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Performance of Brinjal Genotypes for Growth, Yield and Quality Characters under Terai Zone of West Bengal

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ABSTRACT

The present field experiment was conducted during August, 2023–June, 2024 at UBKV, Pundibari, West Bengal, India to evaluate 25 indigenous brinjal (*Solanum melongena* L.) genotypes for growth, yield and quality characteristics. The trial, laid out in Randomized Block Design with three replications and observation were recorded on different growth, yield and quality attributes of brinjal. The results of experiment revealed significant genotypic variation for all traits, highlighting the scope for selection. Genotype 2022/BRLVAR-8 excelled in plant height (103.06 cm) and number of fruits plant^{-1} (25.78), while 2022/BRLVAR-3 recorded maximum branches (5.49). Early flowering was noted in 2022/BRLVAR-6 (60.56 days) and genotype 2022/BRLVAR-5 had the longest fruit lenth (18.31 cm), and 2022/BRR VAR-15 had the maximum fruit width (8.94 cm) and fruit weight (214.60 g). Maximum yield plant^{-1} was observed in 2022/BRR VAR-5 (2.41 kg), while 2022/BRR VAR-2 gave the highest total yield plot^{-1} (41.57 kg). Genotype 2022/BRR VAR-5 also recorded the highest projected yield (30.00 t ha^{-1}). For quality traits, 2022/BRLVAR-5 had the highest TSS (6.65°Brix), 2022/BRLVAR-2 had highest ascorbic acid (12.47 mg 100 g^{-1}), 2022/BRR VAR-2 had the highest anthocyanin (80.52 mg 100 g^{-1}), and 2022/BRLVAR-6 had the highest phenol content (2.24 mg 100 g^{-1}). The genotypes 2022/BRR VAR-5, 2022/BRR VAR-4 and 2022/BRLVAR-5 emerged as promising genotypes for yield and quality traits under Terai conditions of West Bengal. These genotypes should be advanced for multilocation trials and utilized in future breeding programs to develop high-yielding, nutrient-rich brinjal cultivars adaptable to Eastern India.

KEYWORDS: Brinjal, performance, growth, yield, ascorbic acid

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1. INTRODUCTION

Eggplant (*Solanum melongena* L.), commonly known as brinjal, is one of the most important vegetable crops cultivated worldwide, particularly in tropical and subtropical regions mainly India, Japan and Indonesia. (Shilpa et al., 2018). It is a diploid with the chromosome number 2n=24 and belongs to the family Solanaceae. It is a versatile crop valued for its nutritional benefits, culinary uses and economic significance. It is a rich source of vitamins (A, C and B-complex), minerals (calcium, phosphorus and iron), dietary fibre and antioxidants such as anthocyanins, phenolics and flavonoids, which contribute to maintaining good health (Chioti et al., 2022; Lyngdoh et al., 2025, Pohl et al., 2019; Bushra et al., 2022). The crop plays a vital role in food security and income generation for small and marginal farmers, especially in developing countries like India, where it is widely grown and consumed in various forms curried, fried, stuffed or pickled. India is the second-largest producer of brinjal globally, with West Bengal being the leading state in both production and productivity (Kumar et al., 2017). It is primarily grown in the autumn-winter season, but some extent it is also cultivated in spring-summer season as well. However, throughout the spring-summer season, high temperatures (over 35°C) result in a significant drop in brinjal production due to poor fruit set. The optimal temperature range for development and fruit set is 15.5–21.1°C (Verma, 2024). The Terai region of West Bengal, characterized by its fertile alluvial soils and favourable agro-climatic conditions, is a significant brinjal-growing belt. However, productivity in this region is often constrained by several biotic and abiotic factors, including pest and disease infestations (such as shoot and fruit borer, bacterial wilt and fungal infections), climatic variability and the lack of high-yielding superior verities. Moreover, consumer preferences vary region to region, for different fruit shapes, sizes, colours (purple, green, white) and post-harvest qualities, necessitating the development and evaluation of diverse brinjal varieties. The information often required for generating high yielding varieties in a certain species concerns the level of genetic diversity for desirable features in the available germplasm (Dumi et al., 2025). Evaluation of germplasm is the fundamental tool for identifying valuable genotypes. The high degree of natural diversity in many attributes among genotypes means that there is plenty of opportunity for improvement in economic traits (Garcia-Oliveira et al., 2025). Phenotypic variability changes with environmental conditions, while genetic variability remains stable and is crucial for selection and hybridization (Biradar et al., 2023). Since yield is a complex trait influenced by various factors, evaluating germplasm for horticultural traits helps estimate genetic potential (Thota and Delvadiya, 2024, Chaitanya and Reddy, 2022). Farmers often grow local landraces that are adapted to regional conditions but may lack uniformity, high yield and pest resistance. Therefore, assessing improved brinjal genotypes for growth, yield and quality under local conditions is essential to identify superior varieties suited to specific agro-climatic zones. Such evaluation ensures better productivity, profitability and alignment with market demands. Genotype-environment interactions play a key role, as varieties performing well in one region may not excel elsewhere due to soil, climate, and management differences. Hence, location-specific evaluation aids in recommending suitable genotypes or designing effective breeding strategies, ultimately enhancing yield, reducing pesticide use and boosting farmer's income (Dhakre and Bhattacharya, 2013, Kumar et al., 2017, Koundinya et al., 2019, Khankahdani et al., 2021, Chaitanya and Reddy, 2022). Considering the above fact the present study was undertaken to evaluate 25 diverse brinjal genotypes under the Terai region of West Bengal, focusing on their growth, yield and biochemical attributes. These findings would help in identifying promising genotypes that could be recommended for commercial cultivation or it would provide valuable insights into the phenotypic variability among genotypes, aiding future breeding programs aimed at developing improved brinjal varieties with enhanced productivity and nutritional quality.

2. MATERIALS AND METHODS

The present study was conducted during the August, 2023–June, 2024 crop season at the experimental field of department of Vegetable and Spice Crops, UBKV, Pundibari, Cooch Behar, West Bengal, to evaluate the performance of 25 brinjal genotypes in three seasons (E_1- autumn-winter, E_2-spring-summer, E_3-rainy) under the Terai agroclimatic conditions. The experimental site, located at 26°19'86"N latitude and 89°23'53"E longitude, 43 m above sea level, featured sandy loam soil with moderate fertility. The experiment was designed in the Randomized Block Design (RBD) with three replications, using a plot size of 3×3.75 m^2 and a spacing of 75×75 cm^2, accommodating 20 plants $plot^{-1}$. Seeds of brinjal genotypes were procured from the Indian Institute of Vegetable Research (IIVR), located in Varanasi, Uttar Pradesh, for the purpose of varietal evaluation. For conducting field experiment recommended package of practices were followed and observations were recorded on different parameters Table 1–4. Anthocyanin content was estimated using methanol-HCl extraction, ascorbic acid by titration with 2,6-dichlorophenol indophenol and TSS (°Brix) content with a refractometer and phenols via the Folin-Ciocalteu method. The data were analysed following the standard methodology outlined by Panse and Sukhatme

Table 1: Analysis of variance for growth, yield and quality characteristics

Source of variation	Genotype	Envo.	Genotype×Envo.	Pooled error
Plant height (cm)	865.674**	460.233**	52.677**	20.288
Days to 50% flowering	150.889**	250.120**	16.939**	7.359
No. of primary branches plant^{-1}	25.333**	748.971**	3.257**	1.00
No. of fruit plant^{-1}	187.827**	5.851**	8.253**	5.517
Fruit length	123.083**	1339.659**	5.061**	1.05
Fruit diameter	127.102**	244.737**	3.870**	1.24
Fruit weight	262.080**	825.361**	9.293**	1.00
Fruit yield plant^{-1}	1.431**	0.182**	0.129**	0.109
Total yield per plot (kg)	416.832**	39.121**	41.144**	33.431
Projected yield (t ha^{-1})	219.281**	11.690**	21.650**	13.478
TSS (°Brix)	1.684**	7.090**	0.405	0.15
Ascorbic acid content (mg 100 g^{-1})	5.90**	3.559**	0.645	1.12
Anthocyanin content (mg 100 g^{-1})	2969.040**	352.99**	22.420**	6.949
Phenol content (mg 100 g^{-1})	1.608**	0.126**	0.026**	0.002

(1985) utilizing the R-studio software for statistical computations. Whenever significant differences were observed, critical differences (CD) at p=0.05 probability level were calculated to facilitate statistical interpretation.

3. RESULTS AND DISCUSSION

The pooled anova revealed that the genotype and environment differed significantly for the fourteen traits namely, plant height, days to 50% flowering, number of primary branches plant^{-1}, number of fruits plant^{-1}, fruit length, fruit diameter, fruit weight, fruit yield plant^{-1}, total yield plot^{-1}, projected yield ha^{-1}, total soluble solids (TSS), ascorbic acid content, anthocyanin content and phenol content among fourteen traits (Table 1). Similar results were also reported by earlier researchers, Madhavi et al. (2015) and Tabasum et al. (2024).

3.1. Assessment of morphological, phenological and yield characteristics

The performance of 25 brinjal genotypes was evaluated across three different environments for growth, yield and quality characteristics. The considerable variation was observed among genotypes for all traits, indicating the presence of substantial genetic diversity (Table 2–3).

Across environments, the plant height ranged from 59.79 cm to 105.80 cm. The genotype 2022/BRLVAR-8 recorded the maximum mean plant height (103.06 cm), followed closely by 2022/BRR VAR-5 (101.32 cm). In contrast, 2022/BRLVAR-1 showed the minimum plant height (63.93 cm), suggesting its suitability for cultivation systems requiring compact growth. The grand mean for plant height across genotypes was 85.74 cm, 83.04 cm, and 87.99 cm in E_1, E_2 and E_3 respectively. Plant height was influenced by the activity of growth-promoting hormones (e.g., gibberellins), internodal length and leaf area index. The observed variation likely stems from differences in vegetative Vigour, root-shoot balance and responsiveness to environmental cues. Researchers like Vasa et al. (2025), Rahaman et al. (2025), Yadav et al. (2025) reported wide variability in brinjal plant height among germplasm, confirming the trait's suitability for selection and breeding. The number of primary branches plant^{-1} varied notably across genotypes, with values ranging from 3.29 to 5.49. The genotype 2022/BRLVAR-3 (5.49), 2022/BRLVAR-5 (5.20) and 2022/BRR VAR-9 (5.20) were among the top performers in terms of branching, which was often associated with higher yield potential. The lowest mean number of branches was observed in 2022/BRRVAR-11 (3.29), suggesting limited vegetative proliferation. The environmental means for this trait were 4.08 (E_1), 4.26 (E_2), and 4.80 (E_3). Branching was governed by apical dominance, nutrient partitioning, and hormonal gradients (particularly auxin-cytokinin balance). High branching might also reflect better adaptation to light interception and increased fruit set potential. Singh et al. (2025) reported that branching was a major trait in enhancing fruit load and overall productivity in brinjal. The earliest days to 50% flowering was observed in 2022/BRLVAR-6 (60.56 days mean), followed closely by 2022/BRLVAR-8 (61.56 days), which was advantageous for areas with short growing seasons or late sowing conditions. The maximum days to 50% flowering genotype was 2022/BRR VAR-2 (75.56 days). Variation in flowering time might be attributed to inherent genetic makeup influencing hormonal regulation and photo-thermal sensitivity among genotypes. Early flowering variability in brinjal has been documented by (Shinde et al., 2012), indicating that this trait was moderately heritable and suitable for selection. The highest fruit plant^{-1} was found in 2022/BRLVAR-3 (26.02), 2022/BRLVAR-8 (25.78), whereas genotype 2022/BRR VAR-15 had the lowest fruit plant^{-1} (9.89) (Kumar et al., 2013; Singh et al., 2024). The maximum fruit length was recorded in 2022/BRLVAR-5 (18.31 cm), 2022/BRLVAR-3 (17.48 cm) and minimum fruit length were seen in 2022/BRR VAR-6 (7.22 cm). Similarly, Teja et al., (2025) recorded significant variation in fruit length ranged from 10.50–27.50 cm in different genotypes of brinjal (Kousalya et al., 2024). The maximum fruit diameter was recorded in the genotype 2022/BRR VAR-15 (8.94 cm), followed by 2022/BRR VAR-4 (8.10 cm) and minimum were observed in 2022/BRLVAR-8 (2.51 cm). The fruit weight among the 25 brinjal genotypes exhibited considerable variability across the three environments, with mean values ranging from 48.20 g (2022/BRLVAR-10) to 214.60 g (2022/BRR VAR-15). Higher fruit weights observed in genotypes might be attributed to their genetic potential for larger fruit size, as supported by prior studies

Table 2: Performance of brinjal genotypes for growth and flowering characteristics

Treatment	Plant height (cm)				No. of pr. branches				Days to 50% flowering			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	62.37	59.79	69.63	63.93	4.87	5.43	6.13	5.48	66.00	68.67	57	63.89
2022/BRLVAR- 2	77.01	72.27	78.74	76.01	3.93	3.80	3.73	3.82	69.00	65.00	63.33	65.78
2022/BRLVAR- 3	98.07	97.47	104.59	100.04	5.20	5.07	6.20	5.49	67.67	62.00	59.67	63.11
2022/BRR VAR-1	79.08	82.18	85.85	82.37	4.20	4.53	4.67	4.47	71.33	69.00	74.33	71.56
2022/BRR VAR-2	82.25	88.01	90.41	86.89	4.13	4.20	4.53	4.29	78.33	75.33	73.00	75.56
2022/BRLVAR-4	88.80	80.37	91.90	87.03	3.67	3.40	4.33	3.80	65.00	61.67	59.00	61.89
2022/BRLVAR-5	95.27	90.21	99.41	94.96	4.47	5.33	5.80	5.20	65.67	67.33	62.67	65.22
2022/BRLVAR-6	86.08	88.63	81.78	85.50	4.20	4.53	4.60	4.44	64.00	61.00	56.67	60.56
2022/BRLVAR-7	72.83	77.58	82.29	77.57	3.27	3.87	4.00	3.71	68.00	70.00	65.33	67.78
2022/BRR VAR-3	74.79	65.26	73.33	71.13	3.60	4.27	6.27	4.71	72.00	76.00	72.00	73.33
2022/BRLVAR-8	100.08	103.29	105.80	103.06	4.47	4.67	5.07	4.73	66.33	62.00	56.33	61.56
2022/BRR VAR-4	96.20	88.47	94.63	93.10	3.67	3.80	4.20	3.89	67.67	62.33	65.33	65.11
2022/BRR VAR-5	101.68	104.32	97.97	101.32	3.60	4.20	4.33	4.04	71.33	67.33	64.67	67.78
2022/BRR VAR-6	95.13	82.79	89.04	88.98	3.87	3.53	4.53	3.98	64.00	67.00	62.33	64.44
2022/BRR VAR-7	93.65	90.92	98.91	94.49	3.73	3.93	4.40	4.02	70.67	67.67	64.33	67.56
2022/BRR VAR-8	95.68	74.24	93.33	87.75	4.13	5.20	5.80	5.04	62.00	64.00	62.33	62.78
2022/BRR VAR-9	88.35	88.88	88.66	88.63	4.53	5.27	5.80	5.20	70.33	71.33	67.33	69.67
2022/BRLVAR- 9	88.57	82.77	89.27	86.87	3.40	3.67	4.00	3.69	63.00	64.33	61.33	62.89
2022/BRRVAR- 10	78.95	79.99	81.69	80.21	4.53	4.53	4.80	4.62	72.67	69.67	66.33	69.56
2022/BRRVAR- 11	76.05	79.73	80.14	78.64	3.33	3.00	3.53	3.29	69.33	62.67	63.67	65.22
2022/BRRVAR- 12	86.14	81.92	85.62	84.56	3.67	3.20	3.87	3.58	74.00	72.33	72.33	72.89
2022/BRLVAR- 10	85.36	70.43	89.40	81.73	5.20	4.73	5.33	5.09	62.67	64.67	64.67	64.00
2020/BRRVAR-13	90.70	97.32	91.71	93.24	5.07	5.00	6.00	5.36	71.33	68.33	71.67	70.44
2022/BRRVAR-14	82.53	83.24	83.63	83.14	3.27	3.47	3.53	3.42	72.00	70.00	69.00	70.33
2022/BRR VAR-15	67.92	65.84	71.93	68.56	3.87	3.93	4.47	4.09	72.33	68.00	71.00	70.44
Mean	85.74	83.04	87.99		4.08	4.26	4.8		68.67	67.11	65.03	
CD (p=0.05)	7.18	7.56	7.50		0.84	0.72	0.56		4.36	4.50	4.538	
SEm±	2.0	2.65	2.63		0.30	0.25	0.19		1.53	1.58	1.59	
C.V. %	5.02	5.53	5.18		12.58	10.20	7.08		3.85	4.07	4.23	

Table 2: Continue...

Treatment	No. of fruit plant^{-1}				Fruit length (cm)			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	11.67	10.73	11.4	11.27	11.97	11.01	11.77	11.58
2022/BRLVAR- 2	15.27	14.33	15.93	15.18	14.30	16.33	13.87	14.83
2022/BRLVAR- 3	26.00	28.73	23.33	26.02	17.51	18.29	16.64	17.48
2022/BRR VAR-1	12.27	15.07	13.40	13.58	14.62	14.48	14.72	14.61
2022/BRR VAR-2	11.33	14.60	12.27	12.73	11.59	11.51	11.26	11.45
2022/BRLVAR-4	13.13	15.27	14.47	14.29	16.13	15.16	14.29	15.19
2022/BRLVAR-5	16.53	19.33	15.33	17.07	17.49	18.94	18.50	18.31
2022/BRLVAR-6	15.07	15.20	15.93	15.40	11.84	9.23	9.98	10.35
2022/BRLVAR-7	19.73	17.13	19.47	18.78	15.36	16.13	14.36	15.28
2022/BRR VAR-3	14.00	16.53	17.53	16.02	11.67	10.33	9.66	10.55
2022/BRLVAR-8	27.87	25.33	24.13	25.78	11.67	13.28	12.60	12.52
2022/BRR VAR-4	11.07	12.53	10.53	11.38	8.97	7.28	8.19	8.15
2022/BRR VAR-5	12.40	10.20	11.67	11.42	10.62	8.01	9.72	9.45
2022/BRR VAR-6	18.27	18.60	17.07	17.98	7.44	7.08	7.15	7.22
2022/BRR VAR-7	15.20	14.87	13.87	14.64	10.13	10.57	11.56	10.75
2022/BRR VAR-8	11.60	12.20	14.53	12.78	9.78	9.29	10.02	9.70
2022/BRR VAR-9	10.13	12.40	13.13	11.89	8.17	7.73	7.93	7.94
2022/BRLVAR- 9	10.60	14.40	11.80	12.27	14.16	12.25	15.13	13.85
2022/BRRVAR- 10	12.00	13.20	14.53	13.24	9.72	7.98	8.67	8.79
2022/BRRVAR- 11	15.27	15.73	15.93	15.64	11.25	10.47	10.66	10.79
2022/BRRVAR- 12	11.13	12.60	12.53	12.09	8.55	11.02	11.11	10.23
2022/BRLVAR- 10	25.80	22.27	20.13	22.73	13.36	13.93	14.65	13.98
2020/BRRVAR-13	25.40	18.80	24.93	23.04	12.17	10.90	10.23	11.10
2022/BRRVAR-14	10.67	13.93	11.80	12.13	8.88	7.57	8.27	8.24
2022/BRR VAR-15	8.53	10.73	10.40	9.89	10.82	11.01	11.34	11.06
Mean	15.24	15.79	15.44		11.93	11.59	11.69	
CD (p=0.05)	3.87	4.08	3.63		1.31	1.83	1.02	
SEm±	1.36	1.43	1.27		0.46	0.64	0.35	
C.V. %	15.42	15.73	14.28		6.67	9.56	5.3	

(Singh et al., 2024a), which emphasized genotype as a key determinant of fruit morphology in brinjal. Environmental factors such as temperature and nutrient availability during fruit development stages could also influence fruit mass (Singh et al., 2024b). Fruit yield plant^{-1} (kg) varied significantly among genotypes, with mean values ranging from 0.97 kg (2022/BRLVAR-6) to 2.41 kg (2022/BRR VAR-5). The average across all genotypes was 1.79 kg, higher yielding genotypes like 2022/BRR VAR-8 and 2022/BRR VAR-5 combined both high fruit weight and fruit count plant^{-1}, which were known contributors to higher plant yield (Tripathy et al., 2025, Singh et al. (2025) and Shilpa et al. (2018). Lower yields in genotypes like 2022/BRLVAR-6 might be due to lesser biomass allocation to fruiting branches or suboptimal flowering and fruit set. Earlier findings suggested that yield plant^{-1} was a complex trait governed by multiple factors, including genotype-environment interaction and resource partitioning (Shinde et al., 2012). Total yield plot^{-1} (kg) ranged from 16.82 kg (2022/BRLVAR-6) to 41.57 kg (2022/BRRVAR-11) across environments, with a pooled mean of 31.70 kg. High total yield across environments, likely due to their combined high plant^{-1} yield and uniform fruit development. The variation in fruit yield also influenced by environmental variations (e.g., rainfall, temperature, soil conditions) might also contribute to differential performance across environments.

Projected yield (t ha^{-1}) showed notable differences among genotypes, ranging from 13.32 t ha^{-1} (2022/BRLVAR-10) to 30.00 t ha^{-1} (2022/BRR VAR-5), with a pooled mean of 22.31 t ha^{-1}. High-yielding genotypes like 2022/BRR VAR-8 and 2022/BRR VAR-5 demonstrated superior adaptability and yield stability, a desirable trait for commercial cultivation. Projected yield was an essential metric for evaluating the field-scale performance of genotypes. High performance in genotypes like 2022/BRR VAR-8 might result from favourable combinations of fruit size, number of fruits and efficient resource utilization.

3.2. *Quality characteristics*

The significant variation was observed for different quality charecterstics among all genotypes (Table 4). The total soluble solids (TSS) content, an important quality parameter linked with fruit sweetness and consumer acceptability, exhibited notable genotypic variation across the 25 brinjal entries evaluated over three environments.TSS values ranged from 3.50 °Brix (2022/BRLVAR-10) to 6.65 °Brix (2022/BRLVAR-5), with a pooled mean of 4.82 °Brix. Environment-wise, mean TSS values were slightly higher in E_2 (5.15 °Brix) than in E_1 (4.77 °Brix) and E_3 (4.54

Table 3: Performance of brinjal genotypes for fruit and yield characteristics

Treatment	Fruit diameter (cm)				Fruit weight (g)				Fruit yield pant^{-1} (kg)			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	5.36	4.58	4.65	4.86	98.70	94.13	104.2	99.01	1.16	1.02	1.19	1.12
2022/BRLVAR- 2	4.99	4.58	4.57	4.71	127.64	112.43	126.22	122.10	1.95	1.62	2.01	1.86
2022/BRLVAR- 3	2.65	3.55	3.64	3.28	78.14	69.80	69.63	72.52	2.03	1.99	1.62	1.88
2022/BRR VAR-1	6.05	5.72	6.39	6.06	129.10	125.74	116.44	123.76	1.59	1.91	1.57	1.69
2022/BRR VAR-2	7.11	6.56	6.89	6.85	159.65	160.25	134.88	151.59	1.80	2.33	1.65	1.93
2022/BRLVAR-4	4.10	4.83	5.14	4.69	97.17	90.29	76.45	87.97	1.29	1.37	1.11	1.26
2022/BRLVAR-5	3.54	3.78	3.75	3.69	91.24	90.06	81.14	87.48	1.52	1.73	1.25	1.50
2022/BRLVAR-6	3.36	2.58	2.61	2.85	64.05	62.59	63.83	63.49	0.96	0.96	1.00	0.97
2022/BRLVAR-7	3.86	3.27	3.27	3.47	82.81	88.20	87.58	86.20	1.64	1.49	1.72	1.62
2022/BRR VAR-3	5.56	6.33	6.28	6.06	125.37	139.86	115.12	126.78	1.75	2.31	2.03	2.03
2022/BRLVAR-8	2.75	2.49	2.29	2.51	72.43	72.59	74.51	73.18	2.03	1.86	1.79	1.89
2022/BRR VAR-4	7.50	8.84	7.97	8.10	202.54	198.98	218.11	206.55	2.23	2.49	2.30	2.34
2022/BRR VAR-5	7.66	7.20	6.87	7.24	207.42	210.20	213.04	210.22	2.58	2.15	2.49	2.41
2022/BRR VAR-6	6.12	5.55	5.41	5.69	102.98	91.04	154.78	116.27	1.89	1.71	2.62	2.07
2022/BRR VAR-7	7.14	6.59	6.07	6.60	119.96	124.99	121.22	122.05	1.82	1.87	1.67	1.79
2022/BRR VAR-8	5.40	5.18	4.81	5.13	168.22	177.60	145.15	163.66	1.95	2.19	2.11	2.08
2022/BRR VAR-9	6.17	7.30	5.69	6.39	195.21	186.63	171.41	184.42	1.97	2.33	2.26	2.19
2022/BRLVAR- 9	5.42	4.99	4.87	5.09	103.28	117.96	113.89	111.71	1.09	1.69	1.34	1.37
2022/BRRVAR- 10	6.29	7.15	6.55	6.66	149.51	140.11	138.78	142.80	1.79	1.85	2.03	1.89
2022/BRRVAR- 11	7.40	7.16	6.47	7.01	156.79	155.98	146.51	153.09	2.40	2.46	2.32	2.39
2022/BRRVAR- 12	5.31	5.70	6.31	5.77	166.08	164.11	158.37	162.85	1.85	2.06	1.97	1.96
2022/BRLVAR- 10	2.92	2.30	2.53	2.58	42.62	50.91	51.06	48.20	1.11	1.13	1.03	1.09
2020/BRRVAR-13	6.48	6.73	5.52	6.25	74.25	78.93	74.38	75.85	1.91	1.5	1.85	1.75
2022/BRRVAR-14	6.31	5.89	5.35	5.85	138.21	140.73	136.67	138.54	1.47	1.97	1.61	1.68
2022/BRR VAR-15	9.28	9.40	8.15	8.94	222.62	199.92	221.25	214.6	1.9	2.16	2.29	2.12
Mean	5.55	5.53	5.28		127.04	125.76	124.59		1.75	1.85	1.79	
CD (p=0.05)	0.92	0.71	0.65		11.50	17.22	15.84		0.54	0.60	0.49	
SEm±	0.32	0.25	0.23		4.03	6.03	5.54		0.19	0.210	0.17	
C.V. %	10.02	7.80	5.50		5.50	8.32	7.72		18.69	19.74	16.56	

Table 3: Continue...

Treatment	Total yield plot^{-1}(kg)				Projected yield (t ha^{-1})			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	19.9	17.55	20.85	19.43	14.47	12.69	14.78	13.98
2022/BRLVAR- 2	33.68	28.23	35.36	32.42	24.28	19.49	25.06	22.94
2022/BRLVAR- 3	35.32	34.50	28.42	32.74	25.21	23.53	20.16	22.97
2022/BRR VAR-1	27.78	33.28	27.40	29.49	19.79	24.79	19.47	21.35
2022/BRR VAR-2	31.47	40.43	29.00	33.63	22.44	28.12	20.53	23.70
2022/BRLVAR-4	22.01	23.76	19.48	21.75	16.03	15.87	13.81	15.24
2022/BRLVAR-5	26.67	29.63	21.99	26.10	18.97	21.62	15.52	18.70
2022/BRLVAR-6	16.47	16.42	17.55	16.82	11.92	12.57	12.45	12.31
2022/BRLVAR-7	28.14	25.52	29.74	27.80	20.45	18.80	21.33	20.19
2022/BRR VAR-3	30.19	39.33	35.00	34.84	21.74	29.44	25.23	25.47
2022/BRLVAR-8	34.91	31.64	31.02	32.52	25.28	21.08	22.33	22.90
2022/BRR VAR-4	39.11	40.21	39.89	39.74	27.80	32.87	28.58	29.75
2022/BRR VAR-5	44.27	35.19	43.00	40.82	32.15	26.87	30.97	30.00
2022/BRR VAR-6	32.42	28.74	45.45	35.54	23.47	20.36	32.60	25.48
2022/BRR VAR-7	31.70	32.37	29.06	31.04	22.62	21.48	20.85	21.65
2022/BRR VAR-8	33.66	37.64	36.66	35.98	24.31	24.48	26.31	25.03
2022/BRR VAR-9	34.10	37.82	40.89	37.60	24.51	30.67	28.10	27.76
2022/BRLVAR- 9	19.01	27.45	24.33	23.60	13.56	21.65	16.73	17.31
2022/BRRVAR- 10	30.70	30.20	36.74	32.55	22.22	23.10	25.24	23.52
2022/BRRVAR- 11	41.88	40.67	42.17	41.57	29.85	29.02	28.90	29.26
2022/BRRVAR- 12	32.46	33.90	35.69	34.01	23.06	24.12	24.49	23.89
2022/BRLVAR- 10	19.16	18.51	18.66	18.78	13.79	13.39	12.78	13.32
2020/BRRVAR-13	32.83	24.09	33.44	30.12	23.74	19.72	22.97	22.15
2022/BRRVAR-14	25.81	32.60	29.12	29.18	18.31	22.54	20.00	20.29
2022/BRR VAR-15	32.77	35.66	41.57	36.67	23.66	24.32	28.54	25.51
Mean	30.26	31.01	31.7		21.75	22.5	22.31	
CD (p=0.05)	9.44	10.56	8.43		6.69	5.28	6.08	
SEm±	3.31	3.705	2.96		2.35	1.85	2.13	
C.V. %	18.96	20.69	16.15		18.7	14.23	16.55	

°Brix), reflecting potential environmental influence on sugar accumulation. These results aligned with earlier findings by Tabasum et al. (2024), who reported a TSS range of 2.6 to 5.96 °Brix in brinjal genotypes.

Similarly, Hamadziripi et al. (2012) observed that higher TSS was positively associated with better fruit taste and consumer appeal. Ascorbic acid content played a vital role in enhancing the nutritional quality of brinjal fruits. The current study revealed a substantial range in ascorbic acid content across genotypes, with values from 8.46 mg 100 g^{-1} (2022/BRLVAR-1 in E_2) to 12.47 mg (100 g)$^{-1}$ (2022/BRLVAR-2 in E_2). The pooled mean was 10.93 mg 100 g^{-1}, while environment-wise means were 11.02 (E_1), 11.09 (E_2), and 10.68 (E_3). Promising genotypes with high ascorbic acid content, making them suitable candidates for improving nutritional quality through breeding. These findings were consistent with Arti et al. (2020) of who reported brinjal genotypes with ascorbic acid contents ranging between 5.29–18.89 mg 100 g^{-1}, and noted significant genotypic and environmental effects on this trait.

Anthocyanin content, an important pigment influencing the purple coloration and antioxidant properties of brinjal, exhibited substantial genotypic variability across the 25 genotypes evaluated in three environments. The values ranged from 2.17 mg 100 g^{-1} (2022/BRLVAR-1 in E_3) to a remarkable 82.50 mg 100 g^{-1} (2022/BRR VAR-2 in E_1), with a pooled mean of 46.43 mg $(100\ g)^{-1}$. Genotypes such as 2022/BRR VAR-2 (80.52 mg 100 g^{-1}), 2022/BRR VAR-3 (77.29 mg 100 g^{-1}), and 2022/BRLVAR-9 (69.13 mg 100 g^{-1}) consistently recorded high anthocyanin contents across environments, indicating their stability and suitability for pigment-rich brinjal breeding programs. Conversely, genotypes like 2022/BRLVAR-1 and 2022/BRLVAR-4 had the lowest anthocyanin concentrations. The environment-wise mean anthocyanin contents were 48.34 (E_1), 46.81 (E_2), and 44.13 (E_3) mg 100 g^{-1}, indicating a slight environmental influence, likely due to temperature and light differences. These findings corroborated those of Harisha et al. (2023) who reported a similar anthocyanin range from 0.24 to 139.04 mg 100 g^{-1}, attributing variability to both genetic factors and environmental modulation. The current study affirmed that anthocyanin content was a genetically controlled and moderately heritable trait, suitable for selection in antioxidant-rich brinjal cultivar development.

Total phenolic content, a crucial determinant of antioxidant

Table 4: Performance of brinjal genotypes for quality characteristics

Treatment	TSS (°Brix)				Ascorbic acid content (mg 100 g^{-1})			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	5.36	5.94	4.96	5.42	9.89	8.46	8.91	9.09
2022/BRLVAR- 2	4.61	4.75	4.28	4.55	11.93	12.47	12.05	12.15
2022/BRLVAR- 3	5.01	5.16	4.86	5.01	10.24	11.24	11.15	10.88
2022/BRR VAR-1	4.59	6.17	4.48	5.08	12.31	11.74	11.32	11.79
2022/BRR VAR-2	4.60	5.15	4.55	4.77	9.76	9.79	9.97	9.84
2022/BRLVAR-4	5.48	6.05	4.67	5.40	9.69	10.56	9.55	9.93
2022/BRLVAR-5	5.89	6.65	4.90	5.81	11.57	11.97	11.57	11.71
2022/BRLVAR-6	4.59	4.60	5.21	4.80	11.04	11.17	11.18	11.13
2022/BRLVAR-7	5.08	5.56	4.53	5.06	11.64	11.53	10.47	11.21
2022/BRR VAR-3	4.91	5.10	4.70	4.90	10.35	10.37	10.86	10.53
2022/BRLVAR-8	4.89	5.73	4.57	5.06	8.93	10.77	8.84	9.51
2022/BRR VAR-4	5.06	5.89	4.77	5.24	10.42	11.02	10.70	10.72
2022/BRR VAR-5	5.01	5.61	4.70	5.11	10.25	10.51	9.58	10.11
2022/BRR VAR-6	5.19	4.95	4.33	4.83	11.58	11.21	10.24	11.01
2022/BRR VAR-7	4.65	4.74	4.60	4.66	11.40	11.90	11.53	11.61
2022/BRR VAR-8	4.78	5.08	4.92	4.93	11.14	10.77	10.39	10.77
2022/BRR VAR-9	3.95	4.40	4.21	4.19	11.73	11.86	10.82	11.47
2022/BRLVAR- 9	4.96	4.62	4.37	4.65	9.96	10.93	10.42	10.43
2022/BRRVAR- 10	3.93	4.23	3.68	3.95	11.48	10.54	9.73	10.58
2022/BRRVAR- 11	4.54	4.90	4.18	4.54	11.44	11.31	10.61	11.12
2022/BRRVAR- 12	4.75	4.08	4.40	4.41	12.06	12.16	11.79	12.00
2022/BRLVAR- 10	3.50	4.81	4.49	4.27	10.83	10.13	10.79	10.58
2020/BRRVAR-13	4.46	4.19	4.72	4.46	11.51	11.48	11.33	11.44
2022/BRRVAR-14	4.33	4.76	3.74	4.28	12.02	11.22	11.78	11.67
2022/BRR VAR-15	5	5.52	4.61	5.04	12.39	12.03	11.45	11.96
Mean	4.77	5.15	4.54		11.02	11.09	10.68	
CD (p=0.05)	0.70	0.66	0.52		1.01	1.03	N/A	
SEm±	0.25	0.23	0.18		0.36	0.36	0.93	
C.V. %	9.00	7.88	7.03		5.60	5.65	15.13	

Table 4: Continue...

Treatment	Anthocyanin content (mg 100 g^{-1})				Phenol content (mg 100 g^{-1})			
	E_1	E_2	E_3	Mean	E_1	E_2	E_3	Mean
2022/BRLVAR- 1	2.45	2.28	2.17	2.3	0.99	1.12	1.09	1.06
2022/BRLVAR- 2	41.97	45.42	35.40	40.93	0.9	0.92	0.9	0.91
2022/BRLVAR- 3	68.53	66.96	62.27	65.92	0.89	1.13	1.16	1.06
2022/BRR VAR-1	35.48	38.99	34.83	36.43	0.70	0.64	0.67	0.67
2022/BRR VAR-2	82.50	80.87	78.18	80.52	0.72	0.72	0.71	0.72
2022/BRLVAR-4	22.21	24.05	20.75	22.33	1.71	1.71	1.73	1.71
2022/BRLVAR-5	28.86	25.43	21.38	25.22	1.98	2.00	1.95	1.98
2022/BRLVAR-6	22.41	28.42	25.36	25.40	1.90	2.23	2.24	2.12
2022/BRLVAR-7	62.13	64.83	58.07	61.68	2.12	2.15	2.11	2.12
2022/BRR VAR-3	79.41	76.75	75.70	77.29	1.66	1.66	1.75	1.69
2022/BRLVAR-8	71.05	67.33	65.75	68.04	2.06	2.06	2.03	2.05
2022/BRR VAR-4	48.17	51.60	37.15	45.64	1.42	1.47	1.42	1.44
2022/BRR VAR-5	38.20	42.00	40.65	40.29	1.36	1.40	1.44	1.40
2022/BRR VAR-6	60.85	58.06	57.07	58.66	1.64	1.67	1.66	1.66
2022/BRR VAR-7	39.46	38.63	36.02	38.04	1.89	1.90	1.87	1.89
2022/BRR VAR-8	61.26	59.80	52.28	57.78	1.38	1.50	1.51	1.46
2022/BRR VAR-9	38.17	33.80	31.89	34.62	1.88	1.65	1.63	1.72
2022/BRLVAR- 9	75.35	64.31	67.72	69.13	1.74	1.90	1.93	1.86
2022/BRRVAR- 10	41.40	39.13	37.27	39.27	1.54	1.53	1.49	1.52
2022/BRRVAR- 11	52.95	47.57	44.74	48.42	1.69	1.64	1.67	1.67
2022/BRRVAR- 12	46.27	40.16	43.21	43.21	1.22	1.51	1.44	1.39
2022/BRLVAR- 10	29.47	28.38	27.94	28.59	1.76	1.78	1.63	1.72
2020/BRRVAR-13	68.45	64.69	67.02	66.72	1.15	1.22	1.43	1.27
2022/BRRVAR-14	50.95	40.82	41.55	44.44	0.93	1.43	1.47	1.27
2022/BRR VAR-15	40.73	39.98	38.97	39.89	0.9	0.95	1	0.95
Mean	48.34	46.81	44.13		1.45	1.52	1.52	
CD (p=0.05)	4.06	4.00	4.86		0.06	0.06	0.06	
SEm±	1.42	1.40	1.70		0.02	0.02	0.02	
C.V. %	5.10	5.19	6.69		2.36	2.71	2.68	

activity and post-harvest shelf life in brinjal, also showed considerable variation among genotypes across different environments. Values ranged from 0.67 mg 100 g^{-1} (2022/BRR VAR-2) to 2.24 mg 100 g^{-1} (2022/BRLVAR-6 in E_3), with a pooled mean of 1.50 mg 100 g^{-1}. Among the genotypes, 2022/BRLVAR-6 (2.12 mg 100 g^{-1}), displayed higher phenol content, suggesting their potential for enhancing antioxidant properties in breeding programs. On the lower end, genotypes like 2022/BRR VAR-1 (0.67 mg 100 g^{-1}) recorded minimal phenolic levels. The mean phenol content showed minimal variation across environments 1.45 (E_1), 1.52 (E_2), and 1.52 (E_3) indicating phenolic content is relatively stable across different growing conditions. Previous studies by Reshmika et al. (2016) have similarly reported phenol contents ranging from 19 to 148 mg 100 g^{-1} in diverse brinjal lines and highlighted the importance of total phenolics in enhancing disease resistance and nutritional quality. The current findings reinforced the existence of exploitable genetic variation for phenol content in brinjal, with selected genotypes offering promising material for biofortified cultivar development.

4. CONCLUSION

Significant genetic variability was recorded among 25 brinjal genotypes under Terai conditions of West Bengal. Genotypes like 2022/BRR VAR-5 and 2022/BRR VAR-

4 showed high yield potential, while 2022/BRR VAR-5 and 2022/BRLVAR-7 excelled in quality traits. Early flowering and high anthocyanin content were noted in 2022/BRR VAR-6 and 2022/BRR VAR-3, respectively. These genotypes were promising for developing high-yielding, nutrient-rich brinjal cultivars and should be validated through multilocation trials for wider adaptability.

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