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Germplasm Evaluation of Soyabean (*Glycine max* L.) through Morphological and Quality Characterization

Rajbeer Singh Gaur and Ayodhya P. Pandey*

Department of Genetics and Plant Breeding, Faculty of Agriculture Science AKS, University, Satna 485001 (M.P.), India

**Corresponding author*

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A B S T R A C T

Soybean (*Glysine max* L.) a important oil seed crop has been characterized previously on various aspects through DUS (distinctiveness, uniformity and stability) test. In this study an attempt is being made to characterized 10 popular varieties of soybean at agriculture research farm of AKS University Satna under natural environment as per the guidelines of The Protection of Plant Varieties and Farmer Right Authority (PPV&FRA 2009). The varieties were characterized for 13 characters viz. plant growth type, days to 50% flowering, leaf shape, leaf colour, plant growth habit, flower colour, plant height, pod colour, pod shattering, days to maturity, seed index, seed shape and seed colour. Most of the varieties have medium height except JS 9560 and JS 2034 were short type and JS 9752, NRC 99 and NRC86 were tall. Most of the varieties have plant growth type semi-determinate and indeterminate except JS 9560 was determinate. Most of the varieties have leaf shape pointed ovate except JS 9560 and JS9305 were lanceolate and NRC 117 and NRC 99 were rounded ovate. Most of the varieties have plant growth habit semi-erect except JS 2069, JS 2034 and JS 335 were erect. All candidate varieties showed purple flower colour whereas JS 2069, JS 2034, JS 2029 and JS 9752 have white flower colour. Most of the varieties have medium maturity duration except JS 9560, JS 9305 and JS 2034 were early maturing type.

Introduction

Soybean (*Glycine max* L. Merril) (2n=40) is the world's most important seed legume native to East Asia, which contributes to 25 % of the global edible oil, about two-thirds of the world's protein concentrate for livestock feeding. Soybean meal is a valuable ingredient in formulated feeds for poultry and fish. It is very important oil seed crop in India and is called as a golden bean or miracle bean because of its versatile nutritional qualities having 20% oil and 38 to 43 percent protein, which has biological value as meat and fish protein and rich in amino acids like lysine and tryptophan (Quayam *et al.*, 1985). Soybean is ranked number one in international market among world's major oilseed crops (Chung & Singh 2008). Total 51 soybean improved varieties have been notified/ released in India

for the cultivation in different agro-ecological zones of the country during 2005 to 2018 (National Food Security Mission). The distinctness, uniformity and stability are to be established by the DUS Test. Therefore candidate varieties are to be compared with all the varieties, whose existence is matter of common knowledge and with the most similar varieties. Characterization of varieties is important in order to avoid the duplication varieties are classified on the basis of morphological and seed characters. Qualitative characters are being more stable over generations (Raut, 2003) hence are reliable for characterization of varieties. For yield improvement, it is essential to have knowledge on the variability of different characters such as days to 50% flowering, days to maturity, plant height (cm), number of branches/plant, number of pods/plant, number of seeds/plant, 1000-seed weight (g), seed yield per plant (g), biological yield (g), and harvest index (%). Morphological traits can be used to assess phenotypic variation in growing environments and are also used as tools for the indirect analysis of genetic variability and diversity (Kaur *et al.,* 2016). Genetic variability is the basic requirement for crop improvement as this provides wider scope for selection.

Knowledge of diversity patterns will allow breeders to better understand the evolutionary relationships among accessions, to sample germplasm in a more systematic fashion and to develop strategies to incorporate useful diversity in their breeding programs (Naik *et al.,* 2016). The information on genetic diversity helps in choosing parents for generation of new varieties, needs of continuous evaluation of germplasm for useful characters, which in earlier days was solely based on the available morphological data. Morphological traits/markers reflect not only on the genetic composition of the cultivar, but also the interaction of the genotype with the environment in which it is expressed (Shadakshari *et al.,* 2011). Therefore, the present study was planned to characterize the 10 soybean varieties for 13 different traits.

Materials and Methods

10 varieties of soybean, 7 obtained from JNKVV Jabalpur JS 2069, JS9560. JS9305, JS 2034, JS 2029, JS 335, JS 9752 and three varieties from Directorate of Soybean Research Indore was NRC 117, NRC 86, NRC 99. Characterization of seed was done in 2017. All 10 varieties were planted in the experimental field of AKS University Satna during Kharif, 2017. Varieties were planted in eight rows in five meter row length (45 x 10 cm). Characterization was done for 13 different characters at different stages of crop growth as per DUS test guidelines (PPV& FRA, 2009). Data were recorded on randomly selected fifteen competitive plants. Correlation was studied between the traits like days to 50% flowering, plant height, days to maturity, and seed index by karl Pearson's correlation method.

Results and Discussion

In the present study, 9 qualitative and four quantitative traits were studied for establishing the varietal distinctness. All the 13 characters were found to be polymorphic in nature (table 1 and 2). Submitted seed samples were characterized for seed characteristics. Six varieties were with small seed size one (JS 95-60) was with large seed size, one(JS 93-05) was with small seed size and rest were with medium seed size. Growth habit was determinate (JS 95-60, JS 335) and semi-determinate (JS 20-69, JS93-05, JS 20-34, JS 20-29, JS 97-52, NRC 117, NRC 86, NRC 99). Leaf color was green in most of the varieties except JS 9560, JS 9305 JS 335 and NRC 86 have dark green leaf color.

Table.1 Qualitative characters and their state of expression

Varieties	Plant: Growth type	Leaf: Shape	Leaf: Colour	Plant growth habit	Flower: Colour	Pod: colour	Pod: shattering	Seed: shape	Seed colour
JS 20-69	semi-determinate	Pointed ovate	Green	Erect	White	Yellow	Non-shattering	Elliptical	Yellow
JS 95-60	Determinate	Lanceolate	Dark green	Erect	Purple	Brown	Non-shattering	Spherical	Yellow
JS 93-05	semi-determinate	Pointed ovate	Dark green	Semi-erect	Purple	Brown	Non-shattering	Elliptical	Yellow
JS 20-34	semi-determinate	Pointed ovate	Green	Semi-erect	White	Brown	Non-shattering	Spherical	Yellow
JS 20-29	semi-determinate	Pointed ovate	Green	Semi-erect	White	Yellow	Shattering	Elliptical	Yellow
JS 335	Determinate	Pointed ovate	Dark green	Semi-erect	Purple	Yellow	Non-shattering	Elliptical	Yellow
NRC 117	semi-determinate	Rounded ovate	Green	Semi-erect	Purple	Yellow	Non-shattering	Elliptical	Yellow
NRC 86	semi-determinate	Pointed ovate	Dark green	Semi-erect	Purple	Yellow	Non-shattering	Elliptical	Yellow
NRC99	semi-determinate	Rounded ovate	Green	Semi-erect	Purple	Yellow	Non-shattering	Elliptical	Yellow
JS 97-52	semi-determinate	Pointed ovate	Green	Semi-erect	White	Yellow	Non-shattering	Elliptical	Yellow

Table.2 Quantitative characters and their state of expression

Varieties	Days to 50% flowering	Plant height (cm)	Days to maturity	Seed index (gm.)
JS 20-69	Late	Medium	Late	Medium
JS 95-60	Medium	Short	Early	Large
JS 93-05	Late	Medium	Early	Small
JS 20-34	Medium	Short	Early	Medium
JS 20-29	Late	Medium	Medium	Medium
JS 335	Late	Tall	Late	Medium
NRC 117	Late	Tall	Late	Medium
NRC 86	Late	Tall	Medium	Medium
NRC99	Late	Tall	Late	Medium
JS 97-52	Late	Tall	Late	Medium

1. Plant: days to 50% flowering; Early ≤35 days, Medium 36-45 days, Late >45 days
2. Plant: height; Short ≤40 cm, Medium 41-60 cm, Tall >60 cm.
3. Plant: days to maturity; Early ≤ 95 days, Medium 96-105 days, Late >105 days.
4. Seed: size; Small ≤10 g, Medium 10.1- 13.0 g, Large >13.0g.

Table.3 Mean and range of quantitative traits

Characters	Mean	Standard Deviation	Range
Days to 50% flowering	50.00	5.946	38.00(JS 20-34) to 60.00(JS 97-52)
Plant height (cm)	56.65	20.316	38.00(JS 95-60) to 73.00(JS 97-52)
Days to maturity	103.8	35.023	80.00(JS 95-60) to 130.00(JS 97-52)
Seed index (gm.)	11.24	3.913	8.72(JS 93-05) to 14.52(JS 95-60)

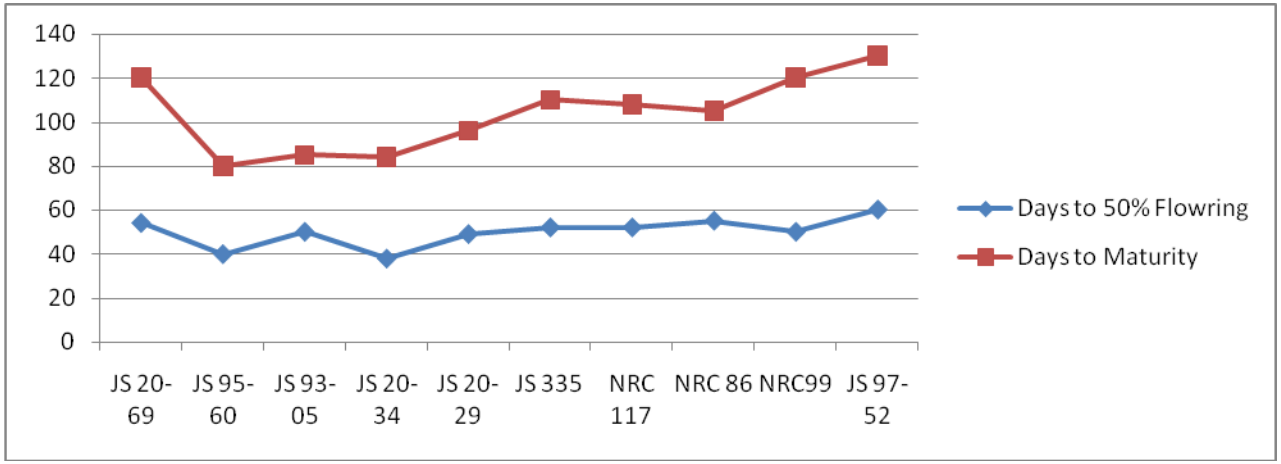
Correlation Matrix

Character	Days to 50% flowering	Plant height (cm)	Days to maturity	Seed index (gm.)
Days to 50% flowering	**1.000**	0.799**	0.8204**	-0.27
Plant height (cm)		**1.000**	0.721*	-0.14
Days to maturity			**1.000**	-0.143
Seed index (gm.)				**1.000**

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Days to 50% flowering is positively correlated with Plant height and Days to maturity at the 0.01 level . Plant height is positively correlated with Days to maturity at the 0.05 level. Seed index (gm.) is negatively correlated between Days to 50% flowering, Plant height and Days to maturity.

Graph.1 Days to 50% Flowering vis-a-vis Days to Maturity



Days to 50% flowering and days to maturity exhibited a significant Positive correlation (0.8204)

Two groups of flower color, white and purple were observed. All varieties except JS 20-69, JS 20-34, JS 20-29 and JS 97-52 were purple flower colored. All three groups of plant height i.e. short (JS 95-60, JS 20-34), medium (JS 20-69, JS 93-05, JS 20-29) and tall (JS 335, NRC 117, NRC86, NRC99, JS 97-52) were observed. It ranged from 73.00 cm (JS97-52) to 38.00 cm (JS 95-60). Pod color was brown in JS 95-60, JS 93-05 and JS 20-34, rest others were yellow pod colored. All varieties were resistant to pod shattering except JS 20-29. Seed shape of all the varieties was generally elliptical except JS 95-60 and JS 20-34. All the varieties were with dull appearance and yellow to yellow green seed color. Days to 50% flowering ranged from 38 days (JS 20-34) to 60 days (JS 97-52) but days to maturity were early ranged from 80 days (JS 95-60) to 130 (JS 97-52) days. Positive significant correlation was found between days to 50% flowering and plant height (0.799), days to 50% flowering and days to maturity (0.8204) and between plant height and days to maturity (0.721). Whereas, highly non significant negative correlation was found between Days to 50% flowering and Seed index (gm.), Plant height(cm) and Seed index (gm.), Days to maturity and Seed index (gm.) (table 4). It is concluded that out of 10 soybean varieties were characterized and found distinct to each other. Thus in the present study morphological descriptors proved to be more helpful as the identity of all the cultivar could be established individually.

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