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Evaluation of growth, yield and quality attributes of different okra genotypes under Nagaland condition

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Abstract
Field experiments on "Evaluation of growth, yield and quality attributes of 28 okra genotypes" were conducted during 2013 and 2014 at the Experimental Farm, Department of Horticulture, School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland University to evaluate the performance of various genotypes of okra under foothill condition of Nagaland. Twenty eight genotypes of okra were evaluated in RBD design with three replications. Results revealed that all the genotypes exhibited significant variation in their performance in terms of growth, yield and quality attributes. Among the genotypes, IIVRO-SKY/DR/RS-66 recorded maximum plant height (176.23 cm) and IIVRO-SKY/DR/RS-107 recorded maximum number of branches plant^{-1} (2.45). Maximum number of leaves (44.06), size of leaf (680.17 cm^2), cumulative leaf area (3.00 m^2) and leaf area index (22.25) were recorded in genotype IIVRO-608-8-1 while genotype IIVRO-770 exhibited least number of days to first flowering (42.52 days), number of nodes for first flower (4.95), number of days for fruit setting (43.55 days) and maturity period (50.95 days). Genotype IIVRO-770 also exhibited maximum duration of flowering (62.48 days) and number of ridges fruit^{-1} (7.13) whereas genotype IC-117319 recorded earliest period from fruit set to harvest (5.35 days). The findings also indicate that genotype IIVRO-608-8-1 recorded maximum result in yield attributes such as number of fruits (18.42), weight of fruits (25.95 g), number of seeds fruit^{-1} (54.09), yield plant^{-1} (477.66 g), and pod yield hectare^{-1} (17.39 t). For quality attributes, it was observed that maximum protein content (4.89%) was observed in genotype IC-218844, maximum vitamin-C (22.30 mg 100g^{-1} of fruit) in Arka Anamika. Genotype IIVRO-599-8-1 was found to be highly resistant to blister beetle infestation whereas genotype IIVRO-307-10-1 II showed high resistance to yellow vein mosaic virus.

Keywords: Okra, growth, yield and quality

Introduction
Okra (*Abelmoschus esculentus* L. Moench) is a member of the family Malvaceae. It is grown as a summer and rainy season crop in India (Kanaujia *et al.*, 2020) [10]. The optimum temperatures are in the range of 20-30°C. Okra plays an important role in the human diet by supplying fats, proteins, carbohydrates, minerals and vitamins. India ranks first in okra production which contributes 67% of the total world production (IHD, 2017) [8]. In Nagaland, the total area under okra is 210 ha with a production of 1670 t with a productivity of 7.95 t/ha (IHD, 2017) [8]. Several reasons for low productivity include use of local unimproved cultivars, less adoption of existing commercial varieties/hybrids, and heavy incidence of biotic stresses particularly yellow vein mosaic disease.

Okra occupies a prominent position among vegetables due to its wide adaptability, year round cultivation and export potential. However, the crop has no proper imprint in the production scenario in the North Eastern region of India in general and Nagaland in particular. Nagaland, like any other North Eastern states is bestowed with the agro-climatic conditions which are suitable for cultivation of all types of vegetable grown in the region. Lack of proper knowledge about the cultivars best suited to the agro-climatic condition, the potential of okra as fresh vegetable is not fully exploited and is still insufficient even to meet the domestic needs of the people. Hence, there is a logistic need for evaluation of commercial and newly developed varieties under hill conditions to increase the productivity of the crop so that the growers can get remunerative price from such potential vegetable crop.

Before the recommendation of any okra cultivar to be grown in the region, it is pertinent to evaluate the available okra cultivars giving emphasis on the aspects of genotypic suitability and yield. Varietal performance of okra varies from place to place due to the varied agro climatic and physiographic conditions and thus the growth and yield of a variety does not remain same for all the regions.

Considering the aforementioned facts, a pertinent need was felt to undertake an experiment on evaluation of okra cultivars and therefore the present investigation was undertaken with the objectives to study the growth, yield and quality attributes of okra genotypes and to study the incidence of pest and diseases on various okra genotypes under the foothill condition of Nagaland.

Materials and Methods

Field experiments on were conducted during 2013 and 2014 at the Experimental Farm, Department of Horticulture, School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland University to evaluate the performance of 28 genotypes of okra under foothill condition of Nagaland. The experimental site is located at an altitude of 310 meters above mean sea level with geographical location of 25˚45'43''N latitude and 93˚53'04''E longitude. The site of the experimental farm has sub-tropical climate, predominantly humid with moderate temperature and medium to heavy rainfall. Twenty eight genotypes of okra collected from IIVR, Varanasi *viz.*,IIVR0-7, IIVRO-608-8-1, IIVRO-SKY/DR/RS-107, IC-042484-B, IC-140880, IIVRO-212-10-1, IIVRO-599-8-1, IC-69257, IIVRO-770, IIVRO-SC-108, IIVRO-307-10-1 II, IIVRO-SKY/DR/RS-66, Kashi Kranti, IIVRO-3, IIVRO-419-01-1, IIVRO-325-10-1, IIVRO-130-10-1, IIVRO-1773, IIVRO-49, IIVRO-363, IC-218844, IC-45831,
IIVRO-137-10-1,2, IIVRO-814-K, IC-039140, IC-117319, Arka Anamika and Prabhani Kranti were used as treatments. The experiment was laid out in Randomized Block Design with 28 treatments (genotypes) and 3 replications. The plot size was 1.8 m × 1.8 m with spacing of 45cm × 30cm accommodating 24 plants per plot. Urea, SSP and MOP were used as the source of fertilizers @ 80:40:40 kg NPK per hectare uniformly on all the experimental plots. The quantitative characters recorded for growth, yield and quality attributes were worked out by the method of analysis of variance using Randomized Block Design (Panse and Sukhatme, 1989) [14]. Quality attributes such as protein content, vitamin C content, crude fibre content and dry matter content of the samples were determined by using the method as given by A.O.A.C. (1984) [1]. Observations on occurrence of blister beetle infestation and Yellow Vein Mosaic disease were made in the respective plots at forthnightly interval during the entire cropping period and the percentage of incidence was worked out for each genotype.

Results and Discussion

Growth attributes

The data obtained on growth attributes revealed significant differences under all the genotypes (Table 1). Plant height obtained from genotypes at 105 DAS ranged from 97.47 to 176.23 cm. Genotype IIVRO-SKY/DR/RS-66 recorded maximum plant height of 176.23 cm
followed by Arka Anamika which recorded a height of 167.60 cm. These genotypes were categorized as fast growers as compared to genotype IC-140880 which exhibited the minimum height. The wide variation among various genotypes in respect of plant height may be due to the fact that the growth of the plants are determined by the genetic make-up of the different genotypes, since all the genotypes were grown under the same climatic condition. This was supported by Biswas *et al.* (2016) [5] who reported that differential growth of crops is normally attributed to their genetic make-up. The attainment of the highest number of leaves (44.06) by genotype IIVRO-608-8-1 and least number of leaves (41.57) by genotype IC-140880 may be due to the genetic make-up of the genotype which influences the performance of a crop. These findings are in conformity with the findings of Biswas *et al.* (2016) [5] who found significant varietal differences for the number of leaves per plant in okra. The attainment of the maximum size of leaves (680.17 cm^2) by genotype IIVRO-608-8-1 and minimum size of leaves (218.40 cm^2) by genotype IC-140880 may be due to the genetic make-up of the genotype which influences the performance of a crop. These results agreed with the findings of Alam and Hossain (2008) [2]. The attainment of the maximum cumulative leaf area (3.00 m^2) by genotype IIVRO-608-8-1 and minimum cumulative leaf area (2.50 m^2) by genotype IC-140880 may be due to the genetic make-up of the genotype which influences the performance of a crop. Singh *et al.* (2006) [20] reported reported that maximum variability among the okra genotypes exist for cumulative leaf area. The attainment of the maximum leaf area index (22.25) by genotype IIVRO-608-8-1 and minimum leaf area index (18.54) by genotype IC-140880 may be due to the genetic make-up of the genotype which influences the performance of a crop. Patro and Ravisankar (2004) [15] reported that maximum variability among the okra genotypes exist for leaf area index. Number of branches per plant was greatly influenced by different genotypes. Highest number of branches per plant (2.45) was recorded from the genotype IIVRO-SKY/DR/RS-107 and the lowest number of branches per plant (0.74) was recorded from the genotype IC-45831. The character like number of branches per plant depends on the genetic make-up of the genotype. Pandey *et al.* (2017) [13] also revealed significant differences among genotypes with a range of 1.38 to 2.30 and reported that the differences may be the result of variation in its genetic makeup and environmental conditions prevailing during the growth period. It was noted that number of days taken to first flowering ranged from 42.52 days (IIVRO-770) to 53.68 days (IC-039140). These results are in accordance to the findings of Salau and Makinde (2015) [19] who reported that the difference in the number of days to flowering might be due to genetic variation among the cultivars. The number of nodes for first flower ranged from 4.95 to 7.30. This is in conformity with Pandey *et al.* (2017) [13] who reported that early flowering may be due to the better adaptability and genetic performance of the genotypes. The number of days taken for fruit setting ranged from 43.55 days (IIVRO-770) to 54.68 days (IC-039140). The minimum days taken by the genotype IC-039140 may be due to early flowering exhibited by it that led to early fruit setting. The number of days taken for fruit setting ranged from 50.95 days (IIVRO-770) to 64.75 days (IC-45831). The minimum days taken by the genotype IIVRO-770 may be due to early flowering exhibited by it that led to early fruit setting and its maturity. These results are in conformity with the findings of Olczyk *et al.* (2002) [12] who observed that first harvest of hybrid varieties occurred approximately 54 days after germination. It was noted that the days taken from fruit set to harvesting ranged from 5.35 days (IC-117319) to 12.63 days (IC-45831). The number of ridges per fruit ranged from 5.03 to 7.13. Karri and Acharyya (2012) [11] reported that that number of ridges per pod ranged from 4.90 to 6.87. The wide variation among various genotypes in respect of number of ridges may be due to the genetic make-up of the genotype which influences the

performance of a crop. The results obtained by visual observation on the colour of fruits among the twenty eight genotypes showed that eight genotypes were dark green, twelve genotypes were green and seven genotypes were light green in colour while one genotype (IIVRO-814-K) showed reddish green fruit colour. These results are in conformity with the findings of Asare *et al.* (2016) [4] who demonstrated genetic variation of okra fruit colour in diverse genetic population.

Table 1: Growth attributes of 28 okra genotypes (Pooled data of 2 years)

Genotypes	Plant height (cm)	Number of leaves plant^{-1}	Size of leaf (cm)	Cumulative leaf area (m^2)	Leaf area index	Number of branches plant^{-1}	Days to first flowering (Days)	Number of nodes for first flower	Days to fruit setting (Days)	Days to marketable maturity (Days)	Days from fruit setting to harvesting (Days)	Number of ridges fruit^{-1}	Colour of fruit
IIVRO-7	158.46	32.74	311.17	1.02	7.55	2.24	47.18	5.50	48.20	54.63	6.43	5.07	Light Green
IIVRO-608-8-1	134.08	44.06	680.17	3.00	22.25	2.00	47.52	6.75	48.58	57.45	8.87	7.00	Dark Green
IIVRO-SKY/DR/RS-107	104.43	29.69	357.54	1.06	7.84	2.45	47.88	6.30	48.92	57.82	8.90	5.04	Green
IC-042484-B	146.36	16.08	309.95	0.50	3.67	0.90	46.90	5.30	47.92	54.13	6.22	5.08	Dark Green
IC-140880	97.47	13.01	218.40	0.29	2.12	2.01	46.22	6.65	47.32	59.23	11.92	5.12	Green
IIVRO-212-10-1	136.62	24.29	346.28	0.84	6.25	1.44	46.00	6.35	47.08	56.25	9.17	5.13	Dark Green
IIVRO-599-8-1	151.91	21.52	526.92	1.13	8.39	1.40	47.43	5.95	48.50	60.05	11.55	5.10	Green
IC-69257	132.39	13.71	250.28	0.35	2.58	1.29	48.40	6.35	49.47	57.92	8.45	5.07	Light Green
IIVRO-770	137.56	41.57	601.33	2.50	18.54	1.99	42.52	4.95	43.55	50.95	7.40	7.13	Green
IIVRO-SC-108	164.47	35.65	494.86	1.77	13.08	1.99	44.50	5.30	45.68	54.08	8.40	6.03	Light Green
IIVRO-307-10-1 II	141.91	17.60	333.88	0.59	4.37	1.25	47.77	6.00	48.70	57.80	9.10	5.13	Dark Green
IIVRO-SKY/DR/RS-66	176.23	22.23	468.07	1.03	7.65	1.82	46.93	6.50	48.10	53.62	5.52	5.07	Light Green
Kashi Kranti	113.41	21.00	332.10	0.70	5.17	2.00	53.58	7.30	54.38	61.30	6.92	5.10	Dark Green
IIVRO-3	153.54	23.33	277.65	0.65	4.80	1.82	46.23	6.90	47.20	53.57	6.37	5.11	Light Green
IIVRO-419-01-1	137.75	19.87	453.58	0.90	6.66	2.39	46.73	5.55	47.28	53.82	6.53	6.97	Green
IIVRO-325-10-1	140.09	16.39	411.32	0.67	4.99	1.24	45.12	6.22	46.03	52.50	6.47	5.08	Dark Green
IIVRO-130-10-1	141.83	23.20	300.37	0.70	5.18	1.79	48.58	6.55	49.02	58.73	9.72	5.08	Dark Green
IIVRO-1773	135.74	14.99	420.43	0.63	4.66	1.24	44.08	6.30	45.17	53.52	8.35	5.10	Light Green
IIVRO-49	153.61	14.14	251.49	0.36	2.63	1.64	47.45	6.35	48.32	57.37	9.05	5.03	Green
IIVRO-363	127.72	27.11	397.41	1.08	7.99	1.01	45.18	6.30	46.30	53.70	7.40	5.03	Light Green
IC-218844	152.88	28.92	313.63	0.91	6.74	1.41	48.47	4.95	49.43	58.90	9.47	5.17	Green
IC-45831	122.82	24.19	302.87	0.74	5.46	0.74	51.03	5.55	52.12	64.75	12.63	5.14	Green
IIVRO-137-10-1,2	117.51	22.58	404.88	0.92	6.81	2.15	48.43	6.65	48.70	57.47	8.77	5.13	Green
IIVRO-814-K	152.87	22.66	264.87	0.60	4.46	1.60	44.87	5.70	45.95	54.37	8.42	5.10	Reddish Green
IC-039140	117.72	19.69	399.95	0.79	5.82	0.80	53.68	6.70	54.68	63.22	8.53	7.10	Green
IC-117319	128.47	29.38	349.17	1.03	7.60	1.00	46.00	6.65	46.68	52.03	5.35	5.03	Green
Arka Anamika	167.60	36.20	539.63	1.96	14.50	1.74	48.83	6.50	49.95	56.58	6.63	5.11	Green
Prabhani Kranti	162.91	29.82	418.44	1.26	9.32	1.66	48.00	6.15	49.13	56.62	7.48	5.18	Dark Green
SEm±	3.76	0.96	13.17	0.06	0.44	0.09	1.14	0.18	1.13	1.20	0.59	0.05	-
CD at 5%	10.55	2.70	36.92	0.17	1.23	0.24	3.20	0.52	3.16	3.38	1.65	0.15	-

Table 2: Yield and quality attributes of okra genotypes (Pooled data for 2 years)

Genotypes	Length of fruit (cm)	Diameter of fruit (cm)	Number of fruits plant^{-1}	Weight of fruit (g)	Number of seeds fruit^{-1}	Yield plant^{-1} (g)	Pod yield ha^{-1} (t)	Protein content (%)	Vitamin C content (mg 100g^{-1} of fruit)	Fibre content (%)	Dry matter content (%)
IIVRO-7	12.36	1.68	13.01	17.90	35.15	227.19	9.47	2.73	22.09	13.06	15.11
IIVRO-608-8-1	14.73	2.06	18.42	25.95	54.09	477.66	19.90	3.81	14.95	11.42	14.50
IIVRO-SKY/DR/RS-107	10.71	1.77	11.12	15.07	47.53	172.08	7.17	4.24	20.55	11.22	14.00
IC-042484-B	13.60	1.81	12.10	17.83	35.18	212.70	8.87	3.68	19.78	10.28	14.29
IC-140880	10.08	1.71	8.17	11.96	31.79	97.19	4.05	3.27	17.51	11.93	14.74
IIVRO-212-10-1	11.78	1.64	9.57	15.00	43.16	143.78	5.99	3.45	16.52	10.44	13.61
IIVRO-599-8-1	12.38	1.78	11.92	19.82	52.32	238.45	9.94	3.55	15.92	11.25	13.39
IC-69257	12.01	1.90	6.15	16.20	38.77	98.78	4.11	2.99	14.28	13.00	14.93
IIVRO-770	14.56	2.06	18.24	24.91	41.39	448.23	18.67	4.33	14.42	12.79	13.82
IIVRO-SC-108	13.32	1.90	13.29	20.32	46.06	271.24	11.30	4.61	20.26	11.27	14.16
IIVRO-307-10-1 II	12.45	2.04	14.93	20.12	42.49	301.88	12.58	4.51	14.10	12.73	15.65
IIVRO-SKY/DR/RS-66	13.39	1.96	14.74	19.58	39.26	285.54	11.89	4.59	14.24	12.09	14.01
Kashi Kranti	14.82	1.97	12.34	20.61	40.18	252.85	10.53	3.16	15.64	10.09	13.91
IIVRO-3	13.79	1.96	11.60	19.53	47.20	224.33	8.84	3.64	17.12	10.25	13.23
IIVRO-419-01-1	12.58	1.95	9.55	21.55	51.89	206.76	8.62	4.04	20.23	8.57	14.52
IIVRO-325-	12.00	1.87	12.01	18.95	32.59	229.77	9.57	3.99	14.22	10.29	14.45

10-1											
IIVRO-130-10-1	11.68	1.95	9.00	19.86	30.95	178.81	7.45	3.13	17.48	13.39	13.25
IIVRO-1773	16.89	1.58	10.80	15.98	42.32	174.18	7.26	3.53	16.85	10.03	13.85
IIVRO-49	12.68	1.71	10.13	14.87	36.10	150.76	6.29	3.50	21.73	9.74	14.73
IIVRO-363	12.95	1.72	12.89	17.01	43.19	217.54	9.05	4.77	17.35	12.41	14.19
IC-218844	10.88	1.77	11.23	18.03	42.75	201.82	8.41	4.89	21.89	10.43	12.33
IC-45831	13.43	1.71	10.08	18.32	45.69	185.31	7.73	3.20	21.87	9.77	14.61
IIVRO-137-10-1,2	13.28	1.99	13.99	24.17	43.58	341.53	14.24	3.41	19.03	13.92	14.00
IIVRO-814-K	12.66	1.67	11.10	17.88	34.57	200.04	8.34	2.67	21.21	9.33	15.19
IC-039140	13.55	1.65	11.64	16.12	39.20	189.27	7.89	3.88	20.93	9.89	12.97
IC-117319	12.64	1.82	15.03	15.07	33.42	221.87	9.25	4.26	22.20	11.22	14.00
Arka Anamika	14.52	1.76	17.04	21.02	48.61	357.00	14.87	4.17	22.30	12.33	15.05
Prabhani Kranti	12.77	1.79	16.13	16.82	46.65	269.14	11.21	4.67	21.13	11.58	14.82
SEm±	0.53	0.05	0.88	1.16	2.71	21.77	0.47	0.03	0.34	0.25	0.26
CD at 5%	1.48	0.14	2.47	3.25	7.61	61.03	1.32	0.08	0.95	0.70	0.73

Yield attributes

The data obtained on yield attributes revealed significant differences under all the genotypes (Table 2). All the genotypes showed significant difference in fruit length. The longest fruit (16.89 cm) was recorded in genotype IIVRO-1773 followed by genotype Kashi Kranti having 14.82 cm while the shortest length of fruit (10.08 cm) was recorded from genotype IC-140880. These results are also supported by the previous findings of Rahman *et al.* (2012) [17]. The maximum diameter of fruit (2.06 cm) was found in genotype IIVRO-770 which was at par with genotype IIVRO-608-8-1. The minimum diameter of fruit (1.58 cm) was recorded in genotype IIVRO-1773. The differences in diameter of fruit might be due to differences in genetic make-up of the okra genotypes and their response to the prevailing environmental conditions. These results are also supported by the previous findings of Saha *et al.* (2016) who found significant variety effect for diameter of fruit indicating that the okra varieties evaluated are genetically diverse. The maximum number of fruits per plant (18.42) was recorded from genotype IIVRO-608-8-1. The minimum number of fruits per plant recorded was 6.15 from genotype IC-69257. It was observed that the number of fruits per plant is one of the most important yield attributing character of okra. Rahman *et al.* (2012) [17] also observed significant differences amongst okra cultivars for number of pods per plant and reported that this might be due to their genetic characteristics and adaptability of these cultivars to the environmental conditions of the area. The maximum weight of fruit recorded was 25.95 g from genotype IIVRO- 608-8-1 which was followed by genotype IIVR0-770 *i.e.* 24.91g. The minimum weight of fruit recorded was 11.96 g from genotype IC-140880. Previous workers who have also reported differences in the pod weight among different okra genotypes include Rahman *et al.* (2012) [17] and Saha *et al* (2016) [18] reported that changes in the environmental conditions influences the growth and performance of okra. Genotype IIVRO-608-8-1 recorded maximum number of seeds per fruit (54.09) followed by genotype IIVRO-419-01-1 (51.89). The minimum number of seeds per fruit was recorded from genotype IIVRO -130-10-1 *i.e.*30.95. These results are also supported by the previous finding of Amjad *et al.* (2001) [3] who also reported that different okra genotypes differ significantly for traits like number of seeds per pod. Genotype IIVRO-608-8-1 recorded maximum yield per plant (477.66 g) followed by genotype IIVRO-770 (448.23 g). The minimum yield per plant was found in genotype IVRO-IC-140880 (97.19 g). The data revealed that the number of fruits per plant has a direct effect on yield *i.e.* more number of fruits per plant higher the yield per plant. This finding was supported by Saha *et al.* (2016) [18] who reported that yield is the result of complex interaction of the parameters like number of fruits and individual fruit weight. Rahman *et al.* (2012) [17] also found significant differences among various okra cultivars and reported that the differences in weight of pods per plant might be due to the genetic makeup of the genotypes and their response to environmental conditions. The genotype IIVRO-608-8-1 recorded maximum pod yield per hectare (19.90 t) followed by genotype IIVRO-770 (18.67 t). The minimum pod yield per hectare (4.05 t) was found in genotype IVRO-IC-140880. As the data regarding pod yield per hectare was derived from pod yield per plant and number of plants in a hectare, therefore the data per hectare presented the same picture. These results are in conformity with the findings of Saha *et al.* (2016) [18] and Rahman *et al.* (2012) [17].

Table 3: Level of incidence of blister beetle (*Mylabris pustulata*) and yellow vein mosaic virus on various okra genotypes (Pooled data of 2 years)

Genotypes	Incidence of blister beetle		Incidence of yellow vein mosaic virus	
	Incidence (%)	Level of resistance	Incidence (%)	Level of resistance
IIVR0-7	22.21	Resistant	32.50	Moderately Resistant
IIVRO-608-8-1	21.75	Resistant	27.67	Moderately Resistant
IIVRO-SKY/DR/RS-107	34.55	Moderately Resistant	27.28	Moderately Resistant
IC-042484-B	8.21	Highly Resistant	25.65	Moderately Resistant
IC-140880	20.29	Resistant	43.85	Low Resistant
IIVRO-212-10-1	15.19	Resistant	65.25	Highly Susceptible
IIVRO-599-8-1	3.45	Highly Resistant	33.56	Moderately Resistant
IC-69257	10.61	Highly Resistant	35.28	Moderately Resistant
IIVRO-770	24.47	Moderately Resistant	4.10	Highly Resistant
IIVRO-SC-108	21.11	Resistant	15.77	Resistant
IIVRO-307-10-1 II	21.56	Resistant	2.44	Highly Resistant
IIVRO-SKY/DR/RS-66	24.51	Moderately Resistant	3.57	Highly Resistant

Kashi Kranti	15.25	Resistant	23.58	Resistant
IIVRO-3	16.64	Resistant	14.67	Resistant
IIVRO-419-01-1	26.44	Moderately Resistant	25.95	Moderately Resistant
IIVRO-325-10-1	26.88	Moderately Resistant	10.72	Highly Resistant
IIVRO-130-10-1	9.18	Highly Resistant	49.64	Susceptible
IIVRO-1773	16.05	Resistant	32.15	Moderately Resistant
IIVRO-49	12.54	Resistant	30.56	Moderately Resistant
IIVRO-363	18.47	Resistant	2.94	Highly Resistant
IC-218844	8.50	Highly Resistant	2.78	Highly Resistant
IC-45831	28.23	Moderately Resistant	39.38	Low Resistant
IIVRO-137-10-1,2	9.15	Highly Resistant	28.11	Moderately Resistant
IIVRO-814-K	14.40	Resistant	54.15	Susceptible
IC-039140	12.46	Resistant	23.96	Resistant
IC-117319	22.43	Resistant	34.25	Moderately Resistant
Arka Anamika	15.67	Resistant	27.50	Moderately Resistant
Prabhani Kranti	4.18	Highly Resistant	7.67	Highly Resistant
SE(M)±	2.59	–	3.29	–
CD at 5%	7.26	–	9.22	–

Note: 0 – 12% = Highly Resistant 12 – 24% = Resistant
24 – 36% = Moderately Resistant 36 – 48% = Low Resistant
48 – 60% = Susceptible 60 – 72% = Highly Susceptible

Quality characters

The data obtained on quality characters revealed significant differences under all the genotypes (Table 2). The genotype IC-218844 recorded maximum protein content (4.89%) followed by genotype IIVRO-363 (4.77%). The minimum protein content (2.67%) was found in genotype IIVRO-814-K. The variation in protein content among the genotypes is determined by the genetic make-up of the genotypes. These results are also supported by the previous findings of Petropous *et al.* (2018) [16] who reported that the differences in protein content of the okra genotypes could be partly associated with differences in moisture content of fruit as well as to differences in genetic potential between the studied genotypes. The genotype Arka Anamika recorded maximum vitamin C content (22.30%) followed by genotype IC-117319 (22.20%). The minimum vitamin C content (14.10%) was found in genotype IIVRO-307-10-1 II. The variation in vitamin C content among the genotypes is determined by the genetic make-up of the genotypes. From the experimental findings, it was observed that the genotype IIVRO-137-10-1, 2 recorded maximum fibre content (13.92%) while the minimum fibre content (8.57%) was found in genotype IIVRO-419-01-1. These findings are similar to Gemede *et al.* (2015) [7] who reported that the crude fiber content among the accessions of Okra pod varied from 11.97 g/100 g to 29.93 g/100 g. Dry matter content of okra was profoundly affected by the genotypes. The maximum dry matter content (15.65%) was recorded from the genotype IIVRO-307-10 II while the minimum dry matter content (12.33%) was exhibited by the genotype IC-218844. These results are in conformity with the findings of Duzyaman and Vural (2003) [6] who reported that dry matter accumulation remained in between 15.6 – 13.6 in the Indian genotypes.

Insect and disease incidence

The data obtained on insect and disease incidence revealed significant differences under all the genotypes (Table 3). Incidence of blister beetle on okra genotypes ranged between 3.45-34.55%. The maximum incidence of blister beetle (34.55%) was recorded from the genotype IIVRO-SKY/DR/RS-107 followed by IC-45831 while the minimum incidence of blister beetle (3.45%) was exhibited by the genotype IIVRO-599-8-1. Blister beetle has been reportedly observed attacking okra flowers and thus lowering the yield (Kakar and Dogra, 1988) [9]. Incidence of yellow vein mosaic virus on okra genotypes ranged between 2.44-65.25%. The maximum incidence of yellow vein mosaic virus (65.25%) was recorded from the genotype IIVRO-212-10-1 followed by IIVRO-814-K at 54.15% while the minimum incidence of yellow vein mosaic virus (2.44%) was exhibited by the genotype IIVRO-307-10-1 II. The data revealed that all the okra genotypes were infected by yellow vein mosaic virus although they varied in disease severity. Similarly, Asare-Bediako (2016) [4] revealed that all the okra genotypes tested in both the rainy and dry seasons were infected by OkMV although they varied in disease severity. The observed variation in disease severity could be due to different interaction effects between different genotypes and OkMV.

Conclusions

Among all the genotypes, two genotypes namely IIVRO-608-8-1 and IIVRO-770 were found better and superior for most of the growth characters. Genotype IIVRO-608-8-1 exhibited superiority over the other genotypes for its yield. The investigated genotypes were found to be good source of vitamin-C, protein and fibre and most of these genotypes can be adopted for okra production in the region for their superior quality. Genotype IIVRO-599-8-1 - highly resistant to blister beetle infestation whereas genotype IIVRO-307-10-1 II showed high resistance to yellow vein mosaic virus. Considering all the genetic variability studies carried out, it can be concluded that the genetic stocks of okra used in this investigation had wide range of variability. As such, there is enough scope for improvement of these characters by selection. Based on the mean performance of the twenty eight genotypes of okra, it can be concluded that genotype IIVRO-608-8-1, IIVRO-770 and Arka Anamika were among the best performing genotypes. Genotype IIVRO-608-8-1 performed better in most of the measured parameters. High yield potential exhibited by genotype IIVRO-608-8-1 confirmed that it is the best okra genotype under existing agro-climatic condition.

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