Performance of Brinjal (*Solanum melongena* L.) genotypes for Growth and Yield traits under mid hill conditions of Uttarakhand

Abstract

Brinjal (*Solanum melongena* L.), belongs to the family Solanaceae, with chromosome number 2n=2x=24 is an important vegetable crop of sub-tropics and tropics. The present investigation was carried out at the Vegetable Research and Demonstration Block, College of Horticulture, VCSG UUHF, Bharsar, during *Kharif*, 2017 to evaluate diverse germplasm of brinjal under mid hill conditions. The experiment was laid out in RCBD with three replications. In this study, twenty-seven genotypes *viz.*, DRNKV-02-104, IVBL-116-131, NBJ-19, JB-9, Aruna, JB-2, CH-1045, Swarna Shree, JB, DRNKV-104-43, RCMBL-04-04, IBH-2, Kavya, B. Dewariya, DBR-8, DMU-1, Azad Brinjal-2, Co-11, JB-67, KKM-1, BCB-464, PLR-1, JB-18, Bhagyamati, BB-58, Pusa Shyamala including one check cultivar Pant Samrat were evaluated for different horticultural traits. During the investigation, 18 growth, flowering, fruiting, yield and quality parameters were recorded. The result of variance revealed that the mean sum of square due to treatment were significant at 5% level for all the traits. The genotypes, Aruna, DRNKV-02-104, NBJ-19, JB-2, RCMBL-04-04, IVBL-116-131 and Kavya recorded higher fruit yield and also performed better for other horticultural traits than check cultivar. These genotypes need to undergo additional testing before being made available as a replacement for currently available brinjal varieties, or they can participate in additional breeding programmes to create improved varieties or hybrids of brinjal.

Keywords: Brinjal, Evaluation, Mean performance, Genotypes, Hill, Uttarakhand

1. INTRODUCTION

Eggplant or Aubergine (*Solanum melongena* L.) belongs to the family Solanaceae (Nightshades) with diploid chromosome number 2n=2x=24. It is originated in India. Brinjal is a good source of Vitamin A, B and C and also used in curing liver related troubles. For diabetic patient consumption of white brinjal is recommended. Bitter taste of brinjal is due to Solasodine which is a glycoalkaloid (Chaudhary 2015). Brinjal is a warm season crop hence it is vulnerable

to cold. The low night temperature in North India adversely affects the crop during December to February. It is grown year-round in practically all of India, with the exception of higher altitudes. In Himalayan hilly regions it is grown only during summer (May to September) due to prevailing low temperature in other months.

In India it is having a production of 12607 (‘000 MT) from an area of 765 (‘000 ha) with a productivity of 17.53 MT/ha. In Uttarakhand, production of brinjal is 32.12 (‘000 MT) from an area of 2.75 (‘000 Ha) with productivity of 11.68 MT/ha (First advance estimate by Department of agriculture and farmers welfare, Government of India (https://agricoop.nic.in/en/StatHortEst). This clearly indicates that the productivity of brinjal is very low in Uttarakhand state when compared to National values. This may be due to wide variations in the weather and varying night and day temperatures in hilly terrains, heavy rainfall during flowering and fruiting stage, hail storms, lack of high yielding varieties suited for specific agro climatic conditions, lack of varieties meeting the regional references and specific end use, unscientific method of cultivation by farmers, lack of knowledge in selecting suitable varieties, unavailability of quality seeds, pest and diseases, lack of extension services in remote areas of Uttarakhand are the major production constraints that results in low productivity. Considering the importance of the crop and keeping the above issues in mind this experiment was conducted to select elite genotypes which were better in terms of yield and other yield attributing characters in the mid hill conditions of Pauri Garhwal district, Uttarakhand, and the results obtained were further utilized in the crop improvement of brinjal or the better performing genotypes could be directly considered for the cultivation.

2. MATERIALS AND METHODS

2.1 Experimental site

The present investigation was conducted at the Vegetable Research and Demonstration Block, Department of Vegetable Science, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand during *kharif* season in 2017. The experimental site is situated between latitude 29^0 30.05^0 North and longitude 78.99^0 East at an altitude of 1900 m above mean sea level. It belongs to Uttarakhand's mid-hill zone (Bisht and Sharma, 2014). The experimental site's environment is characterised by a mild summer, more precipitation, and a colder or more intensely cold protracted winter. Along with

dew, hailstorms, fog, frost, snowfall, and other sporadic occurrences of precipitation, rain is the primary output of precipitation. While the North-East monsoon occasionally brings winter precipitation from November to February, the South-East monsoon starts around the end of June. throughout this area, snowfall occurs frequently throughout the winter. The valley experiences a hot climate during the summer months for only a few hours each day; nevertheless, nights are chilly and the valley's highest recorded temperature during May and June is between 30°C and 35°C. The coldest months are December and January, with lows between 1°C and -4°C. Relative humidity often reaches its peak during the rainy season (July to August), frequently being measured close to saturation point (92 to 97%), and then progressively declines until December. (Bisht and Sharma, 2014). The soil of research field is comprised of medium clay sandy loam with pH of 6 to 6.5.

2.2 Experimental design and plant material used

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The trial has total of 26 genotypes *viz.*, DRNKV-02-104, IVBL-116-131, NBJ-19, JB-9, Aruna, JB-2, CH-1045, Swarna Shree, JB, DRNKV-104-43, RCMBL-04-04, IBH-2, Kavya, B. Dewariya, DBR-8, DMU-1, Azad Brinjal-2, Co-11, JB-67, KKM-1, BCB-464, PLR-1, JB-18, Bhagyamati, BB-58, Pusa Shyamala and Pant Samrat (Check cultivar), in total 27 genotypes are used in the experiment. These genotypes were obtained from the germplasm of IIVR, Varanasi which was collected from the various parts of the country by the institute.

2.3 Management and cultural practices followed

The nursery was prepared inside the polyhouse. The raised bed of size 3 m × 1 m and 15 cm height was prepared. A well decomposed farmyard manure (FYM) about 15 kg and 500g of 10:20:20 NPK complex fertilizer were mixed thoroughly at the time of bed preparation. The seeds were sown on 20th April 2017. The field was prepared to fine tilth by giving 3 ploughings. The plots of size 1.8 m × 1.35 m were prepared at 20 cm apart as per the layout plan. Transplanting was done on 1st June 2017; forty days old seedlings were transplanted with a spacing of 60 cm × 45 cm in the evening hours. Total experimental area thus had a total of 81 plots with 9 numbers of plants in each plot among which 5 plants were taken for data collection, covering a total experimental area of 284.55 m^2 and a net experimental area of 196.83 m^2**.**

During the time of field preparation, well-decomposed farmyard manure (FYM) was added at a rate of 20 tonnes per hectare. Following to the recommendations, 100 N: 60 P2O5: 50 K2O kg NPK per hectare of urea, single super phosphate, and muriate of potash were used as inorganic fertilizers. Before transplanting, the soil received a full dose of phosphorus and potassium and a half-dose of nitrogen. 45 days after transplantation, the remaining half of the N dosage was administered. During dry periods irrigation was given twice a week or whenever necessary. Weed growth was more vigorous due to heavy rainfall, hence manual weeding was done at an interval of 15 to 20 days or whenever required. Picking of fruits was done, when the fruits attain suitable marketable size, still immature, tender having attractive and glossy appearance. The fruits were picked at least after a week of insecticidal spraying because of the residual effect.

2.4 Data Recording and analysis

The five plants were selected randomly using random number table and tagged for identification. The observations were recorded only from these five tagged plants in every plot for all the characters except days to 50% flowering and yield per plot. Then the value was worked out to compute average value for the character. The quality analysis (Ascorbic Acid content) was estimated as per procedure given by Ranganna (2015). Using MS-Excel and OPSTAT, the statistical analysis was performed for each observed character in the study.

3. RESULTS AND DISCUSSION

3.1 Analysis of variance

The analysis of variance (Table 1) of the experiment indicated that the mean sum of squares due to genotypes was highly significant for all characters studied *viz.*, plant height, number of primary branches per plant, stem girth, leaf area, days to fifty per cent flowering, number of clusters per plant, number of flowers per cluster, number of fruits per cluster, fruit setting percentage, number of fruits per plant, average fruit weight, length of the fruit, diameter of the fruit, yield per plant, yield per plot, shelf life, total soluble solids and ascorbic acid which revealed the existence of good deal of variability in the germplasm. Similar results were reported by the earlier workers like Kumar *et al.,* (2013), Nayak and Nagre (2013), Madhavi *et al.,* (2015) and Yadav *et al.,* (2016).

3.2 Mean performance of genotypes for different traits

3.2.1 Growth parameters

Taller plant is considered to be desirable because it leads to a greater number of branches and ultimately result in increased yield. Maximum plant height was recorded in RCMBL-04-04 (103.60 cm). Among all the genotypes under study, five genotypes gave higher plant height than check cultivar Pant Samrat (72.51 cm). Similar variations for plant height were also reported earlier by Kumar and Aruguman (2013), Nayak and Nagre (2013) Dhaka and Soni (2014), Mili *et al*., (2014), Solaimana *et al.,* (2015) and Madhavi *et al.,* (2015) for the trait under study. Number of branches per plant is considered to be desirable because it leads to a greater number of flowers and hence a greater number of fruits and ultimately results in increased productivity. Maximum numbers of branch per plant was recorded in Aruna (9.82) and it was found statistically at par with JB-18 (9.38). In overall, two genotypes were judged to be superior to the check cultivar. Pant Samrat (9.25). Similar results have also been reported earlier by Karak *et al*., (2012), Lokesh (2013), Rahman *et al*., (2014) and Madhavi *et al.*, (2015) for number of branches per plants in brinjal. Stem girth is also an important parameter in brinjal, as it helps in preventing the breakage of stems due to more weight of fruits and also prevents the plants from lodging. Maximum stem girth was observed in RCMBL-04-04 (2.40 cm) and it was found statistically at par with the genotype CO-11 (2.37 cm). Five genotypes were judged to be superior to the check cultivar Pant Samrat (1.88 cm). Naik (2006) and Madhavi *et al*., (2015) have also reported similar variation for this trait in brinjal. The large number of leaves might increase the photosynthetic activity and ultimately leads to higher plant yield. Maximum leaf area was recorded in RCMBL-04-04 (127.21 cm^2) followed by Bhagyamati (99.91 cm^2) and PLR-1 (97.21 cm^2). Eight genotypes exhibited more leaf area than the reference cultivar Pant Samrat (92.50 cm^2) out of all the genotypes under investigation. Kushwah and Bhandhyopadhya (2005) also found similar findings for brinjal leaf area (cm^2). The results were represented in Table 2.

Table 1: Analysis of variance (mean sum of squares) for fruit yield and its component characters in brinjal

Source of Variation	d.f.	Plant Height (cm)	Number of branches per plant	Stem girth (cm)	Leaf area (cm2)	Days to 50 % Flowering	Number of clusters per plant	Number of Flowers per Cluster	Number of Fruits per Cluster	Fruit Setting Percentage (%)
Replication	2	41.02	0.18	0.0015	15.44	31.37	0.21	0.01	0.01	13.37
Treatment	26	570.50**	4.83**	0.52**	290.04**	293.60**	23.63**	5.74**	1.30**	645.08**
Error	52	108.18	0.08	0.0028	57.39	49.15	0.08	0.01	0.0033	5.57

Source of Variation	d.f.	Number of Fruits per plant	Average fruit weight (g)	Length of Fruit (cm)	Diameter of Fruit (cm)	Yield per Plant (kg)	Yield per plot (kg)	Shelf life (Days)	Total soluble solids (˚Brix)	Ascorbic acid (mg/100g)
Replication	2	0.06	68.96	0.15	0.65	0.0005	0.48	0.92	0.09	0.45
Treatment	26	67.76**	6086.98**	22.33**	6.91**	0.79**	58.08**	51.99**	0.66**	13.14**
Error	52	0.19	16.23	2.37	0.62	0.0017	0.15	0.33	0.11	0.08

** **Significant at 1% level of significance**

3.2.3 Flowering parameters

One of the key determinants of how quickly the fruits reach the harvesting stage is earliness. Minimum days to 50% flowering were recorded in the genotype DRNKV-02-104 (44.00 days) followed by Bhagyamati (56.67 days), JB-67 (57.33 days) and DBR-8 (57.33 days). Four genotypes out of all the ones being studied were discovered earlier than the check cultivar Pant Samrat (60.33 days) for days to 50% flowering. The results were represented in Table 2. Similar outcomes had previously been reported by Muniappan *et al.,* (2010), Kumar and Anumugam (2013), Lokesh (2013), Mili *et al*., (2014) and Solaimana *et al.*, (2015) in brinjal. Number of clusters per plant is a major yield contributing character. Significantly higher number of clusters per plant were observed in the genotype DBR-8 (13.30) followed by CH-1045 (12.67) and Kavya (10.70). Seven genotypes out of the total under study were found to have more clusters per plant than the control cultivar Pant Samrat (7.83). Additionally, Madhavi *et al*. (2015) and Tripathy *et al.* (2017) reported earlier on substantial variations in the number of clusters per plant. Number of flowers per cluster is a major trait contributing towards yield. More number of flowers in a cluster leads to more fruits which ultimately results in high production. Significantly higher number of flowers per cluster was observed in the genotype NBJ-19 (6.70) followed by Kavya (5.53) and IVBL-116-131 (4.87). Six genotypes out of the total under study were found to have more blooms per cluster than the control cultivar Pant Samrat (3.58). Also previously documented were significant changes in the number of clusters per plant by Madhavi *et al.* (2015), Yadav *et al.* (2016), and Ravali *et al*. (2017).

3.2.4 Fruit parameters

Number of fruits per cluster is a major trait contributing yield. More number of flowers in a cluster leads to more fruits which ultimately results in high production. Significantly higher number of fruits per cluster was observed in the genotype NBJ-19 (3.87) followed by IVBL-116-131 (2.87) and Kavya (2.57). Amongst all the genotypes under study, three genotypes were found superior than check cultivar Pant Samrat (2.42) for number of fruits per cluster. Wide variations for number of clusters per plant were also reported earlier by Ravali *et al.,* (2017) and Tripathy *et al.,* (2017). Fruit setting percentage determines the number of fruits per cluster. Brinjal has heterostyly, high fruit setting percentage results in more of flowers to set into fruits hence resulting in high yield. High fruit setting percentage was observed in the genotype BB-58 (86.67 %) and it was statistically at par with Swarna Shree (83.33 %). Eight genotypes out of the

total research population were determined to be superior to the check cultivar Pant Samrat (70.03 %) for fruit setting percentage. Wide variations for fruit setting percentage were also reported earlier by Madhavi *et al.,* (2015). One of the main factors affecting output is the number of fruits per plant. This trait directly influences the yield of the plant. Significantly higher number of fruits per plant was observed in the genotype NBJ-19 (24.17) followed by IVBL-116-131 (20.27) and Kavya (18.43). Four genotypes were found to produce more fruits per plant than the check cultivar pant samrat (12.70) out of all those under evaluation. Dhaka and Soni (2014), Mili *et al.* (2014), Rahman *et al.* (2014), Madhavi *et al.* (2015), and Yadav *et al.* (2016) previously documented significant differences in the number of fruits per plant in brinjal. The results were represented in Table 3.

Fruit weight directly affects yield, and consumers are drawn to this quality. Maximum average fruit weight was recorded in Aruna (226.67 g) and it was found statistically at par with JB-2 (221.33 g). The results were represented in Table 3. Amongst all the genotypes under study, twenty genotypes were found superior over check cultivar (73.11 g) for average fruit weight. Significant variations in average fruit weight were also noted previously by Senapati *et al.* (2014), Rahman *et al*., (2014), Solaimana *et al.,* (2015), Madhavi *et al.,* (2015), Vidhya and Kumar (2015) and Tripathy *et al.,* (2017) in brinjal. Fruit length is a crucial factor that directly affects fruit weight and, in turn, the overall yield. Maximum fruit length was recorded IVBL-116-131 (20.43 cm) followed by DRNKV-02-104 (17.76 cm) and Pant Samrat (17.55 cm). Two genotypes viz, DRNKV-02-104 (17.76 cm) and IVBL-116-131 (20.43 cm) had higher fruit length than check cultivar Pant Samrat (17.55 cm). The results of present studies are in line with Ansari *et al.,* (2011), Madhvi *et al.,* (2015), Yadav *et al.,* (2016), Ravali *et al.,* (2017) and Tripathy *et al.,* (2017) for the trait under study. Fruit diameter directly impacted fruit weight, which in turn affected overall fruit yield. Maximum fruit breadth was observed in Aruna (9.62 cm) followed by RCMBL-04-04 (6.97 cm) and JB-2 (5.19 cm). All the genotypes were found superior than check cultivar Pant Samrat (2.46 cm) except three genotypes viz, IVBL-116-131 (2.04 cm), DRNKV-104-43 (2.30 cm) and Pusa Shyamala (2.29 cm). Madhavi *et al.,* (2015), Ravali *et al.,* (2017) and Pujer *et al.,* (2017) had also reported significant variations for fruit breadth in brinjal.

Table 2. Mean Performance of brinjal genotypes for different growth and flower characters

Sl No	Genotypes	Plant Height (cm)	No of primary branches per plant	Stem girth (cm)	Leaf area (cm2)	Days to 50 % Flowering	No of clusters per plant	No of Flowers per cluster
		Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)
1	DRNKV-02-104	82.33 ± 3.20	5.13* ± 0.11	1.42* ± 0.03	92.17 ± 4.55	44.00* ± 0.58	3.75* ± 0.08	2.23* ± 0.01
2	IVBL-116-131	79.60 ± 4.51	7.61* ± 0.17	1.33* ± 0.03	75.49* ± 3.92	66.33 ± 1.45	8.90* ± 0.02	4.87* ± 0.13
3	NBJ-19	55.39* ± 7.90	7.15* ± 0.14	1.16* ± 0.04	81.89 ± 2.84	70.00 ± 2.65	7.64 ± 0.20	6.70* ± 0.14
4	JB-9	52.90* ± 2.27	6.00* ± 0.17	1.05* ± 0.02	90.41 ± 4.68	86.33* ± 3.33	4.35* ± 0.10	2.70* ± 0.06
5	Aruna	90.31* ± 9.02	9.82* ± 0.22	2.09* ± 0.01	84.05 ± 1.32	78.33* ± 6.44	6.10* ± 0.13	1.43* ± 0.03
6	JB-2	65.83 ± 5.73	8.29* ± 0.02	1.24* ± 0.04	79.13* ± 3.20	61.33 ± 4.63	5.90* ± 0.12	1.85* ± 0.05
7	CH-1045	59.43 ± 1.54	7.50* ± 0.17	1.12* ± 0.03	83.29 ± 5.96	88.33* ± 2.33	12.67* ± 0.28	2.22* ± 0.01
8	Swarna Shree	57.70 ± 3.81	7.67* ± 0.17	1.09* ± 0.02	89.93 ± 5.25	71.33 ± 5.49	3.70* ± 0.01	1.50* ± 0.04
9	JB	73.93 ± 4.10	7.73* ± 0.16	1.21* ± 0.03	93.19 ± 2.23	73.00* ± 2.08	7.37* ± 0.19	1.67* ± 0.04
10	DRNKV-104-43	62.35 ± 6.02	5.82* ± 0.16	1.07* ± 0.02	92.59 ± 3.43	75.67* ± 2.60	4.43* ± 0.10	1.83* ± 0.04
11	RCMBL-04-04	103.60* ± 3.98	8.19* ± 0.18	2.40* ± 0.01	127.21* ± 5.24	64.00 ± 0.58	7.90 ± 0.17	2.40* ± 0.05
12	IBH-2	61.93 ± 2.20	7.62* ± 0.02	1.09* ± 0.03	87.48 ± 3.44	61.00 ± 2.65	9.87* ± 0.20	2.47* ± 0.07
13	Kavya	63.47 ± 3.49	7.25* ± 0.19	1.25* ± 0.03	85.71 ± 4.72	70.33 ± 2.96	10.70* ± 0.29	5.53* ± 0.12
14	B. Dewariya	60.85 ± 2.54	5.60* ± 0.11	2.07* ± 0.06	85.48 ± 5.22	77.67* ± 4.33	6.90* ± 0.18	2.00* ± 0.05
15	DBR-8	63.92 ± 5.00	9.13 ± 0.24	1.40* ± 0.03	93.67 ± 9.88	57.33 ± 4.67	13.30* ± 0.37	2.67* ± 0.06
16	DMU-1	46.25* ± 8.22	6.89* ± 0.19	2.06* ± 0.05	95.21 ± 2.51	85.00* ± 3.46	3.43* ± 0.08	2.00* ± 0.05
17	Azad Brinjal-2	57.10 ± 3.32	6.15* ± 0.16	1.69* ± 0.04	83.04 ± 6.31	62.00 ± 10.69	2.13* ± 0.06	1.60* ± 0.04
18	Co-11	70.42 ± 8.60	8.01* ± 0.17	2.37* ± 0.01	86.65 ± 5.35	67.33 ± 2.73	6.43* ± 0.14	1.82* ± 0.04
19	JB-67	54.10* ± 6.12	6.87* ± 0.14	1.59* ± 0.04	77.16* ± 2.63	57.33 ± 2.96	8.22 ± 0.21	3.93* ± 0.09
20	KKM-1	65.99 ± 7.97	7.44* ± 0.16	1.19* ± 0.03	95.08 ± 3.97	68.67 ± 2.60	6.93* ± 0.15	3.75 ± 0.01
21	BCB-464	43.41* ± 8.65	4.70* ± 0.10	1.19* ± 0.02	82.35 ± 4.61	67.67 ± 5.21	3.38* ± 0.01	1.47* ± 0.04
22	PLR-1	56.57 ± 8.80	6.72* ± 0.14	1.21* ± 0.03	97.21 ± 2.84	74.33* ± 4.91	6.35* ± 0.17	4.77* ± 0.10
23	JB-18	65.00 ± 9.46	9.38 ± 0.26	1.17* ± 0.03	84.00 ± 1.46	73.33* ± 5.78	5.97* ± 0.13	2.73* ± 0.06
24	Bhagyamati	55.12* ± 3.66	7.71* ± 0.17	1.46* ± 0.01	99.91 ± 5.31	56.67 ± 2.33	3.43* ± 0.08	1.63* ± 0.03
25	BB-58	42.28* ± 8.11	7.17* ± 0.02	1.05* ± 0.03	82.33 ± 1.13	71.00 ± 4.04	5.35* ± 0.11	1.67* ± 0.05
26	Pusa Shyamala	52.83* ± 4.37	6.47* ± 0.17	1.37* ± 0.03	86.45 ± 6.56	69.33 ± 3.28	4.85* ± 0.13	2.00* ± 0.05
27	Pant Samrat^{+}	72.51 ± 4.17	9.25 ± 0.20	1.88 ± 0.04	92.50 ± 4.89	60.33 ± 4.06	7.83 ± 0.17	3.58 ± 0.01
	Mean	**63.52**	**7.31**	**1.45**	89.02	68.81	6.58	2.70
	Range	**42.28 ~ 103.60**	**4.70 ~ 9.82**	**1.05 ~ 2.40**	75.49 ~127.21	44.00 ~88.33	2.13~13.30	1.43 ~ 6.70
	SE(d)	**8.49**	**0.22**	**0.04**	6.19	5.72	0.23	0.09
	C.D. $_{(0.05)}$	**17.09**	**0.45**	**0.09**	12.45	11.52	0.46	0.18
	C.V.	**16.37**	**3.76**	**3.67**	8.51	10.19	4.24	4.11

Table 3. Mean Performance of brinjal genotypes for different Fruit characters

Sl No	Genotypes	Number of Fruits per cluster	Fruit Setting Percentage (%)	Number of Fruits per plant	Average fruit weight (g)	Length of Fruit (cm)	Diameter of Fruit (cm)
		Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)
1	DRNKV-02-104	1.33* ± 0.04	58.92* ± 1.29	10.67* ± 0.23	177.41* ± 3.59	17.76 ± 0.39	3.68 ± 0.49
2	IVBL-116-131	2.87* ± 0.06	57.70* ± 1.26	20.27* ± 0.41	52.00* ± 1.44	20.43* ± 1.04	2.04 ± 0.24
3	NBJ-19	3.87* ± 0.08	59.29* ± 1.20	24.17* ± 0.67	84.14* ± 1.85	13.53* ± 0.73	2.96 ± 0.19
4	JB-9	1.65* ± 0.04	62.09* ± 1.72	10.90* ± 0.24	89.12* ± 0.26	11.33* ± 0.99	4.67* ± 0.36
5	Aruna	1.00* ± 0.03	75.64* ± 1.66	4.97* ± 0.02	226.67* ± 5.89	12.45* ± 1.80	9.62* ± 1.63
6	JB-2	1.23* ± 0.03	67.09 ± 0.19	9.53* ± 0.25	221.33* ± 4.86	14.43* ± 1.36	5.19* ± 0.29
7	CH-1045	1.30* ± 0.04	58.33* ± 1.28	10.40* ± 0.23	64.90* ± 1.31	12.30* ± 1.15	4.11* ± 0.36
8	Swarna Shree	1.17* ± 0.03	83.33* ± 1.83	7.20* ± 0.14	65.82* ± 1.82	10.20* ± 0.32	3.67 ± 0.26
9	JB	1.07* ± 0.02	80.00* ± 1.62	7.83* ± 0.22	107.73* ± 2.36	11.96* ± 0.70	4.97* ± 0.62
10	DRNKV-104-43	1.40* ± 0.03	76.11* ± 2.11	9.33* ± 0.21	53.41* ± 0.15	15.13 ± 1.08	2.30 ± 0.18
11	RCMBL-04-04	1.07* ± 0.03	45.96* ± 1.01	6.07* ± 0.02	146.53* ± 3.81	14.25* ± 0.42	6.97* ± 0.83
12	IBH-2	1.40* ± 0.03	56.11* ± 0.16	8.23* ± 0.21	80.55* ± 1.77	11.93* ± 0.87	4.95* ± 0.11
13	Kavya	2.57* ± 0.01	46.44* ± 1.21	18.43* ± 0.40	78.72 ± 1.73	9.87* ± 0.56	4.29* ± 0.13
14	B. Dewariya	1.30* ± 0.03	66.48 ± 1.35	6.30* ± 0.17	93.28* ± 2.04	10.64* ± 0.94	5.07* ± 0.35
15	DBR-8	1.40* ± 0.01	56.11* ± 1.46	14.83* ± 0.33	109.31* ± 2.40	10.45* ± 0.74	4.65* ± 0.24
16	DMU-1	1.33* ± 0.03	66.43 ± 1.84	6.53* ± 0.14	64.68* ± 0.19	9.71* ± 0.88	3.72 ± 0.17
17	Azad Brinjal-2	1.03* ± 0.00	68.64 ± 1.78	7.10* ± 0.16	80.87* ± 1.78	9.52* ± 1.01	4.29* ± 0.40
18	Co-11	1.22* ± 0.04	68.26 ± 1.50	11.57* ± 0.03	95.22* ± 2.47	13.27* ± 0.49	3.43 ± 0.22
19	JB-67	1.50* ± 0.04	37.64* ± 0.76	6.60* ± 0.19	87.31* ± 1.92	11.20* ± 0.60	4.21* ± 0.16
20	KKM-1	1.60* ± 0.04	43.54* ± 0.95	6.67* ± 0.15	92.13* ± 1.86	11.93* ± 0.74	3.66 ± 0.35
21	BCB-464	1.07* ± 0.02	78.57* ± 1.73	5.53* ± 0.11	125.36* ± 3.47	14.07* ± 0.65	4.45* ± 0.39
22	PLR-1	1.27* ± 0.03	26.35* ± 0.53	5.47* ± 0.15	78.94 ± 1.73	9.92* ± 0.55	3.91* ± 0.38
23	JB-18	1.22* ± 0.03	45.65* ± 1.26	10.47* ± 0.23	85.20* ± 0.25	12.49* ± 0.82	3.70 ± 0.37
24	Bhagyamati	1.10* ± 0.03	70.83 ± 1.55	5.80* ± 0.02	83.53* ± 2.17	9.41* ± 0.40	4.98* ± 0.23
25	BB-58	1.40* ± 0.03	86.67* ± 0.25	11.77* ± 0.31	106.38* ± 2.34	12.85* ± 0.39	3.65 ± 0.06
26	Pusa Shyamala	1.40* ± 0.01	75.00* ± 1.95	10.00* ± 0.22	63.00* ± 1.38	14.44* ± 1.18	2.29 ± 0.09
27	Pant Samrat[+]	2.42 ± 0.06	70.03 ± 1.54	12.70 ± 0.28	73.11 ± 1.48	17.55* ± 0.98	2.46 ± 0.11
	Mean	1.53	62.49	9.98	99.51	12.70	4.22
	Range	1.00~3.87	26.35~86.67	4.97 ~ 24.17	52.00 ~ 226.67	9.41 ~ 20.43	2.04 ~9.62
	SE(d)	0.05	1.93	0.36	3.29	1.26	0.64
	C.D. $_{(0.05)}$	0.09	3.88	0.73	6.62	2.53	1.29
	C.V.	3.76	3.78	4.42	4.05	12.12	18.68

*** Significant at 5 % level of significance compared with check cultivar (Pant Samrat)**

3.2.5 Yield parameters

Maximising yield per unit area is the major goal of crop cultivation in order to maximise returns. High fruit output is also the ultimate goal of any breeding programme, thus it demands the most care (Reframe the sentence). The genotype JB-2 had the highest yield (2.12 kg), which was statistically equal to NBJ-19 (2.09 kg). The outcomes were shown in Table 4. Ten genotypes out of the total under research were determined to be superior to the control cultivar Pant Samrat (0.94 kg). Tremendous variations regarding yield parameter in brinjal have also been reported earlier by Dhaka and Soni (2014), Rahman *et al*., (2014), Solaimana *et al*., (2015) and Pujer *et al.,* (2017) in brinjal. A rough notion of the yield that can be obtained over a broad area is provided by yield per plot. Maximising yield per unit area is the major goal of crop cultivation in order to maximise returns. High fruit output is also the ultimate goal of any breeding programme, thus it demands the most care. Maximum yield was recorded in the genotype JB-2 (19.79 kg) followed by DRNKV-02-104 (18.82 kg) and NBJ-19 (18.72 kg). Nine genotypes out of the total under research were determined to be superior to the control cultivar Pant Samrat (9.71 kg). In the past, Shekar *et al*. (2012), Karak *et al.* (2012), Lokesh (2013), and Madhavi *et al*. (2015) observed enormous fluctuations in the yield parameter in brinjal.

3.2.6 Quality parameters

Fruit quality is significantly influenced by shelf life. Fruits with a longer shelf life can be shipped to far-off markets, whereas fruits with a shorter shelf life are more susceptible to damage from long distance shipping and illness. Maximum shelf life was observed in the genotype JB-18 (21.67 days) and it was found statistically at par with RCMBL-04-04 (21.00 days). Three genotypes viz, Aruna (20.33 days), RCMBL-04-04 (21.00 days) and JB-18 (21.67 days) were found superior for shelf life than check cultivar Pant Samrat (19.33 days). Earlier workers like Sharma *et al.,* (2000) and Mili *et al.,* (2014) have also observed similar results for shelf life in brinjal. The data for total soluble solid revealed notable variations across all genotypes. Maximum TSS was observed in Aruna (5.97 ˚Brix) and it was found statistically at par with JB-2 (5.43 ˚Brix) and NBJ-19 (5.60 ˚Brix). Whereas, minimum TSS was observed in CH-1045 (4.03 ˚Brix). All the genotypes were superior than the check cultivar Pant Samrat (4.20 ◦Brix) except CH-1045 (4.03 ˚Brix) and DRNKV-02-104 was same as check cultivar for this trait. Similar results had also reported by Koundinya *et al.*, (2017). Ascorbic acid

Table 4. Mean Performance of brinjal genotypes for different Yield and Quality characters

Sl No	Genotypes	Yield per Plant (kg)	Yield per plot (kg)	Shelf life (Days)	Total soluble solids (°Brix)	Ascorbic acid (mg/100 g)
		Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)	Mean ± S.E.(m)
1	DRNKV-02-104	2.02* ± 0.01	18.82* ± 0.49	13.00* ± 0.28	4.20 ± 0.12	10.19* ± 0.21
2	IVBL-116-131	1.07* ± 0.03	10.97* ± 0.24	14.00* ± 0.31	4.40 ± 0.31	8.91* ± 0.25
3	NBJ-19	2.09* ± 0.05	18.72* ± 0.41	7.67* ± 0.16	5.60* ± 0.31	6.37* ± 0.14
4	JB-9	0.96 ± 0.02	9.68 ± 0.20	10.00* ± 0.28	4.50 ± 0.25	11.46* ± 0.04
5	Aruna	1.20* ± 0.02	12.07* ± 0.34	20.33* ± 0.45	5.97* ± 0.03	6.37* ± 0.17
6	JB-2	2.12* ± 0.06	19.79* ± 0.43	18.67 ± 0.06	5.43* ± 0.32	6.37* ± 0.14
7	CH-1045	0.68* ± 0.00	7.44* ± 0.19	13.67* ± 0.30	4.03 ± 0.03	5.09* ± 0.10
8	Swarna Shree	0.48* ± 0.01	5.46* ± 0.12	16.00* ± 0.35	4.67 ± 0.33	6.37* ± 0.18
9	JB	0.84* ± 0.02	8.66* ± 0.19	17.00* ± 0.34	5.17* ± 0.03	5.09* ± 0.11
10	DRNKV-104-43	0.48* ± 0.01	5.44* ± 0.11	12.67* ± 0.35	5.43* ± 0.07	5.09* ± 0.02
11	RCMBL-04-04	0.90 ± 0.02	9.22 ± 0.26	21.00* ± 0.46	4.87* ± 0.09	6.37* ± 0.17
12	IBH-2	0.68* ± 0.02	7.16* ± 0.16	15.00* ± 0.04	5.10* ± 0.15	8.91* ± 0.20
13	Kavya	1.44* ± 0.03	14.02* ± 0.04	18.33* ± 0.48	4.90* ± 0.06	7.64* ± 0.17
14	B. Dewariya	0.60* ± 0.02	6.50* ± 0.14	17.67* ± 0.36	4.90* ± 0.00	10.19* ± 0.22
15	DBR-8	1.63* ± 0.04	15.81* ± 0.05	12.33* ± 0.32	4.40 ± 0.35	6.37* ± 0.14
16	DMU-1	0.43* ± 0.01	5.23* ± 0.11	6.33* ± 0.18	4.40 ± 0.25	8.91* ± 0.03
17	Azad Brinjal-2	0.55* ± 0.01	6.11* ± 0.02	15.33* ± 0.40	4.80* ± 0.00	8.91* ± 0.20
18	Co-11	1.20* ± 0.02	11.86* ± 0.33	18.00* ± 0.39	4.77* ± 0.03	11.46* ± 0.30
19	JB-67	0.60* ± 0.02	6.64* ± 0.15	9.33* ± 0.19	4.88* ± 0.06	10.19* ± 0.22
20	KKM-1	0.61* ± 0.00	6.62* ± 0.17	18.67 ± 0.41	4.87* ± 0.07	7.64* ± 0.16
21	BCB-464	0.68* ± 0.02	7.40* ± 0.16	16.33* ± 0.36	4.80* ± 0.00	8.91* ± 0.25
22	PLR-1	0.45* ± 0.01	5.08* ± 0.11	19.00 ± 0.38	4.93* ± 0.07	6.37* ± 0.14
23	JB-18	0.89 ± 0.02	9.07* ± 0.18	21.67* ± 0.60	4.60 ± 0.31	6.37* ± 0.02
24	Bhagyamati	0.48* ± 0.01	6.10* ± 0.17	17.00* ± 0.38	4.40 ± 0.31	8.91* ± 0.23
25	BB-58	1.32* ± 0.04	12.98* ± 0.29	12.00* ± 0.04	4.27 ± 0.18	8.91* ± 0.20
26	Pusa Shyamala	0.65* ± 0.02	6.93* ± 0.02	9.67* ± 0.25	4.27 ± 0.18	8.91* ± 0.20
27	Pant Samrat[+]	0.94 ± 0.00	9.71 ± 0.25	19.33 ± 0.42	4.20 ± 0.12	12.73 ± 0.26
	Mean	0.96	9.76	15.19	4.77	8.11
	Range	0.43~2.12	5.08~19.79	6.33 ~ 21.67	4.03 ~ 5.97	5.09 ~ 12.73
	SE(d)	0.03	0.31	0.47	0.27	0.24
	C.D. $_{(0.05)}$	0.07	0.63	0.95	0.54	0.47
	C.V.	4.22	3.93	3.79	6.95	3.54

*** Significant at 5 % level of significance compared with check cultivar (Pant Samrat)**

content is important quality parameters of brinjal. Maximum ascorbic acid was observed in Pant Samrat (12.73 mg/100g) followed by JB-9 and CO-11 (11.46 mg/100g each). In the meanwhile, minimum ascorbic acid was recorded in CH-1045, JB and DRNKV-104-43 (5.09 mg/100g each). A higher ascorbic acid level than the population mean was present in fourteen genotypes, including the check cultivar. Ravali *et al.*, (2017) and Pujer *et al.*, (2017) had also reported wide variability ascorbic acid content in different genotype of brinjal. The results were represented in Table 4.

4. CONCLUSION

According to the results of the investigation, seven genotypes *viz*, Aruna, DRNKV-02-104, NBJ-19, JB-2, RCMBL-04-04, IVBL-116-131, and Kavya (Plate 1) recorded higher fruit yield and also outperformed check cultivar Pant Samrat for other yield-attributing traits. These genotypes require additional testing before being made available as an alternative to currently available brinjal varieties or they can be used in future breeding programmes to create superior varieties or hybrids for improving yield and quality in brinjal grown in Uttarakhand hilly regions.

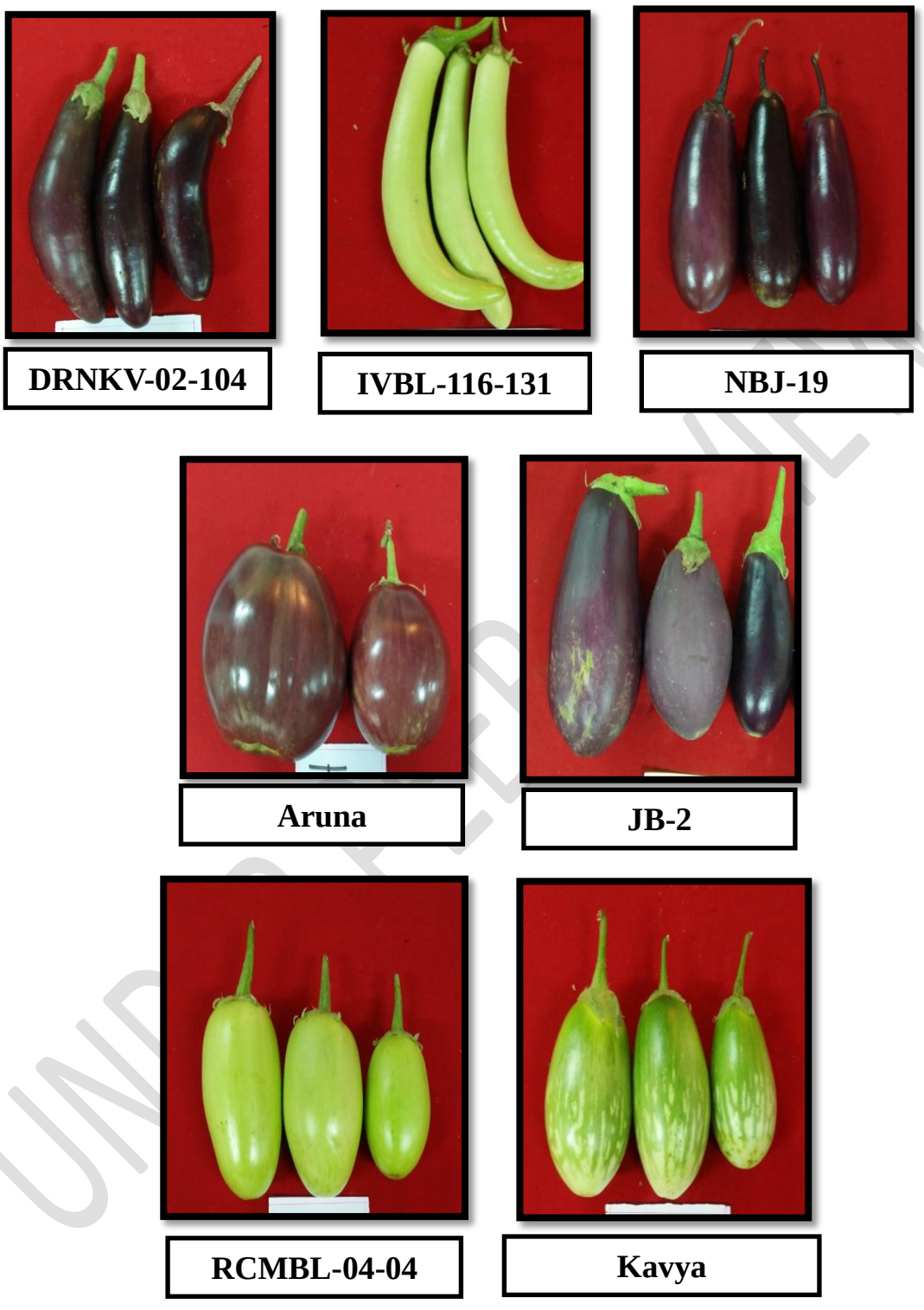

Plate 1: Best performing genotypes for yield and other attributing characters

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