of Agriculture Biochemistry, College of Agriculture, Raichur. The experimental material comprised of 31 okra genotypes (including check variety Arka Anamika) collected from ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi and ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru. These genotypes were evaluated by raising each entry in a plot of 3.6 m length and 2.4 m width, at a spacing of 60 cm × 45 cm in a Randomized Block Design (RBD) with three replications. Recommended agronomic practices and need based plant protection measures were adopted as per the package of practices, UHS, Bagalkot **(Anon., 2013)**.

The observations were recorded on five randomly selected plants per plot in each replication for seventeen different growth (at 105 DAS), flowering, yield and quality characters *viz.*, plant height, stem girth, number of leaves per plant, leaf area index, number

of nodes per plant, chlorophyll content (SPAD readings), days to first flowering, days to 50 per cent flowering, fruit length, fruit girth, ten fruits weight, number of fruits per plant, harvesting period, fruit yield per plant, fruit yield per hectare, shelf-life and fibre content. Analysis for significant treatment effects, standard error of means (S.Em ±) and critical differences at 5 per cent level of significance was done with OPSTAT software. Comparison of genotypes was also performed statistically.

2. RESULTS AND DISCUSSION

Growth parameters

The comparison of okra genotypes for different growth parameters has been presented in Table 1. The results of the evaluation study revealed that plant height differed significantly among the genotypes. The highest plant height (130.69 cm) was observed in genotype OPL-2127, which was significantly higher than all other genotypes, followed by OPL-2121 (118.36 cm), OPL-2116 (95.64 cm) and OPL-2113 (93.69 cm). While minimum plant height (53.84 cm) was observed in genotype OPL-2103. The significant difference in plant height among the genotypes could be due to the genetic setup and inheritance of the character as well as differences in apical dominance, cell division and cell elongation. The obtained results are in accordance with earlier findings of **Saleem et al. (2018), Kelemage et al. (2019)** in okra.

Stem girth of okra genotypes varied significantly. The genotype OPL-2127 recorded significantly higher stem girth (20.45 mm), followed by genotypes OPL-2121 (18.46 mm), OPL-2113 (17.72 mm) and OPL-2116 (17.67 mm), whereas genotype OPL-2103 recorded the minimum stem girth (11.08 mm). In stem girth the significant difference among genotypes might be due to the influence of their genetic makeup regulating the endogenous hormone balance which controls the cell division, cell enlargement and cell differentiation resulting in differential branching which ultimately affects the stem girth. The results of present findings are in line with the observations of **Kumar et al. (2017), Singh et al. (2017) and Meena et al. (2021)** in okra.

The number of leaves per plant varied significantly among genotypes. The genotype OPL-2127 recorded the maximum number of leaves per plant (27.29) and it was at par with genotypes OPL-2122 (25.12) and OPL-2128 (25.06). Whereas, genotype OPL-2105 recorded the minimum number of leaves per plant (17.75). The variation in the number of leaves per

plant between the genotypes might be due to the expression of temporal and spatial enzymes of genes and also due to the production of endogenous plant hormones like cytokinins, which regulates the synthesis and transport of auxin to promote the emergence of leaf primordia. At later stages, cytokinins promote cell proliferation and increases the number of leaf cells in a short period. It could also be due to the variation in the genetic makeup of okra genotypes. These results are in close conformity with the earlier findings **of Saleem et al. (2018), Hasan et al. (2020), Meena et al. (2021) and Walling et al. (2021)** in okra.

Significant variation was observed for leaf area index among okra genotypes. Significantly highest leaf area index (3.62) was recorded in genotype OPL-2127. It was followed by genotypes OPL-2128 (2.65), OPL-2109 (2.63), OPL-2110 (2.60) and OPL-2115 (2.57). Whereas, genotype OPL-2101 recorded the lowest leaf area index (0.66). Genotype OPL-2127 recorded 43.61 per cent higher leaf area index as compared to check cultivar Arka Anamika. The variation observed in the leaf area index may be due to the higher number of leaves per plant and leaf area of a single leaf which might be influenced by the additive × additive or additive × dominance or dominance × dominance gene action. Similar findings were also reported by **Walling et al. (2021)** in okra crop.

The number of nodes per plant among genotypes varied significantly. The genotype OPL-2127 recorded significantly higher number of nodes per plant (16.04), followed by genotypes OPL-2121 (14.52), OPL-2116 (13.91) and OPL-2115 (13.09). The genotype OPL-2118 recorded the minimum number of nodes per plant (7.45). In okra number of nodes and internodes are equal to the number of leaf and all three have a common origin in the phytomer. The increase in number of nodes per plant leads to increase in number of leaves and fruits per plant and leaf area per plant implies higher active photosynthetic area leading to higher production of biomass and yield. These results are in accordance with the findings of **Morey et al. (2012), Kalemoge et al. (2019) and Mourya et al. (2019)** in okra.

The significantly higher SPAD value of 64.26 was recorded in genotype OPL-2127, which is at par with the genotypes. The minimum SPAD value of 41.32 was observed in genotype OPL-2126. The difference in leaf chlorophyll content (SPAD readings) of okra genotypes could be due to its specific genetic constitution regulating the nitrogen uptake and production of endogenous hormones like gibberellins and cytokines which helps to produce chloroplast, which contains chlorophyll pigment and act as site of photosynthesis **(Lakshmipathi et al., 2017)**. The findings of the present study with respect to chlorophyll

content are in agreement with the results of **Morey et al. (2012), Kalemoge et al. (2019) and Mourya et al. (2019)** in okra.

Flowering parameters

The flowering parameters data recorded are represented in Table 1. Days to first flowering differed significantly among different okra genotypes. It varied from 34.50 to 40.50 days. Genotype OPL-2102 recorded the minimum number of days (34.50) for first flowering, whereas genotype OPL-2122 recorded the maximum number of days (40.50) for first flowering. The number of days taken to first flower appearance in check cultivar Arka Anamika was 40.00 days. The variation in days to first flowering in different okra genotypes might be due to variation in the level of gibberellins in the plant. The higher level of gibberellins has been reported to promote early flowering in crop plants **(Vineeta et al., 2017)**. The variation for days to first flowering was also reported by **Osekita et al. (2008), Morey et al. (2012)** in okra.

Days to 50 per cent flowering differed significantly among different okra genotypes. It varied from 38.00 to 44.50 days. Genotype OPL-2119 recorded the minimum number of days (38.00) for 50 per cent flowering, whereas check cultivar Arka Anamika recorded a maximum number of days (44.50) for 50 per cent flowering. Variation in days to 50 per cent flowering might be due to the variation in genetic potential, phenological and growth parameters of the genotypes which might be influenced by the additive × additive or additive × dominance or dominance × dominance gene action. These findings are in close conformity with the results reported by **Osekita et al. (2008), Morey et al. (2012), Kumari et al. (2017)** in okra.

Yield parameters

The data recorded on yield parameters are presented in Table 2. Fruit length varied significantly among different okra genotypes. It ranged from 7.93 cm to 18.69 cm. Significantly highest fruit length (18.69 cm) was recorded in genotype OPL-2127, followed by genotypes OPL-2121 (16.92 cm), OPL-2116 (16.84 cm) and OPL-2115 (16.80 cm). The lowest fruit length (7.93 cm) was recorded in genotype OPL-2108. The fruit length recorded in check cultivar Arka Anamika was 16.00 cm. The variations in fruit length could be attributed due to the inherent transferable parental character in the genotypes of okra. Similar results were also reported by **Saleem et al. (2018), Kolemoge et al. (2019)** in okra.

Fruit girth differed significantly among different okra genotypes. It ranged from 15.21 mm to 41.36 mm. Significantly highest fruit girth (41.36 mm) was recorded in genotype OPL-2108, followed by genotypes OPL-2118 (21.54 mm), OPL-2122 (20.68 mm) and OPL-2126 (20.60 mm). The minimum fruit girth (15.21 mm) was recorded in genotype OPL-2116. Variation in fruit girth might be due to variation in the level of endogenous hormones like GA3 and NAA, which induces cell elongation and leads to more growth of okra fruits **(Vinita et al., 2017),** which are directly controlled by the genetic makeup and inherent character of genotypes. This result is in close conformity with the earlier findings of **Saleem et al. (2018), Kolemoge et al. (2019), Hasan et al. (2020), Meena et al. (2021), Thakur et al. (2021) and Walling et al. (2021)** in okra.

The number of fruits per plant differed significantly between the genotypes under the study. The genotype OPL-2127 recorded the maximum number of fruits per plant (16.10), which is at par with genotypes OPL-2113 (15.30), OPL-2121 (14.30) and Arka Anamika (14.30). Whereas, genotype OPL-2108 recorded the minimum number of fruits per plant (2.90). The observed variation in the number of fruits per plant amongst the okra genotypes might be due to their genetic makeup governing the number of internodes per plant and number and size of leaves due to varying sink-source relationships. The present findings are in accordance with **Singla et al. (2018), Kolemoge et al. (2019), Hasan et al. (2020), Meena et al. (2021), Thakur et al. (2021) and Walling et al. (2021)** in okra.

The ten fruits weight significantly ranged from 125.80 g (OPL-2125) to 230.10 g (OPL-2110). This variation in ten fruits weight in the present study might be due to variation in the fruit length and seed content, which is governed by the genetic makeup of plants. These findings are in close conformity with results reported by **Saleem et al. (2018), Kolemoge et al. (2019), Hasan et al. (2020), Meena et al. (2021), Thakur et al. (2021) and Walling et al. (2021)** in okra. Harvesting period varied significantly, genotype OPL-2127 recorded significantly maximum harvesting period (63.50 days), followed by genotypes OPL-2121 (56.00 days), Arka Anamika (55.50 days), OPL-2115 (54.00 days) and OPL-2116 (54.00 days). Whereas, genotype OPL-2128 recorded the minimum harvesting period (40.50 days).

The fruit yield per plant and fruit yield per hectare differed significantly among genotypes. Fruit yield was recorded significantly highest in OPL-2127 when compared to all other genotypes, followed by genotypes OPL-2121, Arka Anamika, OPL-2116 and OPL-2115. Genotype OPL-2127 produced 16.40 per cent higher fruit yield per hectare as

compared to check cultivar Arka Anamika. The lower fruit yield was recorded in genotype OPL-2108. The maximum fruit yield was observed in genotype OPL-2127 might be due to higher leaf area per plant which provide more active photosynthetic area leading to higher production photosynthates, highest fruit length (18.69 cm), more number of fruits per plant (16.10) and highest fruit yield per plant (293.53 g). This could also be due to the genetic makeup of the genotypes. These results of the present investigation are in agreement with the earlier findings of **Singla et al. (2018), Kolemoge et al. (2019), Hasan et al. (2020), Hayati et al. (2020) and Walling et al. (2021)** in okra.

Quality parameters

The quality parameters data recorded are represented in Table 2. The maximum days of shelf life was recorded in the genotype OPL-2123 (5.50 days). Whereas, genotypes OPL-2113, OPL-2115 and OPL-2118 recorded the least shelf-life (*i.e.*, 3.00 days). The shelf-life recorded in the check cultivar Arka Anamika was 4.50 days. Variation in shelf-life of fruits amongst the okra genotypes might be due to their genetic makeup, nitrogen levels, moisture content and fibre content in the fruits of different okra genotypes. This finding was in accordance with **Meena et al. (2007)** in okra. Fibre content was recorded highest in genotype OPL-2123 (16.09 %), which is at par with genotypes OPL-2114 (14.03 %), OPL-2125 (13.97 %) and OPL-2124 (13.94 %). The lowest fibre content (6.75 %) was recorded in genotype OPL-2115. The fibre content recorded in check cultivar Arka Anamika was 9.81 per cent. Variation in fibre content of fruit amongst okra genotypes might be due to their genetic makeup and inheritance character. Similar findings reported by **Morey et al. (2012), Rambabu et al. (2019) and Walling et al. (2021)** in okra.

CONCLUSION

The present investigation on okra genotypes concluded that, wide range of variation was observed by among the genotypes for all the characters studied. Genotype OPL-2127 recorded significantly highest number of fruits per plant, fruit yield per plant, fruit yield per plot, fruit yield per hectare and it is found to be superior over all other okra genotypes under study. The genotypes OPL-2127, OPL-2121, OPL-2116, OPL-2115 and OPL-2113 were considered as superior okra genotypes for yield and quality and they can be used in future breeding and crop improvement program.

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Table 1: *Per se* performance for growth and flowering parameters of different okra genotypes

Genotypes	Plant height (cm)	Stem girth (mm)	Number of leaves per plant	Leaf area index	Number of nodes per plant	Chlorophyll content (SPAD readings)	Days to first flowering	Days to 50 per cent flowering
OPL-2101	71.17	13.29	20.34	0.66	10.14	54.29	36.50	39.50
OPL-2102	65.16	13.40	20.60	1.79	10.75	53.89	34.50	38.50
OPL-2103	53.84	11.08	18.58	1.59	8.86	57.98	36.50	39.00
OPL-2104	61.99	13.10	20.47	1.38	9.44	52.06	36.00	39.00
OPL-2105	58.78	14.09	17.75	2.49	9.44	58.13	36.00	39.00
OPL-2106	55.82	15.99	20.83	2.50	9.32	59.77	36.00	40.50
OPL-2107	56.04	13.64	20.49	2.51	10.38	55.82	36.50	42.00
OPL-2108	65.31	14.96	19.37	2.18	8.80	53.95	36.00	39.50
OPL-2109	76.87	14.02	23.09	2.63	9.81	56.49	37.00	41.50
OPL-2110	69.13	15.43	23.57	2.60	10.03	57.69	36.00	39.00
OPL-2111	60.58	14.00	24.53	2.01	10.12	54.44	36.50	40.00
OPL-2112	63.33	14.46	22.32	2.12	10.74	59.07	36.00	39.00
OPL-2113	93.69	17.72	22.69	1.97	12.04	57.95	37.00	42.00
OPL-2114	73.80	16.31	23.59	2.51	11.59	58.32	36.50	38.50
OPL-2115	88.97	17.32	24.54	2.57	13.09	60.88	36.00	39.00
OPL-2116	95.64	17.67	21.76	2.43	13.91	57.33	36.00	39.50
OPL-2117	63.08	13.72	23.03	1.83	9.33	57.94	36.50	39.50
OPL-2118	54.55	13.02	22.61	2.26	7.45	60.48	36.50	39.50
OPL-2119	62.56	14.42	22.90	1.98	10.27	59.00	36.00	38.00
OPL-2120	63.04	16.19	23.17	1.93	10.04	57.47	36.00	40.00
OPL-2121	118.36	18.46	23.75	2.29	14.52	57.97	36.00	38.50
OPL-2122	60.52	14.88	25.12	2.24	8.97	55.37	40.50	42.50
OPL-2123	82.22	16.89	23.94	1.49	11.45	57.71	39.00	43.00
OPL-2124	82.08	16.80	21.74	2.09	12.51	57.51	39.00	42.00
OPL-2125	66.24	14.65	22.96	1.70	9.98	44.70	38.00	41.50
OPL-2126	61.54	15.61	23.50	2.50	10.39	41.32	40.00	41.50
OPL-2127	130.69	20.45	27.29	3.62	16.04	64.26	36.00	38.50
OPL-2128	57.26	15.14	25.06	2.65	9.08	47.90	39.00	44.00
OPL-2129	56.87	13.16	21.04	1.77	9.57	47.10	39.00	43.00
OPL-2130	55.28	14.66	22.58	1.70	9.67	45.58	37.00	43.00
Arka Anamika	117.71	16.37	21.86	2.52	14.05	58.37	40.00	44.50

Mean	**72.93**	**15.19**	**22.42**	**2.13**	**10.80**	**55.51**	**37.02**	**40.31**
S.Em. ±	**3.78**	**0.65**	**0.84**	**0.10**	**0.46**	**2.76**	**0.57**	**1.17**
CD @ 5%	**10.92**	**1.87**	**2.42**	**0.28**	**1.32**	**7.97**	**1.66**	**3.38**

Table 2: *Per se* performance for yield and quality parameters of different okra genotypes

Genotypes	Fruit length (cm)	Fruit girth (mm)	Ten fruits weight (g)	Number of fruits per plant	Harvesting period (days)	Fruit yield per plant (g)	Fruit yield per hectare (t)	Shelf life (days)	Fibre content (%)
OPL-2101	12.47	19.57	149.15	8.10	49.00	118.95	6.67	4.50	12.86
OPL-2102	14.75	18.54	153.25	6.10	47.00	95.17	5.33	3.50	8.94
OPL-2103	13.53	17.27	149.85	4.90	45.00	73.57	4.11	3.50	7.98
OPL-2104	13.95	19.35	138.95	4.80	45.00	67.92	3.82	3.50	10.06
OPL-2105	14.03	18.67	162.40	4.20	45.00	70.26	3.95	4.00	9.72
OPL-2106	14.17	19.85	180.35	3.50	43.50	63.96	3.59	4.50	12.49
OPL-2107	11.07	18.33	146.90	4.50	42.00	66.85	3.77	5.00	13.74
OPL-2108	7.93	41.36	157.20	2.90	44.50	47.81	2.69	4.50	13.32
OPL-2109	16.10	18.12	151.35	8.60	51.00	133.16	7.46	4.50	12.32
OPL-2110	14.01	18.73	125.80	8.00	47.50	102.89	5.77	4.00	11.68
OPL-2111	13.10	17.58	130.95	5.90	44.00	76.87	4.32	4.00	8.82
OPL-2112	14.65	17.99	130.85	8.10	50.00	105.63	5.92	3.50	8.22
OPL-2113	16.17	18.41	138.60	15.30	52.00	210.14	11.78	3.00	8.08
OPL-2114	14.03	20.05	143.65	9.00	50.00	124.18	6.98	5.00	14.03
OPL-2115	16.80	18.45	167.05	13.30	54.00	220.3	12.39	3.00	6.75
OPL-2116	16.84	15.21	180.80	12.60	54.00	228.7	12.83	4.50	12.85
OPL-2117	13.49	15.53	143.40	6.50	44.50	91.27	5.10	4.50	13.49
OPL-2118	12.29	21.54	177.55	4.00	44.50	67.07	3.76	3.00	7.79
OPL-2119	13.68	16.53	164.65	5.70	46.00	92.77	5.13	3.50	13.16
OPL-2120	13.58	15.90	178.85	5.00	44.00	89.43	4.89	4.00	12.89
OPL-2121	16.92	15.81	186.15	14.30	56.00	263.71	14.81	5.00	12.13
OPL-2122	13.50	20.68	200.20	3.40	41.50	64.21	3.61	5.00	10.71
OPL-2123	16.01	19.79	209.30	8.30	51.00	165.44	9.30	5.50	16.09
OPL-2124	13.53	20.46	200.95	8.90	52.50	175.3	9.85	5.00	13.94
OPL-2125	15.36	16.76	230.10	4.60	48.50	108.82	6.11	4.50	13.97
OPL-2126	15.13	20.60	185.35	4.90	42.50	91.59	5.14	4.50	11.77
OPL-2127	18.69	18.10	181.85	16.10	63.50	293.53	16.46	5.00	12.61
OPL-2128	11.95	18.48	198.45	3.90	40.00	74.91	4.18	4.50	12.38
OPL-2129	13.61	18.34	203.30	3.20	41.00	65.35	3.66	5.00	13.36
OPL-2130	13.66	19.50	183.05	3.80	41.00	71.22	3.99	3.50	9.03
Arka Anamika	16.00	16.21	177.50	14.30	55.50	251.81	14.14	4.50	9.81

Mean	**14.23**	**19.09**	**168.64**	**7.31**	**47.60**	**121.7**	**6.82**	**4.24**	**11.45**
S.Em. ±	**0.51**	**0.74**	**12.48**	**0.64**	**2.42**	**10.17**	**0.59**	**0.42**	**0.77**
CD @ 5%	**1.46**	**2.14**	**36.04**	**1.85**	**7.00**	**29.38**	**1.69**	**1.21**	**2.21**

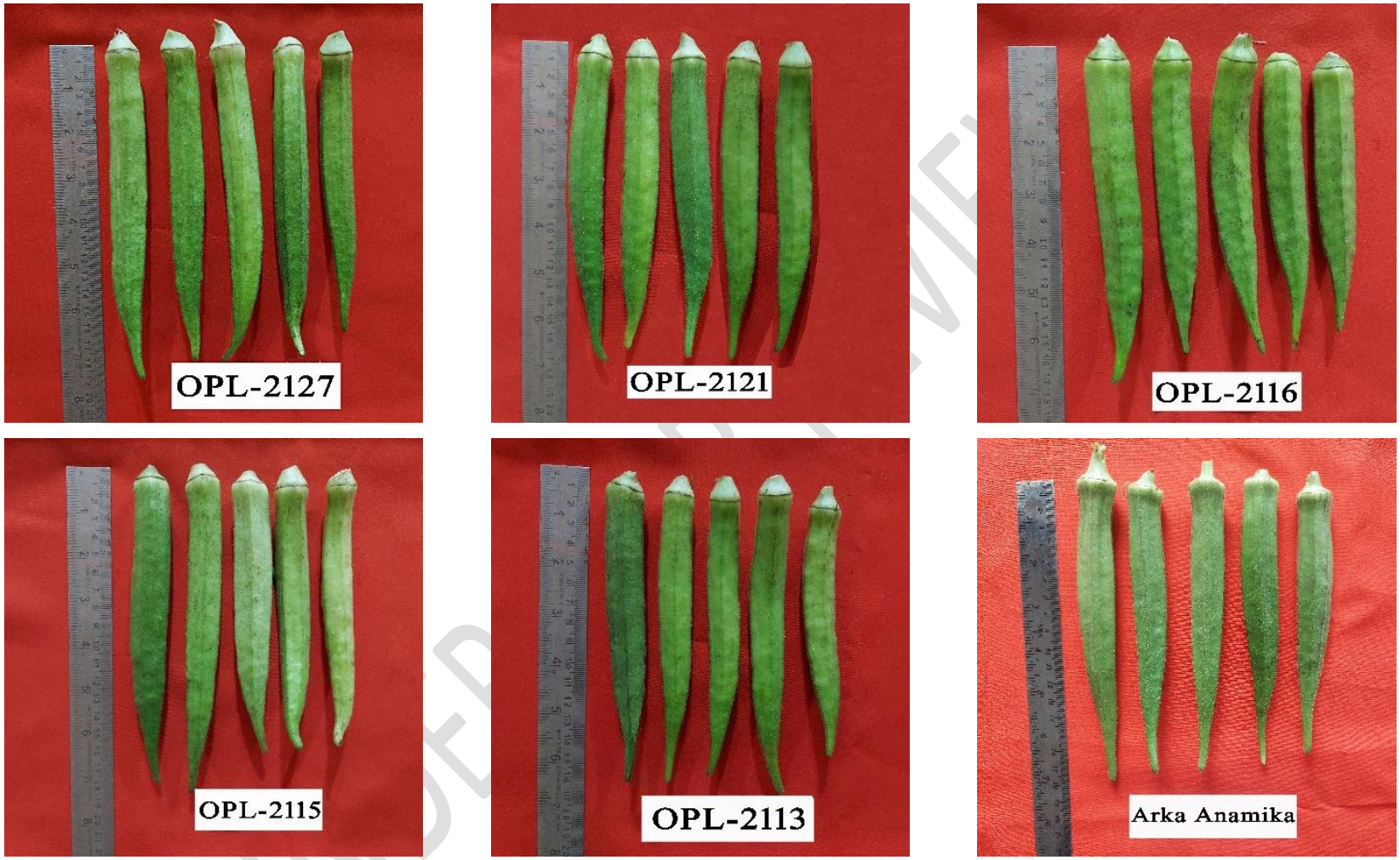

Plate 1. Top five superior genotypes with check cultivar (Arka Anamika)