

RESEARCH ARTICLE

Morphological Diversity Analysis in Brinjal (*Solanum melongena*) Germplasm

TH Singh^{1*}, Sushil Pandey², Chitra D Pandey² and Suresh R Yerasu³

Abstract

An experiment was conducted at the Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, aimed to characterize 480 indigenous and exotic brinjal accessions received from the National Genebank, ICAR-NBPGR, New Delhi. A lot of variability was observed for agro-morphological traits recorded such as mean plant height (88.80 cm), plant spread (53.25 cm), number of primary branches 5.0, leaf length 19.26 cm, leaf width 13.03 cm, days to fifty per cent flowering 50.00, fruit length 11.18 cm, fruit breadth 4.83 cm, number of fruits per plant 14, average fruit weight 80.15g, yield per plant 1.13kg and 100 seed weight 0.5 g. The Principal Component Analysis (PCA) indicated 100% of the total variation based on 12 phenotypic traits. There was a significant positive relationship found among the fruit characters. The majority of the characters studied had high PCV, GCV, heritability, and GAM levels. The brinjal accessions, such as EC316273-X, EC-396492, EC-467275, IC-0090851, IC-0090891-Z, IC-0090858, IC-0090898, EC-384615, IC-0090762, IC-0090774 and IC-090922-X had shown high variability for quantitative characters.

Keywords: Brinjal, Correlation, Genetic advance, Genetic variation, Principal component analysis

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Introduction

India has a strong basis for brinjal research in both public and private sector institutes involved in brinjal breeding. Plant Genetic Resources (PGR) exchange and its utilization in different crop improvement programs are continuous processes. To fulfil future demands caused by the introduction of new diseases, climate change, and increased demands for food and nutritional security, there is an ongoing quest for different new PGRs (De Jonge, 2009). The brinjal (*Solanum melongena* L., $2n = 24$) is a member of the Solanaceae family and is a highly valued vegetable crop cultivated in tropical and sub-tropical regions of the world. It originated in India (the Indo-Burma region is the primary centre of origin), and China is its secondary centre of origin. In India, brinjal is grown in an area of 676.70 thousand hectares, with production of 12.78 million metric tonnes (MT) and with a productivity of 18.90 MT/ha (India Statagri, 2023). In India, major brinjal-producing states are West Bengal, Odisha, Gujarat, Uttar Pradesh, Madhya Pradesh, Bihar, Chhattisgarh, Karnataka, Andhra Pradesh and Telangana. In Karnataka, it is cultivated in an area of 10,387 ha, producing 259,033 MT with a productivity of 24.94 MT/ha (Department of Horticulture, GOK, 2021-22). Brinjal ranked fourth among 25 different crops in terms of seed requests received by ICAR-NBPGR, New Delhi, from 2014 to 2019 (Tyagi *et al.*, 2021). ICAR-NBPGR collaborates with national

organizations for evaluation, multiplication, characterization, documentation, and conservation of PGR, which ensures their sustainable utilization in breeding programme.

The characterization of accessions involves recording and collecting data on crucial phenotypic traits, which facilitates grouping of accessions, formation of a core collection and identification of promising germplasm for crop breeding programs. Such studies enhance comprehension of the collection's composition and genetic diversity. Morphological traits play an important role in germplasm characterization, classification, and genotyping, which is useful in identifying elite genotypes for breeding purposes (Saikia *et al.*, 2021). Understanding genetic variation is essential for effectively utilizing PGR in breeding programs. Yield is a complex trait influenced by various associated plant characteristics, character associations, assessing heritability and genetic progress. The heritability and genetic progress of different traits are pivotal factors in the selection processes. This study aimed to phenotypically characterize existing germplasms for yield and yield-related traits, and to evaluate their breeding potential. These insights will enhance our understanding of the brinjal germplasm potential and its suitability for future breeding programs.

Material and Methods

An experiment was conducted at the ICAR-Indian Institute of Horticultural Research, located in Bengaluru, Karnataka, positioned at latitude 13°8' 1.51"N and longitude 77°29' 27.32"E during the *kharif* 2022.

Plant materials and data collection

A group of 480 brinjal accessions from the National Genebank, ICAR-NBPGR, New Delhi, was used in the experiment (Table 1). Of the 480 brinjal accessions evaluated, one accession *viz.*, *S. viarum*, was a wild relative, whereas the remaining 479 were cultivated *Solanum melongena* L. accessions. The study also included five standard checks, namely, IC628873 (BR-14), Kashi Prakash, Kashi Taru, Arka Kusumakar, and Arka Nidhi. Observations were recorded on the following 12 parameters *viz.*, Plant height (cm), Plant spread (cm), Number of primary branches per plant, Leaf length (cm), Leaf width (cm), Days to fifty percent flowering, Fruit length (cm), Fruit breadth (cm), Number of fruits per plant, Yield per plant (kg), Average fruit weight (g), and 100-seed weight (g). Five plants of each

Table1: List and source of the brinjal accessions used in the study

S. No.	Accessions	S. No.	Accessions
1	IC-0099735	45	IC-136345
2	IC-0099737	46	IC-136347
3	IC-0099750	47	IC-136359
4	IC-0099755	48	IC-136364
5	IC-104088	49	IC-136367
6	IC-0111000	50	IC-136380
7	IC-111001	51	IC-136383
8	IC-0111003	52	IC-136367
9	IC-111004	53	IC-136445
10	IC-111005	54	IC-136551
11	IC-111008	55	IC-0099735
12	IC-111018	56	IC-0099737
13	IC-111027	57	IC-0099750
14	IC-111033	58	IC-136564
15	IC-111037	59	IC-137681
16	IC-111043	60	IC-137702
17	IC-111052	61	IC-137751
18	IC-111069	62	IC-144013
19	IC-111073	63	IC-144015
20	IC-111081	64	IC-144080
21	IC-111082	65	IC-169073
22	IC-111323	66	IC-169089
23	IC-111337	67	IC-201139
24	IC-1112347	68	EC-284270
25	IC-112732	69	EC-304994
26	IC-126640	70	EC-305006
27	IC-126649	71	IC-310883
28	IC-126721	72	IC-310884
29	IC-126829	73	IC-310883
30	IC-126860	74	IC-310884
31	IC-126916	75	IC-310885
32	IC-126860	76	EC-316230
33	IC-601513	77	EC-316242
34	IC-136142	78	EC-316258
35	IC-136206	79	EC-316283
36	IC-136226	80	EC-316315
37	IC-136228	81	EC-316317
38	IC-136226	82	EC-378654
39	IC-136281	83	EC-378820
40	IC-136287	84	EC-379246
41	IC-136311	85	EC-382577
42	IC-136312	86	EC-382579
43	IC-136321	87	EC-383345
44	IC-136312	88	EC-384619

S. No.	Accessions	S. No.	Accessions	S. No.	Accessions	S. No.	Accessions
89	EC-467271	135	IC-111302-X	181	IC-136248-1X	227	IC-345272
90	EC-467273	136	IC-111440-X	182	IC-0239393	228	IC-345275
91	EC-467277	137	IC-111448-X	183	IC-0603202	229	IC-345287
92	IC-510491	138	IC-112713	184	IC-136272	230	IC-345290
93	IC-265644	139	IC-112741	185	IC-136329-X	231	IC-345309
94	IC-136552	140	IC-112744	186	IC-136438-X	232	IC-345326
95	IC-136564	141	IC-112992-X	187	IC-136556	233	IC-345327
96	IC-137681	142	IC-113000-X	188	IC-136561	234	IC-345328
97	IC-320865	143	IC-126912-X	189	IC-137682	235	IC-345330
98	IC-362379	144	IC-135942-X	190	IC-137761	236	IC-345333
99	IC-362380	145	IC-136248-1	191	IC-144109-X	237	IC-345335
100	IC-362381	146	IC-136272-X	192	IC-201132	238	IC-345359
101	IC-362382	147	IC-136329	193	IC-285497	239	IC-345363
102	IC-362383	148	IC-136438	194	EC-305052	240	IC-345368
103	IC-362384	149	IC-136556-X	195	EC-316273-X	241	IC-345370
104	IC-362385	150	IC-136561-X	196	IC-321070-X	242	IC-345372
105	IC-362386	151	IC-137682-X	197	IC-422570	243	IC-345385
106	IC-362387	152	IC-137761-X	198	IC-422571	244	IC-361839
107	IC-362388	153	IC-144109	199	IC-422573	245	IC-361840
108	IC-362389	154	IC-201132-X	200	IC-422574	246	IC-361841
109	IC-362390	155	IC-256208-X	201	IC-422575	247	IC-361842
110	IC-362391	156	EC-305052-X	202	IC-422576	248	IC-369610
111	IC-362392	157	EC-316224-X	203	IC-422577	249	IC-373370
112	IC-362394	158	EC-316273-X2	204	IC-422578	250	IC-374777
113	IC-362395	159	EC-316285-X	205	IC-422579	251	IC-383085
114	IC-362396	160	IC-332498	206	IC-422580	252	IC-383099
115	IC-362397	161	IC-332501	207	IC-422581	253	IC-383101
116	IC-362399	162	IC-332502	208	IC-422582	254	IC-383102
117	IC-371739	163	IC-332503	209	IC-422583	255	IC-383103
118	IC-588090	164	IC-332504	210	IC-422584	256	IC-383119
119	IC-604614	165	IC-332508	211	IC-422585	257	IC-383137
120	IC-90870	166	IC-332510	212	IC-422586	258	IC-383158
121	IC-90893	167	IC-332513	213	IC-422587	259	IC-383170
122	IC-90955	168	IC-332514	214	IC-422588	260	IC-383175
123	IC-90967	169	IC-332515	215	IC-541227	261	IC-383190
124	IC-90980	170	IC-89815-X	216	IC-258028	262	IC-383195
125	IC-324556	171	IC-0603204	217	IC-260999	263	IC-383695-X
126	IC-324775	172	IC-0603970	218	IC-311233	264	IC-395714
127	IC-324870	173	IC-99747	219	IC-333519	265	IC-413668
128	IC-89900-X	174	IC-111089-X	220	IC-333523	266	IC-413717
129	IC-90975-X	175	IC-111308-X	221	IC-333527	267	IC-414993
130	IC-90979	176	IC-111431-X	222	IC-333582	268	IC-415033
131	IC-99630	177	IC-111440	223	IC-333607	269	IC-588104
132	IC-99702-X	178	IC-112741-X	224	IC-345255	270	IC-588106
133	IC-99747-X	179	IC-126912	225	IC-345270	271	IC-604481
134	IC-111089	180	IC-127070	226	IC-345271	272	EC-169075

S. No.	Accessions	S. No.	Accessions	S. No.	Accessions	S. No.	Accessions
273	EC-169080	319	IC-0089868	365	IC-0090118-X	411	IC-602927
274	EC-304976	320	IC-0089880	366	IC-0090119	412	IC-0090905-X
275	EC-304983	321	IC-0089885	367	IC-0090122-X	413	IC-0090907
276	EC-305027	322	IC-0089897	368	IC-0090124	414	IC-0090909
277	EC-305046	323	IC-0089898	369	IC-0090126	415	IC-0090913
278	EC-305129	324	IC-126630	370	IC-0090128	416	IC-090914
279	EC-316213	325	IC-126637	371	IC-0090130	417	IC-090922-X
280	EC-316223	326	IC-600305	372	IC-0090137	418	IC-0090923
281	EC-316234	327	IC-600317	373	IC-0090140	419	IC-0090927
282	EC-316237	328	IC-600330	374	IC-602915	420	IC-0090928
283	EC-316244	329	IC-600331	375	IC-602920	421	IC-0090931
284	EC-316246	330	IC-600788	376	IC-0090142	422	IC-0090932-X
285	EC-316305	331	IC-601079	377	IC-0090144	423	IC-0090935
286	EC-316309	332	IC-601091	378	IC-0090146	424	IC-0090936
287	EC-316310	333	IC-601098	379	IC-0090150	425	IC-0090938
288	EC-377624	334	IC-601154	380	IC-0090156	426	IC-0090939
289	EC-378655	335	IC-601155	381	IC-0090158	427	IC-0090940
290	EC-379244	336	IC-601415	382	IC-0090159-X	428	IC-0090942
291	EC-382582	337	IC-601474	383	IC-0090621	429	IC-0090946
292	EC-383343	338	IC-602528	384	IC-0090750	430	IC-0090951
293	EC-383348	339	IC-602632	385	IC-0090762	431	IC-0090952-X
294	EC-384550	340	IC-602912	386	IC-0090764	432	IC-0090962
295	EC-384556	341	IC-0089918-X	387	IC-0090774	433	IC-0090963-X
296	EC-384565	342	IC-0089928	388	IC-0090775	434	IC-0090965
297	EC-384606	343	IC-0089932	389	IC-0090783-X	435	IC-0090970
298	EC-384615	344	IC-0089935	390	IC-0090785	436	IC-0090972
299	EC-384618	345	IC-0089947	391	IC-0090790	437	IC-0090973
300	EC-384628	346	IC-0089957	392	IC-0090791	438	IC-0090974
301	EC-393239	347	IC-0089974-Z	393	IC-0090804	439	IC-90974
302	EC-396466	348	IC-0089998	394	IC-0090810	440	IC-90981
303	EC-396487	349	IC-0090030	395	IC-0090812-X	441	IC-90983-X
304	EC-396492	350	IC-0090031	396	IC-0090844-X	442	IC-090984
305	EC-467268	351	IC-0090032	397	IC-0090846-Z	443	IC-92719
306	EC-467272	352	IC-0090035	398	IC-0090851	444	IC-94209
307	EC-467274	353	IC-0090041	399	IC-0090858	445	IC-0099614
308	EC-467275	354	IC-0090043	400	IC-0090860-X	446	IC-99621
309	EC-467276	355	IC-0090064	401	IC-0090869	447	IC-99630-X
310	IC-0009081	356	IC-0090087-X	402	IC-0090871	448	IC-99635
311	IC-0074243-X	357	IC-0090100	403	IC-0090872	449	IC-0099640
312	IC-0089814-X	358	IC-0090101	404	IC-0090874	450	IC-0099643
313	IC-0089826	359	IC-0090102	405	IC-0090891-Z	451	IC-99645
314	IC-0089831	360	IC-0090110	406	IC-0090895	452	IC-99656-X
315	IC-0089832	361	IC-0090113-X	407	IC-0090898	453	IC-99658-X
316	IC-0089841	362	IC-0090115-X	408	IC-0090899	454	IC-99660
317	IC-0089845	363	IC-0090116	409	IC-0090901	455	IC-0099661
318	IC-0089846	364	IC-0090117	410	IC-0090902	456	IC-99670-X

S. No.	Accessions	S. No.	Accessions
457	IC-99675	472	IC-421189
458	IC-099686	473	IC-446754
459	IC-99688	474	IC-201136
460	IC-99695-X	475	IC-127074
461	IC-099699	476	IC-397558
462	IC-099703	477	IC-137701
463	IC-099708	478	IC-127115-X
464	IC-99736	479	IC-99703-X
465	IC-99740	480	IC-99758-X
466	IC-99743-X	C1	IC-628873 (BR-14)
467	IC-99744	C2	Kashi Prakash
468	IC-99748	C3	Kashi Taru
469	IC-446729	C4	Arka Kusumakar
470	IC-439263	C5	Arka Nidhi
471	IC-421199		

accession were tagged/selected for recording all the observations.

Experimental design

An augmented randomized complete block design (ABD) was employed as the experimental design to cultivate the accessions, wherein the checks were replicated in each block. A total of 480 accessions were grown in 6 blocks, with 80 accessions in each block. 35-day-old plants were transplanted to the main field with 100 cm × 60 cm space between rows and plants. Recommended agriculture practices were followed to raise a good crop.

Statistical analysis

The R package 'augmented RCBD' was employed to calculate adjusted averages for all considered traits across all genotypes (Aravind *et al.*, 2018). Genetic variability parameters, frequency distributions, and descriptive statistics were computed in R software. Phenotypic variance, genotypic variance, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), broad-sense heritability (h^2) (Lush, 1940), and genetic advances (GA) (Johnson *et al.*, 1955) were estimated as:

$$\text{Genotypic variance } (\sigma_g^2) = \bar{P} - \bar{e}$$

where,

$\bar{P}$ Phenotypic variance = Sum of squares of test treatments (genotypes)

$\bar{e}$ Error Variance = Sum of squares of residuals (error)

$$\text{Phenotypic Coefficient of Variation (PCV)} = \frac{\text{Phenotypic Variance}}{\sqrt{\text{mean}}} \times 100$$

$$\text{Genotypic Coefficient of Variation (GCV)} = \frac{\text{Genotypic Variance}}{\sqrt{\text{mean}}} \times 100$$

$$\text{Broad sense heritability } (h^2) = \frac{\sigma_g^2}{\sigma_p^2}$$

$$\text{Genetic Advance (GA)} = k \times \sigma_g \times \frac{h^2}{100}$$

where k represents the selection intensity, and σ_g denotes the genotypic standard deviation.

Correlation analysis was conducted in the R package 'metan' (Olivoto and Lúcio, 2020), while PCA was done with the R package 'FactoMineR' (Le *et al.*, 2008).

Results and Discussion

Genetic parameters

Accurate estimation and reporting of genetic diversity within germplasm are crucial for its effective utilization (Islam *et al.*, 2004). Genetic diversity is often assessed using morphological traits and aid in cultivar development because of their simplicity and cost-effectiveness (Fufa *et al.*, 2005). In the present study, a significant range of variance was observed among the twelve characters analysed in the brinjal accessions. ANOVA results indicated that the variation for all characters was highly significant, highlighting inherent genetic differences. Each characteristic exhibited a wide range (Table 2), with the coefficient of variation (CV %) ranging from 0.23 for average fruit weight to 31.58 for fruit breadth. This study focused solely on morphological characteristics for diversity analysis. Previous research has utilized morphological features for diversification studies in brinjal (Savan kumar *et al.*, 2018; Khan *et al.*, 2023; Nagar *et al.*, 2024). The phenotypic coefficient of variance (PCV) for all traits exceeded the genotypic variance (GCV), suggesting environmental effect on these traits, except for days to 50% flowering, leaf width (cm), leaf length (cm), and the number of primary branches per plant. The remaining characters displayed high phenotypic and genotypic coefficients of variation (PCV and GCV). Most of the characters exhibited high broad-sense heritability, excluding days to 50% flowering and the number of primary branches per plant. Heritability, along with genetic advance, provides a more accurate estimate of selection value (Johnson *et al.*, 1955). All the characters exhibited a high genetic advance (GA) percentage except for the number of primary branches per plant (7.45) and days to 50% flowering (9.05). The minimum GCV and PCV observed for the number of primary branches per plant and days to 50% flowering indicate

Table 2: Genetic variability parameters of the brinjal germplasm

Trait	Mean	Range	CV %	GCV	GCV category	PCV	PCV category	ECV	hBS(h ²) (%)	hBS category	GA	GAM (%)	GAM category
PH	88.80	53-183	2.48	28.42	High	28.53	High	2.48	99.24	High	51.80	58.41	High
PS	53.25	40-132	4.94	24.94	High	25.42	High	4.91	96.27	High	27.06	50.49	High
NPB	5.0	3.0-7.0	16.87	8.22	Low	18.72	Medium	16.82	19.29	Low	0.37	7.45	Low
LL	19.26	2.2-28.2	19.24	15.16	Medium	15.93	Medium	4.88	90.63	High	5.73	29.78	High
LW	13.03	1.80-23.50	12.81	19.08	Medium	21.33	High	9.54	80.01	High	4.51	35.21	High
DFF	50.00	42.0-58.0	6.19	6.20	Low	8.76	Low	6.19	50.06	Medium	4.55	9.05	Low
FL	11.18	4.30-20.13	13.32	22.87	High	26.59	High	13.56	74.00	High	4.46	40.59	High
FB	4.83	1.80-10.10	31.58	26.23	High	27.36	High	31.90	68.42	High	3.25	38.86	High
FP	14.00	6-64	0.29	43.79	High	43.79	High	0.29	99.00	High	12.78	90.33	High
YPP	1.13	0.2-5.1	2.82	52.04	High	52.11	High	2.81	98.51	High	1.21	107.20	High
FW	80.15	11-188	0.23	33.22	High	33.22	High	0.23	97.12	High	55.21	68.52	High
100SW	0.5	0.2-0.5	12.94	25.42	High	28.51	High	12.91	79.50	High	0.22	46.76	High

PH = Plant height (cm), PS=Plant spread (cm), NPB = Number of primary branches, LL=Leaf length (cm), LW=Leaf width(cm), DFF = Days to fifty per cent flowering, FL=Fruit length (cm), FB=Fruit breadth (cm), FP= Number of fruits per plant, YPP = Yield per plant (kg), FW = Average fruit weight (g) and 100SW= 100 seed weight (g).

limited variation in these traits. This led to low heritability and low GA as a percentage of the mean for these two traits. In contrast, the remaining characteristics showed high GCV and broad-sense heritability, resulting in high GA as a percentage of the mean (Table 2). The variation found among the genotypes for the studied characters can be attributed to genetic diversity and differences in adaptability (Nagar *et al.*, 2024). Variability and genetic diversity among genotypes, combined with higher heritability, provide greater genetic gains in breeding programs (Balasubramaniyam *et al.*, 2021; Kumar *et al.*, 2021; Uddin *et al.*, 2021; Soumya *et al.*, 2023).

Yield frequency distribution

Yield plays a significant role in crop improvement programmes. The average yield per plant among the germplasm varied from 0.2 to 5.1 kg. Accessions such as EC-316273-X (2.53 kg), EC-396492 (2.55 kg), EC-467275(2.60 kg), IC-0090851(3.19 kg), IC-0090891-Z(3.19 kg), IC-0090858(3.20 kg), IC-0090898 (3.40 kg), EC-384615 (3.76 kg), IC-0090762 (4.10 kg), IC-0090774 (4.50 kg) and IC-090922-X (5.10 kg) had superior fruit yieldsimilar findings were also reported by Soumya *et al.*, (2023) and Nagar *et al.*, (2024).

Correlation

Correlation analysis is a crucial aspect of any breeding program as it helps in understanding how associated characters influence selection and the genetic gain of complex traits like yield. Pearson correlation

coefficients were calculated to estimate the relationships among the characteristics (Fig. 1). Yield per plant has significant positive correlation with number of fruits per plant ($r = 0.72$, $P < 0.01$) & average fruit weight ($r = 0.61$, $P < 0.001$). Sonagara *et al.*, (2022) also reported a strong and significant relationship between fruit yield and the number of fruits per plant. Yield was negatively correlated with Leaf length ($r = -0.09$, $P < 0.05$, Plant spread ($r = -0.13$, $P < 0.01$) & Plant height ($r = -0.15$, $P < 0.001$). Plant height showed a

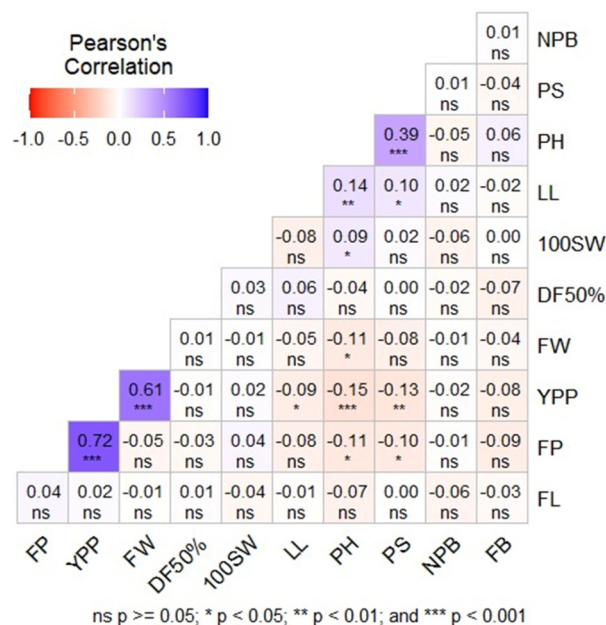


Fig. 1: Graphical depiction of correlation among the quantitative characteristics of the brinjal germplasm.

positively significant correlation with the plant spread ($r = 0.39$, $P < 0.001$), Leaf length ($r = 0.14$, $P < 0.01$) & 100 seed weight ($r = 0.09$, $P < 0.05$) and negatively correlated with average fruit weight ($r = -0.11$, $P < 0.05$). Plant spread exhibited a positive correlation with leaf length ($r = 0.10$, $P < 0.05$) these findings were in agreement with Balasubramaniyam *et al.*, (2021), Kumar *et al.* (2021), Sonagara *et al.*, (2022), and Khan *et al.*, (2023).

Principal component analysis

Principal component analysis (PCA) was employed to assess diversity on a multivariate scale. PCA simplifies the relationships among a large set of characters into a few components, retaining essential information from the original dataset. This method highlights the most influential characteristics contributing to the overall variation (Sanni *et al.*, 2008). In the present investigation, the initial five components with eigenvalues that were greater than 1.0 explained 56.90% of the variance among brinjal genotypes (Table 3). The first component

(PC1) accounted for 15.77% of the variation, primarily due to plant traits such as leaf length, leaf width, plant height, and the number of primary branches per plant. The second component (PC2) explained 12.50% of the variation, driven by plant spread, plant height, and leaf width. The third component (PC3) contributed 10.62% variation through the number of fruits per plant and leaf length (Fig. 2). The fourth component (PC4) showed 9.34% of the variation due to 100-seed weight and plant height, while the fifth component (PC5) contributes 8.66% of the variation mainly through average fruit weight. The first two PCs described 28.28% of the overall variation, with eigenvalues of 1.89 and 1.50, respectively. These components indicated that plant height, plant spread, the number of primary branches per plant, leaf length, and leaf width were the main discriminatory characteristics. Rahman *et al.*, (2014), Kumar *et al.*, (2016), and Savankumar *et al.*, (2018) found similar results, indicating that plant characteristics significantly contributed to the variation among brinjal germplasms.

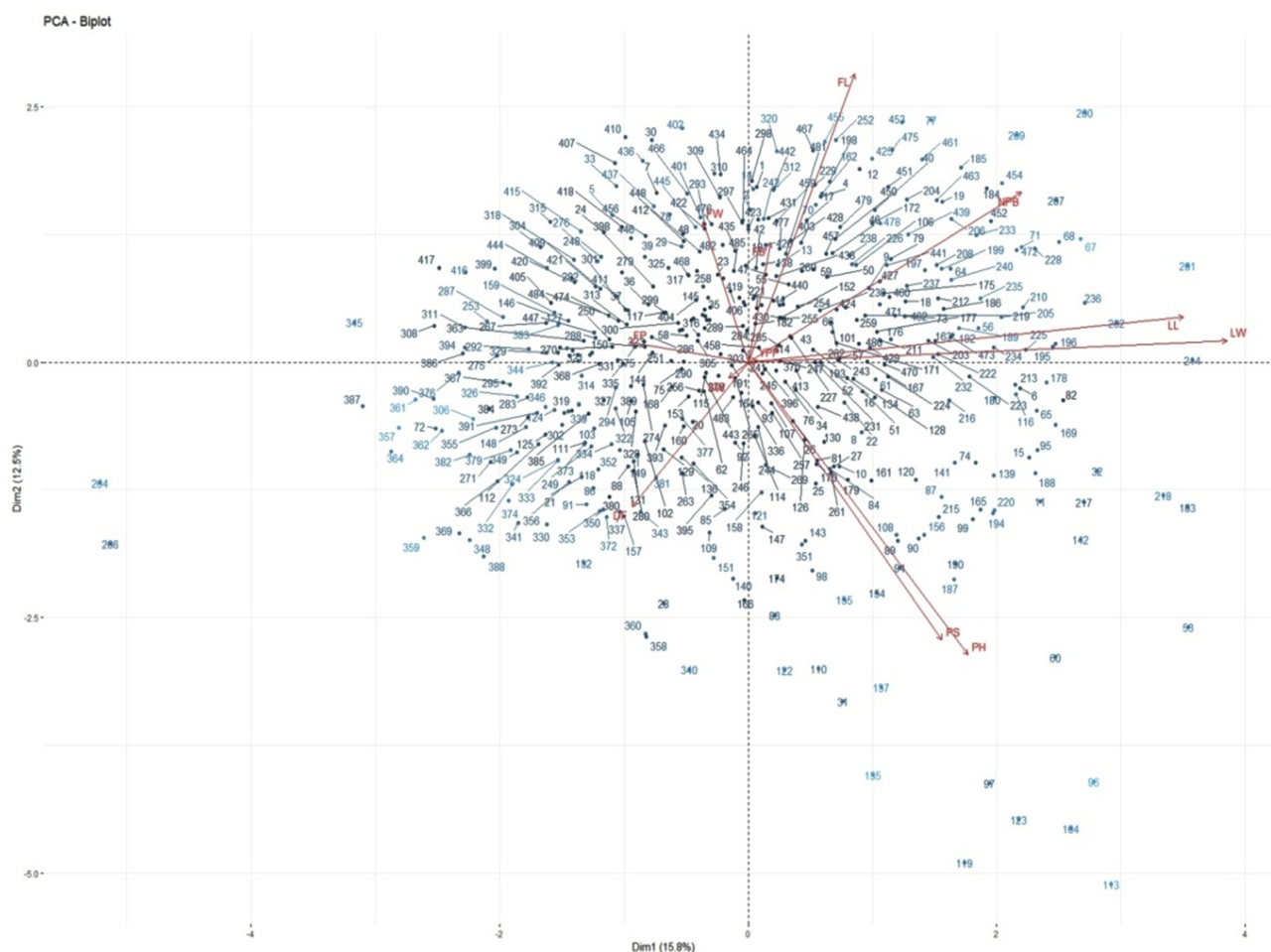


Fig. 2: Two-dimensional graphical representations of component patterns along with different variables based on PC1 and PC2.

Table 3: Eigenvalues, proportion of the total variance represented by the first eight principal components, cumulative per cent variance and component loading of different characters in Brinjal

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
Eigen Value	1.89	1.50	1.27	1.12	1.04	0.58	0.98	0.93	0.90	0.32%
variance Expressed	15.77	12.50	10.62	9.34	8.66	4.86	8.21	7.77	7.49	2.69
Cumulative variance expressed	15.77	28.28	38.90	48.24	56.90	97.31	65.11	72.87	80.37	100.00
PH	0.174	0.808	0.029	0.112	-0.063	-0.103	-0.051	-0.106	-0.201	0.037
PS	-0.041	0.837	-0.102	-0.059	-0.002	0.055	0.043	0.090	0.209	-0.120
NPB	0.167	0.015	0.004	0.024	-0.002	-0.012	-0.051	0.052	0.939	0.141
LL	0.910	0.017	0.109	0.035	0.052	0.050	-0.042	0.025	0.055	-0.043
LW	0.868	0.101	-0.161	-0.070	-0.071	-0.013	0.003	0.034	0.123	0.063
DF	-0.034	-0.005	-0.001	0.025	-0.003	0.001	0.992	0.039	-0.047	-0.087
FL	0.012	-0.074	-0.064	0.029	0.045	0.044	-0.090	0.006	0.137	0.972
FB	0.035	-0.034	0.020	-0.005	0.005	0.994	0.001	0.019	-0.009	0.042
FP	-0.035	-0.061	0.984	0.044	-0.016	0.020	-0.001	0.056	0.003	-0.061
YPP	0.053	-0.008	0.055	0.000	0.021	0.019	0.039	0.988	-0.047	0.005
FW	-0.012	-0.050	-0.015	0.030	0.995	0.005	-0.003	0.021	-0.002	0.043
100SW	-0.029	0.038	0.044	0.992	0.030	-0.005	0.025	0.000	0.021	0.028

PH = Plant height (cm), PS=Plant spread (cm), NPB = Number of primary branches, LL=Leaf length (cm), LW=Leaf width(cm), DF = Days to fifty per cent flowering, FL=Fruit length (cm), FB=Fruit breadth (cm), FP=Number of fruits per plant, YPP = Yield per plant (kg), FW = Average fruit weight (g) and 100SW= 100 seed weight (g).

Conclusion

Accessions such as IC-090922-X, IC-0090774, IC-0090762, EC-384615, IC-0090898, IC-0090858, IC-0090891-Z, IC-0090851, EC-467275, EC-396492, and EC-316273-X demonstrated strong contributions to yield and yield-related traits. These diverse germplasm accessions serve as reservoirs of important genes/alleles that help to get higher yield and can be utilized as foundational material in future breeding programs to develop new, improved varieties and advanced breeding lines in brinjal.

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