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Estimation of Phenotypic Diversity of Soybean Genotypes Available in Sri Lanka for Varietal Improvement

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ABSTRACT

Soybean is an introduced crop to Sri Lanka with extensive cultivation increase during 1970s with the intervention of developmental programs. But still the requirements for the animal feed industry is importing due to non availability of oil processing within the country. The genetic diversity studies play a vital role in an effective plant breeding program in order to utilize and manage existing germplasm. Present study aim to understand the genetic diversity received from plant Genetic Resource Center, Gannoruwa for the future breeding needs. 65 genotypes of soybean were characterized and evaluated in the research field of Grain legumes and Oil Crops Research and Development Center, Angunakolapelessa during 2012/13 Maha season. Principal Component analysis reveals that three components explained 72% of total variability. Also in the cluster analysis genotypes were grouped in to 5 clusters, where 20, 17,15,9 and 4 was the genotype numbers in each cluster. The reference variety Pb 01, which is the most popular variety of soybean in Sri Lanka, was in the main cluster which contains 20 genotypes. Cluster group 3 has shown the highest mean values for grain yield per plant, terminal leaflet width and terminal leaflet width. Therefore to improve the variety PB 01 use of genotypes from the cluster group 3 may be possible with considering the other qualitative characteristics.

Key Words: Cluster analysis, genetic diversity, germplasm, soybean

INTRODUCTION

Soybean (*Glycine max* (L) Merr.) is a legume of global importance for the nutrition of human and animals (Singh *et al*., 2012). The seed of soybean contain around 40% of protein and 20% of fat. This crop is called as "Golden Bean" or "Miracle Crop" of the 20th century, because of its multiple uses. It is a nitrogen fixing legume, which originated in Asia and has edible users such as cooking oil, Soy sauce and as animal feed (Singh *et al*., 2014). Industrial uses range from cosmetics and printing inks to lubricants and bio diesel. Soybean is not an indigenous crop in Sri Lanka, it is introduced during colonial periods and the extensive cultivation of this species was begun only after the establishment of the International Soybean. Due to non development of oil processing industry from soybean even at present, the marketing of the soybean is rather difficult. But the total requirement of soybean meal for the animal feeds is importing from other countries and various value added products of soybean such as "soymeat" and "samaposha" are becoming popular within the country. So at present country has to expand its production alone with the oil processing industry to meet the domestic demand in near future. The Department of agriculture has recommended three soybean varieties for general cultivation, where pb 01 is the most popular variety among local farmers and further it was introduced during early stages of the soybean development program (Aberathne and Chitrapala, 2013).With the attention on increase the production within the country, there is a timely need of improved varieties of soybean. Genetic diversity analysis is an important part in effective plant breeding program. Genetic diversity studies reveal genetic backgrounds and relationship of germplasm and also provide strategies to establish utilize and manage crop core collections (Salimi *et al*., 2012). Morphological characterization is the first step in the description and classification of germplasm (Singh *et al*., 2010a). Data on the level of genetic diversity of a gemplasm collection may increase the efficiency of efforts to improve a species. Soybean breeding program needs to include screening techniques, selection of

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suitable parents, identification of source of resistance, and crossing (Arunaldy, 1995 and Singh *et al*., 2010a). Since there was very little effort has made on varietal improvement of soybean, the present study was aimed to study the genetic diversity of available germplasm collection at Plant Genetic Resources Center, (PGRC) Gannoruwa for their characterization and evaluation so that the trait specific germplasm may be utilized in the future breeding programme (Singh *et al*., 2010b), due to bilateral and multinational international treaties, the flow of desired germplasm is diminishing day by day (Singh *et al*., 2015 and Verma *et al*., 2014).

MATERIALS AND METHODS

Sixty five germplasms which were received from Plant Genetic Resources Center, Gannoruwa, Sri Lanka were evaluated in the research field of Grain Legumes and Oil Crops Research and Development Center, Angunakolapelessa in 2012 and 2013 during Maha Season. The experiment was established as a non replicated trial with 3 rows of 2 meter per one accession. The established lines were evaluated based on the descriptor published by PGRC, Sri Lanka for soybean evaluation for specific trait to identify trait specific germplasm (Singh *et al*., 2010a). Data were collected using randomly selected five plants from the middle row of each soybean accession. Terminal leaflet length, terminal leaflet width, Days to maturity, Plant height at maturity, number of pods per plant, 100 seed weight and grain yield per plant were recorded. SPPSS16 computer software package was used to analyze these genotypes where Principal Component analysis and cluster analysis were done. In the Principal Component Analysis (PCA) factor analysis with varimax rotation method was used to study the variable independence and balanced weighting of traits. Custer analysis was done using wards method of squared Euclidian distance in order to investigate the distance, similarity and relatedness of these genotypes.

RESULTS AND DISCUSSION

According to the principal component analysis it is observed that three principal components and factors with Eigen value more than one explained 72 % of total variability (Table 1).

According to the Table 1, the 1st principal component is related to terminal leaflet width, terminal leaflet length, grain yield per plant and number of pods per plant. It explained 32.2 % of the total variability. The 2nd principal component explained 20.9 % of the total variability, which related to 100 seed weight, number of pods per plant and days to maturity. The 3rd principal component explains the characters such as days to maturity and plant height at maturity.

Genetic studies on soybean are very rare in Sri Lanka, as this is an introduced crop to the country. Most of the germplasm of soybean available in the plant genetic resource center have unknown origin and it is important to get an understanding about the genetic diversity of available germplasm in order to carry out a strong varietal improvement program for soybean. A dendrogram of the hierarchical cluster analysis of evaluated accessions were presented in the Fig. 1. Considering the dendrogram at Euclidian distance of 10 there were 05 clusters where these accessions grouped. Number of genotypes in the cluster 1, 2 and 3 were 20, 17 and 15 respectively. Two other minor clusters consist of 9 and 4 genotypes respectively. The reference variety Pb 01, which is the most popular variety of soybean in

Table 1: Principal components (PCs) for 7 morphological traits in 65 soybean genotypes.

Character	1st component	2nd component	3rd component
Days to maturity	-0.066	-0.076	0.903
Plant height at maturity	0.287	0.478	0.600
No; of pods/plant	0.410	0.755	-0.181
100 seed weight	0.237	-0.797	-0.172
Grain yield/plant	0.559	0.144	0.345
Terminal leaflet length	0.896	0.067	-0.067
Terminal leaflet width	0.912	-0.056	0.013
Eigen value	2.258	1.467	1.360
Proportion	0.322	0.209	0.194
Cumulative	0.322	0.532	0.726

Sri Lanka was in the main cluster which contains 20 genotypes.

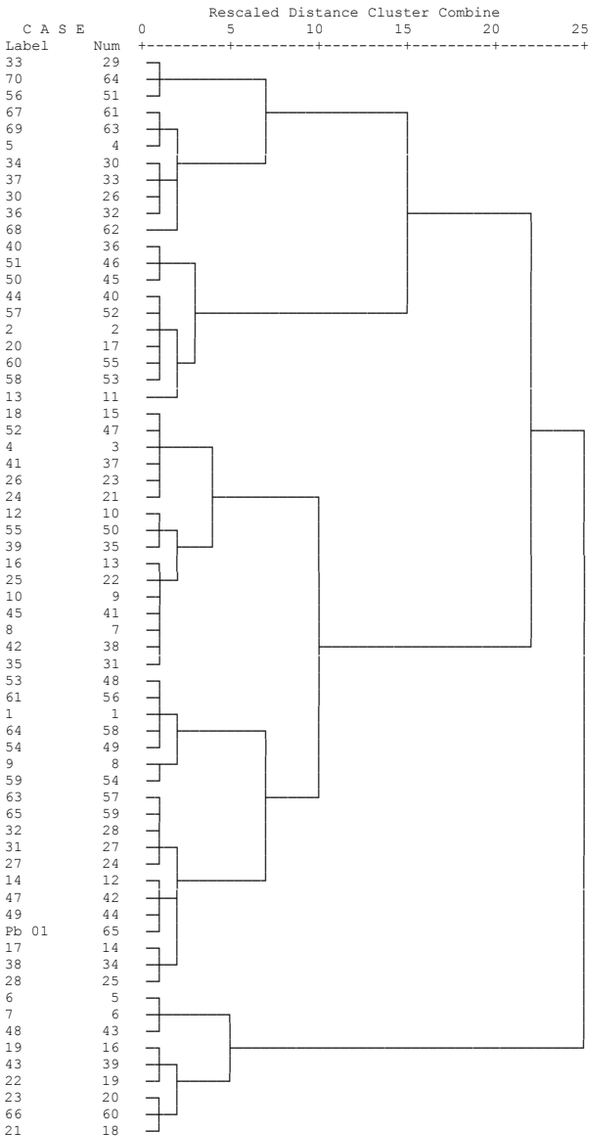

Fig. 1 : Dendrogram using Ward Method

Cluster group 3 has shown the highest mean values for grain yield per plant, terminal leaflet width and terminal leaflet width (Table 2). The cluster group 4 has the highest value for days to maturity but the seed weight and the grain yield per plant was very low in the cluster. May be the genotypes in that cluster has not performed or adapted well to the local environmental conditions. The accessions in the cluster group 3 have better morphological characters compared to other clusters. Selection of proper parents play a vital role in a successful plant breeding program and depending on the breeding objective, results of cluster analysis could be applied for the crossing program for crop improvement. Therefore to improve the variety PB 01 use of genotypes from the cluster group 3 may be possible with considering the other qualitative characteristics.

CONCLUSION

As soybean crop improvement is a timely need in the country, genetic studies are important for successful varietal improvement program. The soybean germplasm available in the country may be having narrow genetic variability, but still breeders need to find effective genetic resources for their breeding programs. Within the tested genotypes most of the lines have similar characters compared to PB 01, the popular variety in the country. According to the study some lines which have some level of different genetic background can be used as parents in the crossing program, especially in improving the existing varieties.

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Table 2: Means of characters in five cluster groups in 65 soybean genotypes.

Cluster group	Number of genotypes	DM	PHM	NPP	SW	GYP	TLL	TLW
1	20	96.9	28.9	30.7	12.9	12.1	6.5	4.1
2	17	86.7	21.4	39.6	17.4	9.4	6.4	4.3
3	15	94.7	30.7	49.7	17.0	16.7	8.1	5.3
4	9	99.7	31.1	33.5	7.7	8.2	4.5	2.9
5	4	92.7	39.6	118.3	8.4	15.7	7.4	4.7

Note: DM: Days to maturity, PHM: plant height at maturity (cm), NPP: No of pods per plant, SW: 100 seed weight(g), GYP: grain yield per plant, TLL: terminal leaflet length(cm), TLW: Terminal leaflet width (cm).

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