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Research Article

Qualitative Trait Based Variability Among Soybean Genotypes

Akash Sharma[1], Nishi Mishra[2], Niraj Tripathi[3], Shagun Nehra[1], Jyoti Singh[1], Sushma Tiwari[1,2] and Manoj Kumar Tripathi[1,2]*

[1]Department of Genetics and Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, India

[2]Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, India

[3]Directorate of Research Services, Jawaharlal Nehru Krishi Vishwa Vidyalaya, India

***Corresponding Author:** Manoj Kumar Tripathi, Department of Genetics and Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, India.

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Abstract

Soybean is a significant crop among all leguminous crops in India. It has higher nutritional values which are essential for human as well as animals. Exploitation of crop genotypes mostly depends on the existence of variability among or between them. Qualitative characters have played major role in the categorization of crop genetic resources. The current investigation was undertaken with the objectives to categorize 60 soybean genotypes on the basis of 12 different qualitative parameters. Qualitative characters were able to categorize the studies genotypes as dendrogram divided these genotypes into two clusters. Genotypes were grouped according to their qualitative characters.

Keywords: Characters; Crop Genetic Resources; Germplasm; Gene Bank; Phenotyping

Introduction

Soybean is one of the significant basic foods grown on more than 123 million hectares (MHA) worldwide. It was expected to produce more than 346 million tonnes annually in 2019-20 [1]. Argentina, Brazil and the United States are the top three soybean-producing countries. To the stock of edible oils in India, soybean contributes significantly. In India now, soybeans account for 43% of all oilseed production and 25% of all oil production. In several regions of the nation, soybean production has significantly improved the economic standing of farmers. Due to the substantial export market for soybean de-oiled cake, growers typically receive better prices [1-5]. India is the 4th largest producer of soybean in the world and produced 13.63 million tonnes during the year 2019-20 with 11.34 million ha area and 1200 kgha^{-1} productivity [6]. During the current season, soybean acreage was up 6.7 percent to 10.84 million hectares from 10.16 million ha in the previous season [7,8]. Madhya Pradesh is recognised as "Soya State" and has made significant contributions in all areas to the growth and extension of soybean farming [9-13]. With 5.516 million ha under soybean production and a productivity of 1285 kgha^{-1}, Madhya Pradesh is the country's greatest producer of soybeans, producing 6.73 million tonnes in 2019–20 [6].

Phenotyping is generally employed for the analysis of variability present among a specific set of genotypes [14-16]. It is an essential action to estimate the exploitation of the genetic resource collection existed in a gene bank. The two types of morphological data, qualitative and quantitative features, are typically the foundation of diversity studies. Continuous variation can be seen in quantitative qualities [17-20]. When analysing genotype performance without being influenced by environmental influences, qualitative features provide an easy technique to measure genetic variation [21-23].

Sharma., *et al.* (2016) [24] used 11 qualitative parameters to categorise 124 regionally varied roselle accessions. For the purpose of comparing the genetic links among 17 sorghum accessions, nine qualitative morphological features were noted. In light of the foregoing, the current study was conducted to analyse variability among various soybean genotypes using twelve qualitative traits.

Materials and Methods

The present research consisted 60 genotypes of soybean (Table 1) was conducted in the years 2019 and 2020. The field experiment was conducted at the experimental field, Department of Genetics and Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India. The field was prepared by cultivating it with a tractor-driven cultivator and harrowing it twice with disc harrows to create a fine tilth. The land was finally levelled using a leveller powered by a tractor. The experiment was then laid out. In all treatments, hand dribbling was used to plant the seeds. Each plot received a 20:60:20:20 kg ha^{-1} application of nitrogen, phosphorus, potassium, and sulphate. Five plants from each replication of each treatment were chosen at random to be observed. The link and significant differences between soybean genotypes were evaluated by qualitative analysis. For the genetic diversity investigation, twelve characteristics were used. According to UPOV descriptor, UPOV (1998) [25] qualitative features were described. Obtained data was employed to construct dendrogram to confirm the grouping of genotypes. Dendrogram was constructed on the basis of Unweighted Pair Group Method with Arithmetic Mean (UPGMA) using NTSyS-PC software [26].

Results and Discussion

Characterization of crop genotypes is fundamental approach for their categorization [27-32]. This also aids to avoid duplication of genotype. Qualitative characters have played an important role in the classification of crop genotypes owing to their stable inheritance over generations. These characters have proved their reliability for characterization of genotypes. One of the important reasons behind the steadfastness is that they are fewer influenced by fluctuations in environmental circumstances. During the present investigation, oobservations on different qualitative traits were recorded for all the 60 genotypes (Table 2; Figure 1a-e; Figure 2). Leaf types were classified among all soybean genotypes and a to-

S. No.	Genotypes	Source/ Origin	S. No.	Genotypes	Source/Origin
1	RVS2011-76	RVSKVV, Gwalior	31.	Bragg	USA
2	RVS2011-35	RVSKVV, Gwalior	32.	Hardee	USA
3	RVS 28	RVSKVV, Gwalior	33.	Gaurav	JNKVV, Jabalpur
4	RVS2011-10	RVSKVV, Gwalior	34.	DS3106	Delhi
5	RVS2012-15	RVSKVV, Gwalior	35.	DS3105	Delhi
6	RVS2011-77	RVSKVV, Gwalior	36.	JSM240* SL517	JNKVV, Jabalpur
7	RVS2011-73	RVSKVV, Gwalior	37.	HIMSO-16	JNKVV, Jabalpur
8	RVS2011-74	RVSKVV, Gwalior	38.	PS1225	GBPUA&T, Pantnagar
9	RVS2011-21	RVSKVV, Gwalior	39.	CAT87	JNKVV, Jabalpur
10	RVS2012-01	RVSKVV, Gwalior	40.	RSC1052	Raipur
11	RVS2011-32	RVSKVV, Gwalior	41.	BAUS102	Ranchi
12	RVS2011-04	RVSKVV, Gwalior	42.	PK885	GBPUA&T, Pantnagar
13	RVS2011-75	RVSKVV, Gwalior	43.	Shivalika	JNKVV, Jabalpur
14	NRC136	NRCS, Indore	44.	AUKS-174	JNKVV, Jabalpur
15	NRC37	NRCS, Indore	45.	SP-37	Not known selection
16	NRC7	NRCS, Indore	46.	JS335	JNKVV, Jabalpur
17	SL688	PAU, Ludhiana	47.	AMS475	PDKV, Akola
18	SL958	PAU, Ludhiana	48.	AMS243	PDKV, Akola
19	SL96	PAU, Ludhiana	49.	AMS-MB5-18	PDKV, Akola
20	SL953	PAU, Ludhiana	50.	JS2009* PS1475	JNKVV, Jabalpur
21	SL983	PAU, Ludhiana	51.	JS2063*JS9560	JNKVV, Jabalpur

22	SL995	PAU, Ludhiana	52.	JS2053*JS2034	JNKVV, Jabalpur
23	SL525	PAU, Ludhiana	53.	JS20-90	JNKVV, Jabalpur
24	SL1074	PAU, Ludhiana	54.	JS97-52	JNKVV, Jabalpur
25	EC602288	Exotic collection	55.	JS21-17	JNKVV, Jabalpur
26	EC538828	Exotic collection	56.	JS20-78	JNKVV, Jabalpur
27	EC46728	Exotic collection	57.	JS93-05	JNKVV, Jabalpur
28	Young	JNKVV, Jabalpur	58.	AMS100-39	PDKV, Akola
29	C-2797	JNKVV, Jabalpur	59.	RVS2001-04	RVSKVV, Gwalior
30	PK472	GBPUA&T, Pantnagar	60.	JS16-11	JNKVV, Jabalpur

Table 1: List of genotypes with their source.

tal of 14 genotypes were found with pointed ovate leaf, 30 with rounded ovate, 8 with lanceolate and 8 with triangular leaf (Table 3; Figure 2). Maximum (dark) leaf colour intensity was reported in 22 genotypes, medium in 25 genotypes, and light in 13 genotypes (Table 3; Figure 2). Only two sorts of blossom colour were seen among the 60 genotypes, with 43 genotypes being white and the remaining 17 being purple (Table 3; Figure 2). A total of 18 genotypes had medium pod colour intensity, 12 had light pods, and 22 had dark pods (Figure 2). While the remaining 18 genotypes lacked pod hairs, a total of 42 genotypes were determined to be pod hairy. Table 3 and Fig. 2 Ten genotypes had sparse tawn hair, while 23 genotypes had dense tawn hair, five had sparse white hair, and four had light tawn genotypes. The remaining 18 genotypes had no hair. Among 60 genotypes, 36 genotypes were spherical flattened seed shape, 4 genotypes were elongated seed shape, 10 genotypes were elongated flattened while 10 genotypes were spherical seed shape. A total of 43 genotypes had presence of pubescence whereas rest

S. No.	Genotypes	Flower colour	Intensity of leaf color	Leaf shape	Plant growth habit	Presence of pubescence	Size of lateral leaflet	Testa colour	Seed shape	Helium color	Hair colour	Hair
1.	RVS 2011-76	Purple	Dark	Pointed Ovate	Erect	Present	Medium	Yellow	Spherical flattened	Imperfect black	sparse tawn	Present
2.	RVS 2011-35	White	Dark	Rounded Ovate	Erect	Absent	Medium	Yellow green	Spherical flattened	Black	Hairless	Absent
3.	RVS 28	White	Dark	Lanceolate	Semi erect	Present	Small	Yellow	Spherical flattened	Dark black	Light tawn	Present
4.	RVS 2011-10	White	Dark	Rounded Ovate	Semi erect	Absent	Medium	Yellow green	Spherical flattened	Dark black	Hairless	Absent
5.	RVS 2012-15	White	Dark	Lanceolate	Semi spread	Present	Large	Yellow	Elongated flattened	Brown	Dense tawn	Present
6.	RVS 2011-77	White	Medium	Lanceolate	Semi spread	Present	Medium	Yellow green	Spherical flattened	Imperfect black	Dense tawn	Present
7.	RVS2011-73	White	Medium	Pointed Ovate	Semi spread	Present	Large	Yellow green	Spherical flattened	Brown	Spare white	Present
8.	RVS 2011-74	Purple	Light	Pointed Ovate	Semi erect	Absent	Large	Yellow green	Elongated flattened	Imperfect black	Hairless	Absent
9.	RVS 2011-21	White	Medium	Pointed Ovate	Semi erect	Present	Medium	Yellow green	Spherical flattened	Dark black	Sparse tawn	Present
10.	RVS 2012-01	White	Dark	Lanceolate	Semi erect	Present	Medium	Yellow	Spherical flattened	Brown	Dense tawn	Present
11.	RVS 2011-32	White	Medium	Pointed Ovate	Erect	Absent	Medium	Yellow	Spherical flattened	Brown	Hairless	Absent
12.	RVS 2011-04	White	Medium	Rounded Ovate	Erect	Absent	Medium	Yellow green	Elongated flattened	Dark black	Hairless	Absent
13.	RVS 2011-75	Purple	Light	Rounded Ovate	Erect	Absent	Small	Yellow green	Spherical flattened	Dark black	Hairless	Absent

14.	NRC 136	White	Light	Rounded Ovate	Erect	Present	Small	Yellow green	Elongated flattened	Brown	Dense tawn	Present
15.	NRC 37	White	Medium	Triangular	Semi erect	Present	Medium	Yellow	Spherical flattened	Brown	Sparse white	Present
16.	NRC 7	Purple	Medium	Triangular	Semi erect	Present	Small	Yellow green	Spherical flattened	Grey	Light tawn	Present
17.	SL 688	Purple	Light	Rounded Ovate	Semi erect	Present	Small	Yellow green	Spherical flattened	Brown	Dense tawn	Present
18.	SL 958	White	Light	Triangular	Erect	Present	Medium	Yellow green	Elongated flattened	Imper-fect black	Sparse white	Present
19.	SL 96	White	Light	Rounded Ovate	Semi erect	Present	Small	Yellow green	Spherical flattened	Dark black	Dense tawn	Present
20.	SL 953	White	Light	Pointed Ovate	Semi erect	Present	Medium	Yellow green	Spherical	Grey	Sparse tawn	Present
21.	SL 983	White	Medium	Pointed Ovate	Erect	Present	Medium	Yellow	Spherical flattened	Black	Dense tawn	Present
22.	SL 995	White	Light	Rounded Ovate	Erect	Present	Small	Yellow green	Spherical flattened	Grey	Sparse tawn	Present
23.	SL 525	White	Dark	Pointed Ovate	Erect	Present	Medium	Yellow green	Elongated flattened	Imper-fect black	Sparse tawn	Present
24.	SL 1074	White	Medium	Rounded Ovate	Erect	Present	Small	Yellow green	Spherical flattened	Black	Dense tawn	Present
25.	EC 602288	White	Medium	Rounded Ovate	Erect	Present	Medium	Yellow green	Elongated flattened	Brown	Dense tawn	Present
26.	EC 538828	Purple	Dark	Rounded Ovate	Semi erect	Absent	Medium	Yellow	Spherical flattened	Brown	Hairless	Absent
27.	EC 46728	Purple	Medium	Triangular	Erect	Present	Small	Yellow green	Spherical flattened	Imper-fect black	Dense tawn	Present
28.	YOUNG	White	Medium	Rounded Ovate	Erect	Present	Medium	Yellow green	Spherical flattened	Brown	Dense tawn	Present
29.	C-2797	White	Light	Rounded Ovate	Erect	Present	Medium	Yellow green	Elongated flattened	Dark black	Sparse tawn	Present
30.	PK 472	White	Dark	Pointed Ovate	Erect	Present	Medium	Yellow green	Elongated	Grey	Light tawn	Present
31.	BRAGG	White	Light	Triangular	Semi erect	Present	Medium	Yellow green	Elongated flattened	Dark black	Dense tawn	Present
32.	HARDEE	White	Medium	Rounded Ovate	Erect	Present	Medium	Yellow green	Spherical flattened	Brown	Sparse tawn	Present
33.	GAURAV	Purple	Medium	Triangular	Semi erect	Present	Medium	Yellow green	Spherical flattened	Brown	Sparse tawn	Present
34.	DS 3106	Purple	Dark	Rounded Ovate	Semi spreading	Absent	Large	Yellow green	Spherical flattened	Dark black	Hairless	Absent
35.	DS 3105	Purple	Dark	Rounded Ovate	Semi spreading	Absent	Large	Yellow green	Spherical	Imper-fect black	Hairless	Absent
36.	JSM240* SL517	White	Medium	Pointed Ovate	Semi erect	Present	Large	Yellow	Spherical	Imper-fect black	Dense tawn	Present
37.	HIMSO-16	White	Medium	Triangular	Erect	Present	Small	Green	Spherical flattened	Imper-fect black	Dense tawn	Present

38.	PS 1225	White	Medium	Rounded Ovate	Semi erect	Present	Medium	Yellow	Spherical flattened	Dark black	Spares white	Present
39.	CAT 87	White	Medium	Rounded Ovate	Semi erect	Present	Medium	Yellow green	Elongated flattened	Imper-fect black	Dense tawn	Present
40.	RSC 1052	Purple	Dark	Rounded Ovate	Erect	Present	Large	Yellow green	Spherical flattened	Imper-fect black	Hairless	Absent
41.	BAUS 102	White	Dark	Triangular	Semi erect	Present	Medium	Yellow	Elongated	Brown	Dense tawn	Present
42.	PK 885	White	Medium	Rounded Ovate	Erect	Present	Small	Yellow	Spherical	Black	Sparse tawn	Present
43.	SHIVALIKA	White	Medium	Rounded Ovate	Speading	Present	Small	Yellow green	Spherical	Black	Dense tawn	Present
44.	AUKS-174	Purple	Dark	Pointed Ovate	Semi spreading	Present	Large	Yellow	Spherical	Brown	Dense tawn	Present
45.	SP-37	White	Dark	Rounded Ovate	Erect	Absent	Medium	Black	Spherical flattened	Dark black	Hairless	Absent
46.	JS 335	Purple	Dark	Rounded Ovate	Erect	Absent	Small	Yellow green	Spherical flattened	Imper-fect black	Hairless	Absent
47.	AMS 475	Purple	Medium	Lanceo-late	Erect	Absent	Small	Yellow green	Spherical	Black	Hairless	Absent
48.	AMS 243	White	Dark	Pointed Ovate	Erect	Present	Medium	Yellow	Spherical	Brown	Dense tawn	Present
49.	AMS-MB 5-18	White	Light	Pointed Ovate	Erect	Present	Medium	Yellow green	Spherical flattened	Brown	Sparse tawn	Present
50.	JS2009* PS1475	White	Dark	Lanceo-late	Erect	Absent	Medium	Yellow green	Spherical flattened	Imper-fect black	Hairless	Absent
51.	JS2063* JS95-60	White	Medium	Rounded Ovate	Erect	Present	Medium	Yellow green	Spherical flattened	Brown	Dense tawn	Present
52.	JS20-53*JS20-34	Purple	Light	Rounded Ovate	Semi erect	Absent	Small	Yellow	Elongated	Dark black	Hairless	Absent
53.	JS 20-90	White	Dark	Lanceo-late	Semi erect	Present	Small	Yellow green	Spherical flattened	Dark black	Dense tawn	Present
54.	JS 97-52	White	Medium	Rounded Ovate	Erect	Present	Small	Yellow	Spherical flattened	Grey	Dense tawn	Present
55.	JS 21-17	White	Light	Rounded Ovate	Erect	Present	Small	Yellow green	Spherical	Black	Sparse white	Present
56.	JS 20-78	White	Dark	Rounded Ovate	Semi erect	Present	Medium	Yellow green	Spherical flattened	Black	Dense tawn	Present
57.	JS 93-05	Purple	Medium	Lanceo-late	Erect	Absent	Medium	Yellow	Spherical	Imper-fect black	Hairless	Absent
58.	AMS100-39	White	Medium	Rounded Ovate	Erect	Absent	Medium	Green	Elongated	Imper-fect black	Hairless	Absent
59.	RVS 2001-04	White	Dark	Rounded Ovate	Semi erect	Present	Medium	Yellow green	Spherical flattened	Dark black	Light tawn	Present
60.	JS 16-11	Purple	Dark	Pointed Ovate	Semi spreading	Absent	Medium	Yellow green	Spherical flattened	Imper-fect black	Hairless	Absent

Table 2: Different qualitative traits of soybean genotypes.

Description	Category	Number of genotypes	Frequency (%)
Leaf shape	Lanceolate	8	13.33
	Rounded Ovate	30	50.00
	Pointed Ovate	14	23.33
	Triangular	8	13.33
Leaf intensity of green colour	Dark	22	36.66
	Medium	25	41.66
	Light	13	21.66
Flower colour	White	43	71.66
	Violet/purple	17	28.33
Hairiness	Absent	18	30
	Present	42	70
Pod colour	Dark green	9	15
	Medium green	28	46.66
	Light green	23	38.33
Hair colour	Sparse tawn	10	16.66
	Dense tawn	23	38.33
	Sparse white	5	8.33
	Light tawn	4	6.66
	Hairless	18	30
Seed shape	Spherical flattened	36	60
	Elongated	4	6.66
	Elongated flattened	10	16.66
	Spherical	10	16.66
Presence of pubescence	Present	43	71.66
	Absent	17	28.33
Size of lateral leaflet	Large	8	13.33
	Medium	34	56.66
	Small	18	30
Plant growth habit	Erect	31	51.66
	Semi-erect	21	35
	Spreading	1	1.66
	Semi-spreading	7	11.66
Helium colour	Brown	17	28.33
	Black	8	13.33
	Imperfect black	16	26.66
	Dark black	14	23.33
	Grey	5	8.33
Testa colour	Yellow green	40	66.66
	Yellow	17	28.33
	Green	2	3.33
	Black	1	1.66

Table 3: Distribution of phenotypic classes among different qualitative traits.

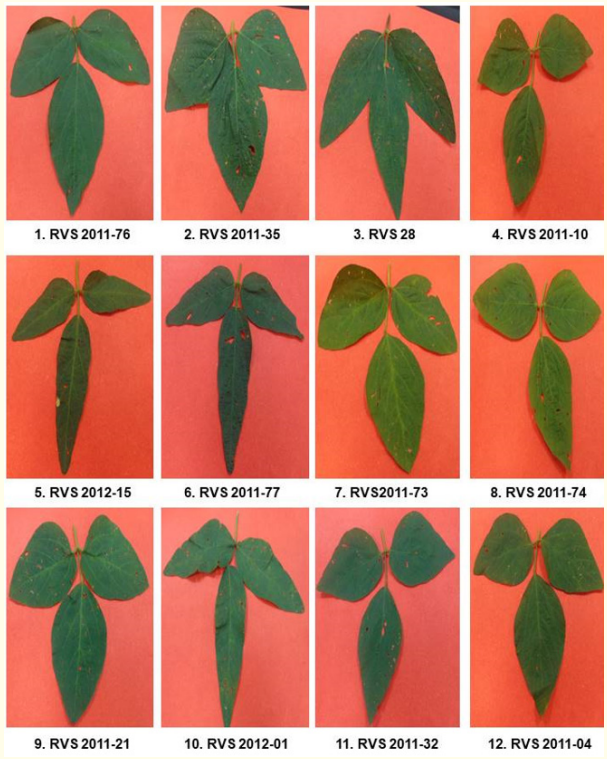

Figure 1a: Variability in leaves of soybean genotypes.

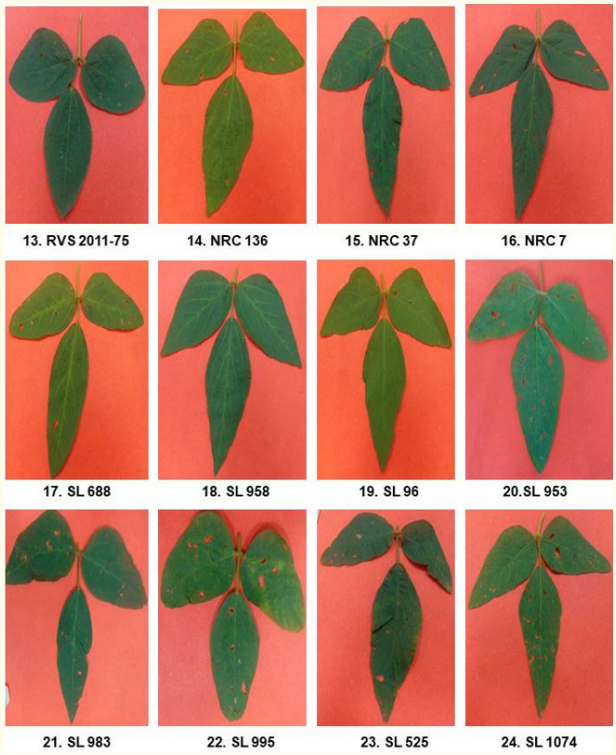

Figure 1b: Variability in leaves of soybean genotypes.

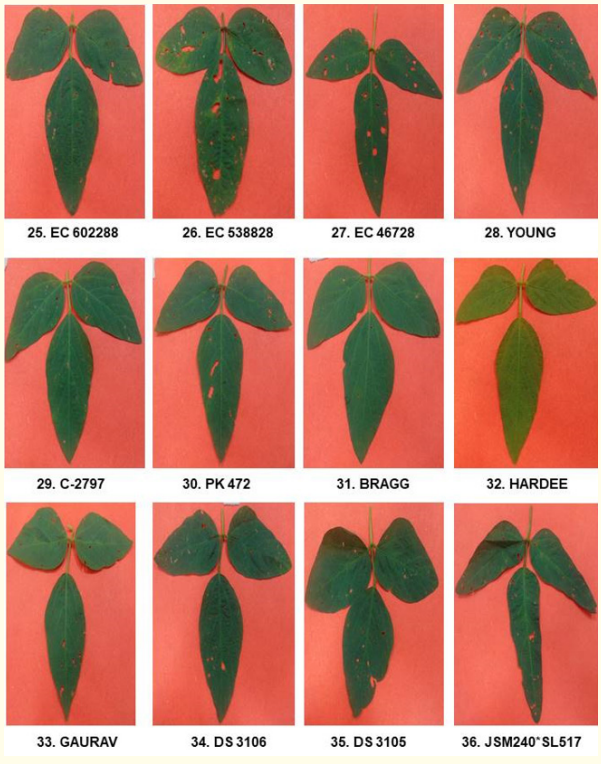

Figure 1c: Variability in leaves of soybean genotypes.

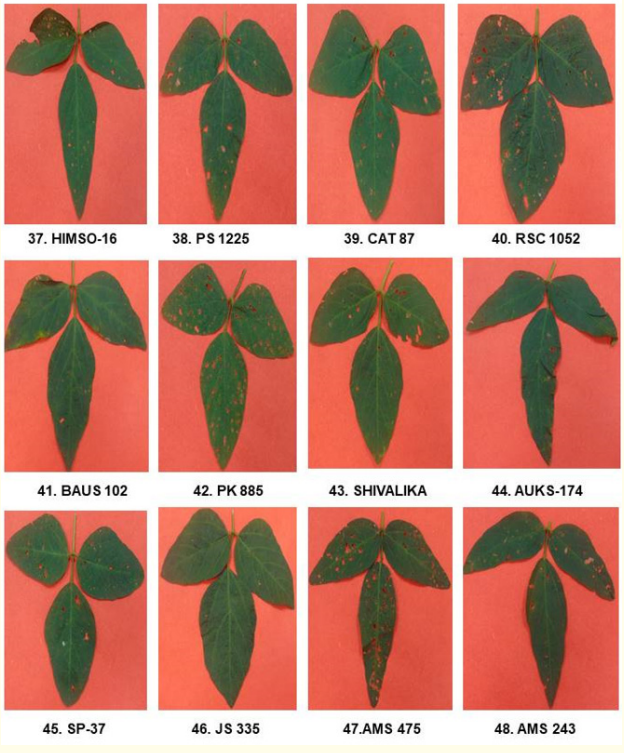

Figure 1d: Variability in leaves of soybean genotypes.

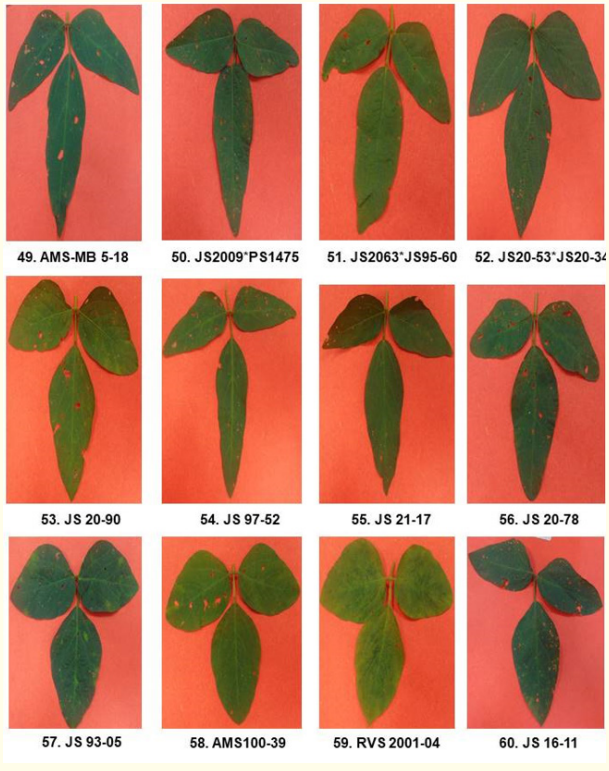

Figure 1e: Variability in leaves of soybean genotypes.

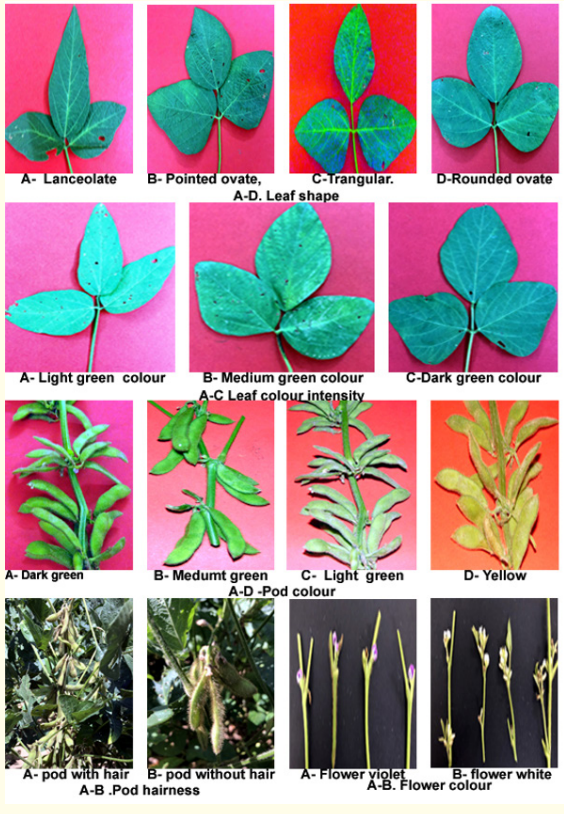

Figure 2: Different qualitative traits of soybean.

of 17 genotypes were lack of presence of pubescence. Eight genotypes had lateral leaflets that were large in size, 34 genotypes had lateral leaflets that were medium in size, and 18 genotypes had lateral leaflets that were tiny in size. Seven genotypes possessed a semi-spreading type of plant growth behaviour, compared to 31 erect, 21 semi-erect, and 1 spreading genotypes. 60 genotypes were identified, of which 17 were brown helium, 8 were black, 16 were imperfect black, 14 were dark black, and the remaining 5 were grey helium. There were 40 genotypes in all with yellow, green, and black testa colours; 17 genotypes had yellow, green, and black testa colours (Table 3).

Similar to the current experiment [33] observed eleven qualitative traits for 45 genotypes of soybean. Plant growth habits were divided into four categories: erect, semi-erect, spreading, and semi-spreading. Out of the 45 genotypes that were examined, 27 genotypes were found to be semi-erect, 14 to be erect, 3 to be spreading, and 1 to be semi-spreading. The majority of genotypes [31] were examined with medium-sized lateral leaflets, while 10 genotypes had small and four genotypes had large-sized lateral leaflets. According to research, the intensity of green was found to be at its highest (darkest) in 11 genotypes, medium in 26 genotypes, and light in eight genotypes. Out of the 45 genotypes, 41 had hairs and the remaining four did not. There was a total of 19 genotypes with scant tawn hair, 17 with thick tawn, 4 with sparse white hair, and only one with light tawn hair, whereas hairs were lacking in 4 genotypes. Only two flower colour variations were tested; 35 genotypes were white and the remaining 10 were violet. A total of 30 genotypes had light, medium, or dark pods, with only two genotypes having dark pods. Only 10 genotypes were spherical, six elongated flattened, and one had an extended seed shape, whereas the majority of genotypes had spherical flattened seed shapes [28]. The majority of the genotypes [34] had testas that were yellow-green, with 10 of them yellow and one green colour.

Reports on five qualitative traits were also documented during our previous study [22] for the 53 soybean genotypes. Leaf types were varied among all soybean genotypes and a total of 22 genotypes were found with pointed ovate leaf, 20 with rounded ovate, 9 with lanceolate while two with triangular leaf. Maximum (dark) leaf colour intensity was found to occur in 8 genotypes, medium in 30 genotypes, and light in 15 genotypes. Only two varieties of bloom colour were examined among the 53 soybean genotypes; 25 genotypes were white and the remaining 28 were purple. There was a total of 18 genotypes with medium-intensity pods, 12 with light pods and 22 with dark pods. A total of 29 genotypes were examined, while the remaining 24 genotypes lacked pod hairs.

The Shannon algorithm was used to compute the genetic diversity index (Shannon index) of soybean genotypes with twelve qualitative features. Each section's Shannon index value was very dissimilar from the others. The H' of twelve qualitative qualities was used to estimate the frequency distribution of the diversity index. The characteristic helium color's H' value was found to be the highest (1.525) for all the traits. Among all the features, an average index (H') of 0.966 was studied (Table 4). Earlier, the Shannon index was also used by [34], [35,22] to experiment with high variability in various qualitative soybean attributes. According to the phenotypic dissimilarity index, genotypes that diverged from others can be used as parents in upcoming breeding programmes through hybridization for the investigational qualitative qualities.

Dendrogram created during the current experiment using sixty different soybean genotypes' qualitative characteristics (Figure 3). Two clusters, one major and one minor, were created from the genotypes of the investigated soybeans. The minor cluster has 16 genotypes including RVS2011-74, SL995, SP37, AMS100-39, RVS2011-21, RSC1052, PK472, Gaurav, DS3106, BAUS102, JS20-09*PS1475, JS20-53*JS20-34, RVS2011-73, AUKS174, RVS2011-32 and RVS2011-04 whereas the big cluster has 44 genotypes. The major cluster was further divided into two sub clusters. Major sub cluster has 36 genotypes while minor cluster contained only 8 genotypes *viz*., SL688, PS1225, SL953, RVS2011-10, NRC136, SL958, SL1074 and JS20-78. The major sub group consisted 36 genotypes including RVS 2011-75, RVS2011-76, RVS 2012-15, AMS 243, AMS -MB 5-18, Young, Bragg, DS 3105, RVS 2012-01, RVS 2011-77, JS2063*JS95-60, EC 602288, HIMSO-16, AMS 475, JS21-17, JS 97-52, RVS 28, RVS 2001-04, SL 96, CAT 87, JS 16-11, JS 20-90, JS 93-05, PK 885, Shivalika, RVS2011-35, NRC37, SL983, SL525, C-2797, Hardee, JSM240*SL517, JS335, NRC 7, EC 46728 and EC 538828.

Phenotypic characterization of a set of crop genetic resources is an important activity which provides basic information for conservation of genetic resource as well as their efficient exploitation particularly in breeding programmes. In the present research, 60 soybean genotypes were characterized to evaluate their qualitative

Character	LS	LCI	FC	PC	PH	HC	SS	PP	SL	PG	HC	TC	Avg.
Shannon-H'	1.223	1.064	0.523	1.088	0.611	1.415	1.084	0.596	0.592	1.028	1.525	0.809	0.966

Table 4: Shannon- Weaver diversity indices (H') of traits.

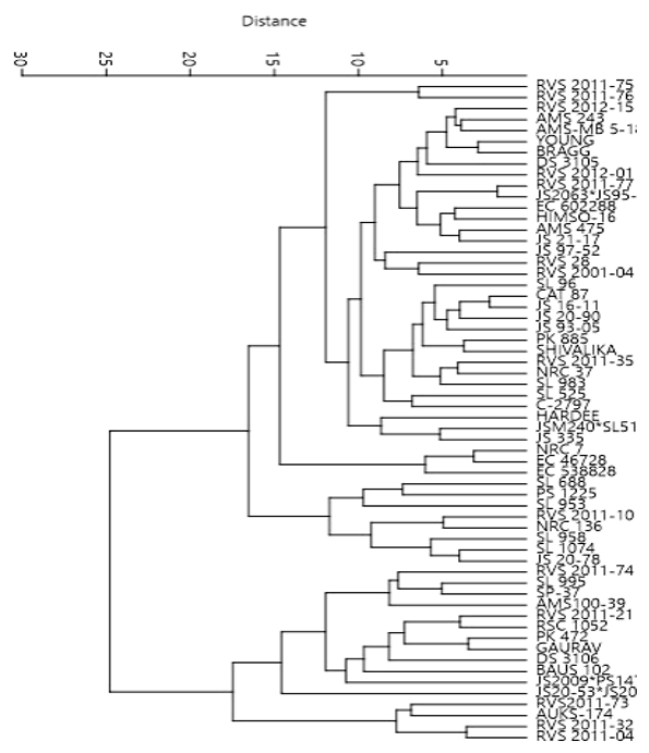

Figure 3: Dendrogram showing relationship among soybean genotypes based on different qualitative traits.

trait-based variability. Diversity analyses showed that the qualitative traits undertaken had low variability. In order to enhance the multiplicity of qualitative characters in the collection of Indian soybean genotypes many more investigations needed [17,20]. Qualitative characters should be in our mind while conducting collections of soybean germplasms. Other important features that can be considered throughout assortment of the soybean genotypes are the traits that have high correlations with other traits. The accomplishment of any agenda for conservation of germplasm could also be considered by the amount of which the collected genotypes are being exploited.

Conclusions

Data obtained from qualitative trait-based characterization of these 60 soybean genotypes may be utilized as fundamental information for the exploitation of these genotypes for further soybean breeding program. Assessment of these genotypes should be conducted to analyze their efficiency as donor parents for development of new varieties with enhanced responses to different biotic and abiotic situations.

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