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Distinctness in Indian soybean (*Glycine max*) varieties using DUS characters*

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Soybean (*Glycine max* (L.) Merr.) is an important oilseed crop of the world accounting for more than 50% of oilseeds and about 30% of the total supply of all vegetable oils (Tiwari 2006). Till today, more than 90 improved varieties have been released in India for the cultivation in different parts of the country. The characterization of a variety is essential for a plant breeder, seed inspectors, researcher and other clientele to meet their specific needs. In present context, identification of plant varieties of common knowledge is essential for the protection of new plant varieties under the Protection of Plant Varieties and Farmers Right Act (PPV&FRA), 2001. Article 15.3(b) of the PPV&FR Act states that the new variety must be clearly distinguishable by one or more essential characters from any variety whose existence is a matter of common knowledge at the time of seeking protection. The uniqueness of a variety is to be established by test called DUS (Distinctness, Uniformity and Stability). Therefore, candidate variety is to be compared with all the varieties, whose existence is matter of common knowledge, which is a huge task. This task can be minimized by comparing candidate variety with the most similar variety. Therefore, it is pre-requisite to study the essential characters of all the varieties of common knowledge because these characters are explicit and repeatable. The present investigation was undertaken to study the essential characters of soybean varieties for grouping them and to study the distinctness among them.

The experiment was conducted at VPKAS experimental farm, Hawalbagh (1250 m above sea level; 29°36'N latitude and 79°40' E longitude) using genetically pure seeds of 89 soybean varieties released in India. An 78 varieties were grown in 2005 and 2006 rainy (*kharif*) season, while 11 and 89 varieties were grown in 2007 and 2008 *kharif* season, respectively. At each season each variety was grown with in plot of 6 rows of 5 m long with a spacing of 45 cm between rows and 10 cm between plants with 3 replications.

To establish distinctness among varieties, the descriptor of essential characters (Table 1) were used in a sequential

Table 1 List of essential characters along with their descriptor code and name used

Character's name	Descriptor code and name		
Flower colour	White	Violet	
Hypocotyl anthocyanin colour	Non-pigmented	Pigmented	
Peroxidase activity	1a: Absent	1b: Present	
Pod hairs	2a: Absent	2b: Present	
Pod hair colour	3a: Grey	3b: Tawny	
Colour of testa	4a: Yellow	4b: Yellow green	4c: Green 4d: Black
Seed: hilum colour	5a: Brown	5b: Black	5c: Imperfect black
Leaf shape	6a: Lanceolate	6b: Pointed ovate	6c: Round ovate
Plant growth type	7a: Determinate	7b: Semi-determinate	7c: Indeterminate
Time of maturity	8a: Early(100 days)	8b: Medium(100–125 days)	8c: Late(> 125 days)
Time for 50% flowering	9a: Early(48days)	9b: Medium(48–58 days)	9c: Late(> 58 days)
Seed shape	10a: Spherical	10b: Elongated	

*Short note

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Table 2 Soybean varieties having common essential characters

Varieties	Descriptor code
Violet flowered group	
'CO soya 2', 'MAUS 71', 'JS 71–05', 'JS 335'	1a, 2a, 4a, 5b, 6c, 7a, 8b, 9b, 10a
'MAUS 32', 'Indira Soya 9'	1a, 2b, 3a, 4a, 5a, 6b, 7b, 8c, 9c, 10a
'JS 2', 'Shilajeet', 'Palam Soya'	1a, 2b, 3b, 4a, 5a, 6a, 7a, 8b, 9b, 10a
'MACS 57', 'Gaurav', 'Gujarat Soya 1', 'Punjab 1', 'Improved Pelican'	1a, 2b, 3b, 4a, 5a, 6a, 7b, 8c, 9c, 10a
'Gujarat Soya 2', 'CO Soya 3', 'MAUS 61–2', 'JS 80–21'	1a, 2b, 3b, 4a, 5a, 6a, 7a, 8b, 9b, 10a
'Pusa 16', 'Pusa 22'	1a, 2b, 3b, 4a, 5b, 6b, 7a, 8b, 9b, 10a
'JS 75–46', 'Pusa 40'	1b, 2b, 3b, 4a, 5a, 6b, 7b, 8c, 9c, 10a
White flowered group	
'Pusa 37', 'Bragg', 'SL 525'	1a, 2b, 3b, 4a, 5a, 6b, 7a, 8b, 9b, 10a
'PK 416', 'PS 1342'	1b, 2b, 3b, 4a, 5a, 6b, 7a, 8b, 9b, 10a
'SL 295', 'NRC 2'	1b, 2b, 3b, 4a, 5b, 6b, 7a, 8b, 9b, 10a

manner as per the National test guidelines for the conduct of test for Distinctness, Uniformity and Stability on Soybean (Ramteke *et al.* 2006).

The distinctness among the varieties are depicted through dendrogram. Two characters hypocotyls, anthocyanin colour and flower colour were directly linked. All the pigmented hypocotyl varieties exhibited violet coloured flowers, whereas non-pigmented hypocotyl exhibited white coloured flowers. However, Payne and Sundermeyer (1977) observed bronze band pigmentation on hypocotyls of certain white flowered soybean, when grown on continuous light. This explanation implies that pigmented hypocotyls may occur in white flowered varieties. Thus both the characters are rightly included in the DUS test guidelines published by International Union for the Protection of New Varieties of Plants (UPOV) as well as Directorate of Soybean Research in India. Indian soybean varieties were grouped into 2 major groups on the basis of flower colour. Thirtyfive soybean varieties exhibited

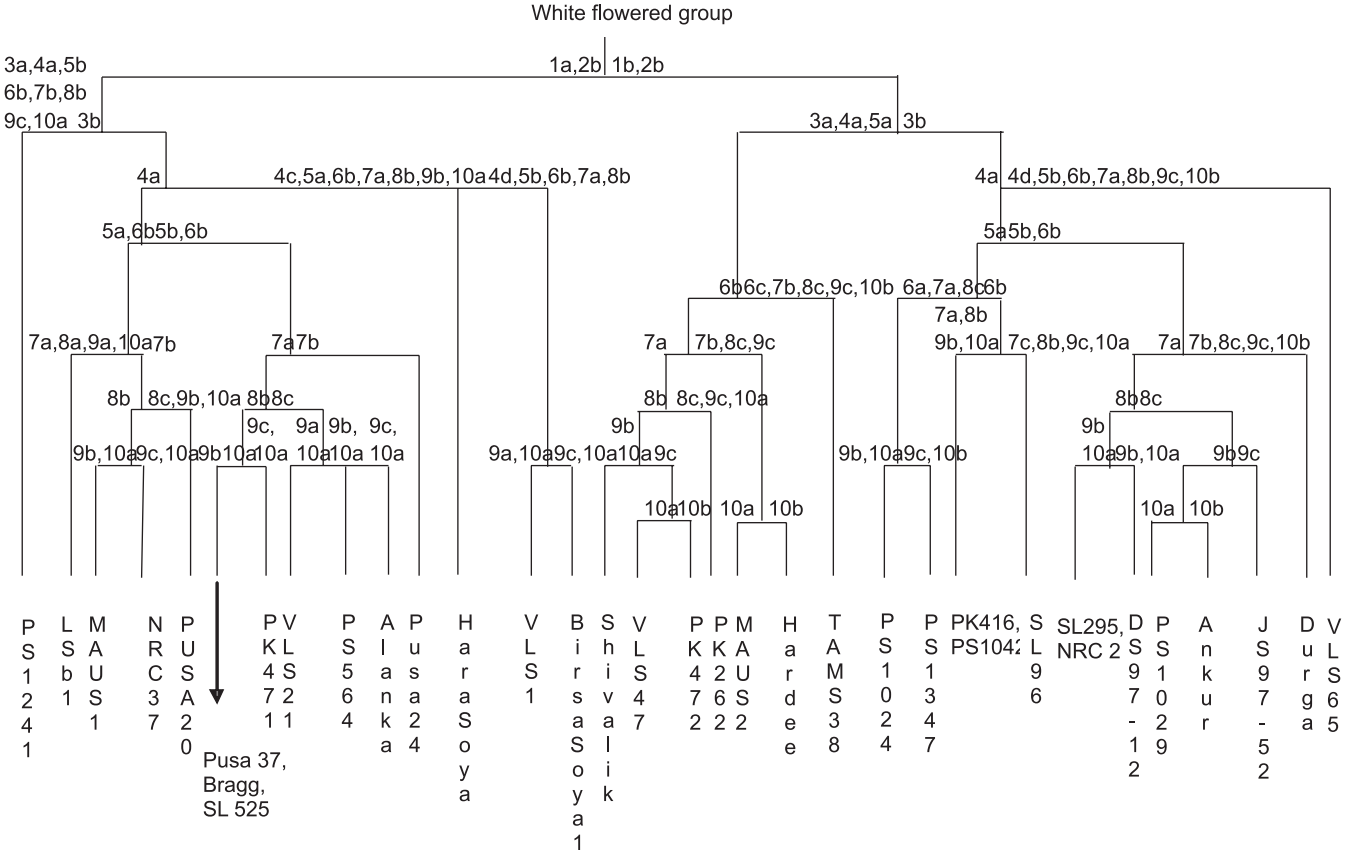

Fig 1 Distinctness in white flowered soybean varieties

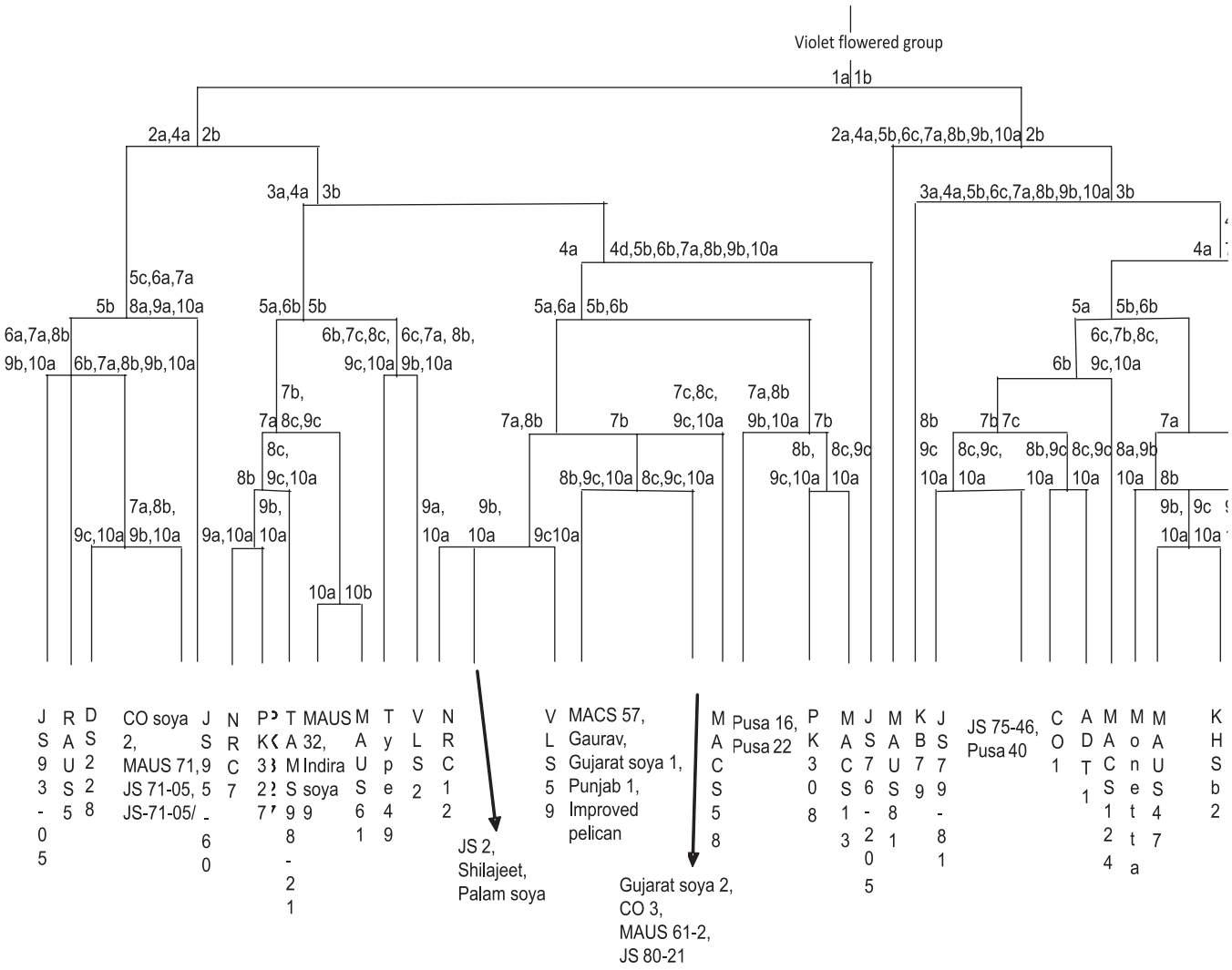

Fig 2 Distinctness in violet flowered soybean varieties

white coloured flowers, whereas 54 varieties exhibited violet flower. Characters, namely peroxidase activity and presence and absence of hair on pod were further used for recording distinctness. 'MAUS 81' soybean was found distinct from other soybean varieties as it exhibited violet flowers, peroxidase activity present and hair on pod was absent. Further 'PS 1241' in white flowered group and 'KB 79' in violet flowered group were found distinct from the rest of varieties as they exhibited grey hair colour on the pod. Varieties 'Hara soya' and 'VLB 65' in white flowered group and 'JS 90–41', 'JS 76–205' and 'Kalitur' in violet flowered group were found distinct from rest of the varieties on the basis of testa colour. 'JS 95–60' was found distinct from rest of the soybean varieties on the basis of imperfect black hilum colour. Five soybean varieties, namely 'JS 93–05', 'RAUS 5', 'Type 49', 'VLS 2' in violet flowered group and 'TAMS 38' in white flowered group were found distinct from rest of the varieties on the basis of leaf shape. Seven varieties, viz 'MACS 450', 'Lee' and 'MACS 58' in violet flowered group and 'LSb 1', 'Pusa 24', 'SL 96' and 'Durga' in white flowered group exhibited distinctness from the rest of 67 varieties, when the grouping character growth habit was imposed. When time of flowering was used as grouping character 9 varieties exhibited distinctness, whereas when days to flowering was imposed as grouping character 22 varieties exhibited distinctness. Of the 36 varieties, 7 varieties, viz 'MAUS 61', 'VLS 47', 'PK 472', 'MAUS 2', 'Hardee', 'PS 1029' and 'Ankur' were found distinct, when the grouping character seed shape was imposed (Figs 1, 2). Comparison of present work with the results published by Satyavathi *et al.* (2004), Rani *et al.* (2004) and database of Directorate of Soybean Research and National Bureau of Plant Genetic Resources (NBPGR) indicate that the flower colour, presence and absence of pod hair, colour of hair, colour of testa were the most stable characters across the zone and no deviation was observed when tested in different agro-climatic zones.

These characters could be used in identifying the reference varieties for each candidate variety. Eight per cent variation was observed for characters leaf shape and hilum colour. The variation in leaf shape was mainly observed between round ovate and pointed ovate leaf and *vice versa*. This indicates that subjective recording of leaf shape is prone to error or environment plays a role in expression of this character. For leaf shape, ratio of leaf length to leaf width as suggested by UPOV should be used. The variation in hilum colour of same varieties at different location mainly due to production environment, disease infection, failure of synthesis of anthocyanin pigment or masking (Yadav and Sharma 2001). Thus, for distinguishing varieties based on leaf shape and hilum colour, varieties must be grown over more than 1 year and data should be recorded by group of scientist to arrive at valid conclusion. Variation war observed for plant growth type (23%), time of flowering (45.3%) and days to maturity (45.3%). This variation was expected as soybean is a photosensitive crop and its growth behaviour changes with the change in altitude. Therefore, both UPOV and Protection of Plant Varieties and Farmers Rights Authority of India have decided to conduct the DUS test in 2 locations over 2 years. The responsibility for conducting DUS testing in soybean lies with Directorate of soybean Research, Indore (located in central India); University of Agricultural Sciences, Dharwad (located in southern India) and Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora (northern hill region). These test locations are the representative climate of agro-ecological regions for which the varieties have been developed. Repeating of trial over location is also essential so as to compensate for possible failure of trial at one location due to natural calamities (Gopal *et al.* 2008).

Of the 89 soybean varieties studied, 60 varieties were found to be distinct on the basis of 10 essential characters. Remaining 29 varieties formed the 10 groups (Table 2). These 10 groups were distinct from each other but the varieties within group exhibited similar characters. Therefore, it is necessary to examine distinctness through quantitative characters. UPOV has also endorsed that varieties can be clearly distinguishable if the difference between two varieties equals or exceeds the least significant difference at specified probability level. The number of registered varieties is increasing steadily; it would be thus practically impossible to grow all varieties of common knowledge in the DUS trials to test the distinctness of the candidate varieties. The results of the present study could be used for the selection of reference varieties for DUS testing of new soybean varieties. For seeking protection under Protection of Plant Varieties and Farmers Rights Act, the study shall guide the breeder, what essential characters to be incorporated in the new soybean variety to make it distinct from others.

SUMMARY

Twelve morphological and a biochemical characters were used to develop the identification key for the establishment of distinctness among Indian soybean (*Glycine max* (L.) Merr.) varieties. Of the 89 soybean varieties studied, 60 varieties were found to be distinct on the basis of 12 essential characters. Remaining 29 varieties can be classified into 10 groups. These groups were distinct from each other but the varieties within group exhibited similar characters. Characters, viz flower colour, presence and absence of pod hair, colour of hair, and colour of testa were found reliable and reproducible across the zones. The study shall be helpful in identifying most similar reference variety for comparing it with candidate variety. For seeking protection under Protection of Plant Varieties and Farmers Rights Act, the study shall guide the breeder, what essential characters should be incorporated in the new soybean variety to make it distinct from others.

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REFERENCES

Gopal J, Pandey S K, Kumar V, Kumar R, Pande P C and Singh S V. 2008. Morphological descriptors for DUS testing of potato varieties. *PGR Newsletter* **154**: 40–7.

Payne R C and Sundermeyer E W. 1977. Pigmentation differences of soybean with green hypocotyl color when grown in continuous light. *Crop Science* **19**: 124–6.

Ramteke R, Satyavathi C T, Husain S M and Karmakar P G. 2006. *National test guidelines for conduct of tests for distinctness, uniformity and stability on soybean* (*Glycine max* (L.) Merrill). National Research Centre for Soybean, Indore, Madhya Pradesh.

Rani A, Kumar V and Hussain S M. 2004. Identification of soybean cultivars using biochemicals and morphological characteristics at seed and seedling stage. *Indian Journal of Plant Genetic Resources* **17:** 1–7.

Satyavathi C T, Bharadwaj C H, Husain S M, Karmakar P G, Tiwari S P, Joshi O P and Mohan Y. 2004. Identification key for soybean (*Glycine max*) varieties released or notified in India. *Indian Journal of Agricultural Sciences* **74:** 215–8.

Tiwari S P. 2006. Plant introduction in soybean- achievements and opportunities. *Indian Journal of Plant Genetic Resources* **19:** 353–65.

Yadav S P and Sharma S P. 2001. Variation in hilum colour and its stability during four crop seasons in soybean (*Glycine max*). *Indian Journal of Agricultural Sciences* **71**: 23–6.