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COMPARATIVE PERFORMANCE OF DIFFERENT MATURITY GROUPS OF SOYBEAN (*Glycine max* L. Merrill) GENOTYPES UNDER PUNJAB CONDITIONS

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ABSTRACT : Soybean (*Glycine max* L. Merrill) is an important leguminous pulse and vegetable oil seed crops growing in tropical and sub-tropical regions of India. It is a thermo-sensitive crop and its response to yield is governed by genotype which differing maturity. Fifteen genotypes differing in maturity dates-early, medium and late were selected and sown on first fortnight of June. The genotypes with late maturing date produced higher yield as compared to the early and medium maturing genotypes. The results revealed that the genotypes early (EC 457161), medium (SL 983) and late (SL 958) produced higher numbers of pods per plant, plant height, more 100-seed weight, harvest index and maximum seed yield (2053.67, 2441.91 and 2370.86 kg/ha) than other because of their better genotypic records. Finally, the genotype SL-958 at late maturing date seemed to be more effective in getting higher grain yields.

Keywords : *Maturity groups, soybean genotypes, seed yield.*

Considering the present Punjab scenario as depleting natural resources and unabated soil degradation as a consequence of intensive agriculture calls for crop diversification. Soybean is most viable option, which requires less number of irrigations and inputs as compared to paddy. Soybean (*Glycine max* L. Merrill), belonging Fabaceae family, is one of the important-vegetable legume crops and major source of high quality protein for human daily diet and livestock feed in the world (Lie *et al.,* 12). It is one of the most important oil seed crops in the world (Aduloju *et al.,* 1). In addition to its rich protein (35-45%) and oil content (15-25%), soybean seed also contains about 33% carbohydrates, upto 16.6% of which are soluble sugars (Hou *et al.,* 7). Besides being an important source of protein for human diet and animal feed, soybean has been considered to be one of the most promising crops for producing bioenergy (biodiesel) in the near future (Soy Stats, 19). India ranks fifth in the world after USA, Brazil, Argentina and China in soybean production. Soybean production in India accounts for only 3% of total production in the global market. As per latest USDA report 8,800 thousand metric tonnes is the estimated domestic output in 2010-2011. Cultivation of soybean in India is restricted mainly to Madhya Pradesh, Uttar Pradesh, Maharashtra and Gujarat. It is also grown on a small acreage in Himachal Pradesh and Punjab.

Several studies have been made to understand their performances which mainly include the contribution of various yield components towards yield (Chettri, 5; Jian *et. al.,* 9; and Mehta *et al.,* 15). To understand the physiological basis of yield difference among the genotypes of soybean, it is essential to quantify the components of growth, and the relevant variables, which is useful in crop improvement. Variation in dry matter accumulation and pod production in different maturity group genotypes may be related to some factors such as leaf area (LA), Leaf area index (LAI), crop growth rate (CGR), net assimilation rate (NAR) and relative growth rate (RGR). A better understanding of crop growth and yield parameters and the partitioning of assimilates into seed would help to expedite yield improvement of field crops. Very little work has been done in this regard in soybean in sub-tropic areas. A detailed analysis of growth and yield parameters of fifteen soybean genotypes which were differing in maturity groups was therefore undertaken.

MATERIALS AND METHODS

The experiment was carried out at the experimental field of Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana Punjab in Kharif (June - October) season of 2012. With fifteen soybean genotypes, five early (SL 688, SL 778,SL 795,EC 457161and EC457286), five medium (SL 525, SL 744,SL 955, SL 983 and SL 1123) and five late (SL 900, SL 958,DS 12-5, DS 26-13 and DS 26-14) maturing dates genotypes were used as planting materials. Experiment was laid out in randomized block design with three replicates. The soil of the experimental field was sandy loam. The plot size was 4 m × 5 m and row to row and plant to plant distances were 45 and 5 cm, respectively. Normal cultural practices for raising a successful crop were followed uniformly throughout the experiment. Irrigation was

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applied at weekly intervals or as when needed. Data were collected on some morpho-physiological parameters viz leaf area (LA), leaf area index (LAI), harvest index (HI) and yield attributes such as number of pods per plant, 100-seed weight and seed yield per plant and seed yield per plot. Sampling were taken at vegetative, flowering and pod stages. From each sampling, five plants were selected randomly and uprooted from each plot for collecting necessary parameters. Leaf area of each sample was measured by automatic leaf area meter and leaf area index was measured by Sun scan canopy analyser. Yield components were recorded at harvest from ten randomly selected plants of each plot. The seed yield was measured as mature seed harvested and seed weight was recorded as weight of 100 randomly selected seeds from a bulk at each plot. All data were analyzed statistically using Least Significant Difference (LSD) test at 0.05% probability level to compare the differences among the genotypes.

RESULTS AND DISCUSSION

Leaf area

The data given in Fig.1 revealed that leaf area per plant indicated significant differences between early, medium and late maturing genotypes at all the stages. It differed significantly with all the genotypes, In early maturing group, the genotype EC 457161 recorded significantly higher leaf area per plant and lower leaf area was recorded in SL 688 at all the growth stages.

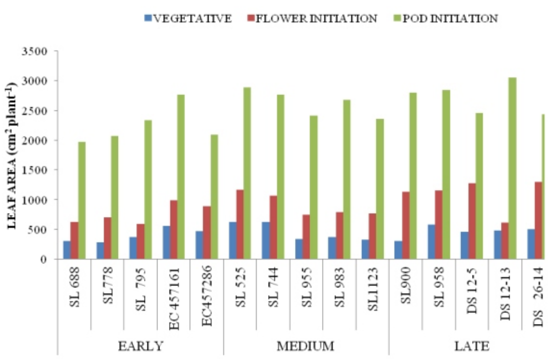

Figure 1 : Leaf area (cm^2 $plant^{-1}$) of diverse soybean genotypes at different growth stages.

In medium maturing group genotypes, the maximum leaf area was recorded in genotype SL 983 and minimum in SL 955 at all the growth and development stages. Whereas, in late maturing group, the genotype SL 958 attained maximum leaf area and minimum in SL 900 at all the stages. The mean proportion of leaf area of late maturing genotypes was higher from vegetative to pod initiation stage followed by medium and least in early maturing group genotypes. The data indicated a wide genotypic variability with respect to leaf area. This is in agreement with the reports of Nijhawan and Chandra (17). It is evident from the data that the genotypes which yielded high maintained significantly higher leaf area over other genotypes thereby indicating the importance of leaf area in yield determination. Greater leaf area improved seed yield due to increased interception of solar radiation and enhanced carbon exchange rate (Kumudini *et al.,* 11).

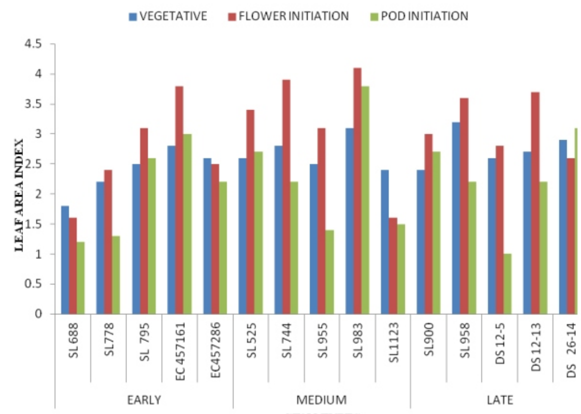

Figure 2 : Leaf area index of diverse soybean genotypes at different growth stages.

Leaf area index

The data on leaf area index per plant (Fig.2) indicated significant differences between the early, medium and late maturing genotypes at all the stages. There was a linear increase in leaf area index upto flowering stage and declined thereafter in all the genotypes during later stages.

Among the early maturing group, the genotype EC 457161 recorded significantly higher leaf area index upto flowering stage and decreased during pod initiation stage. Significantly lower leaf area index at all stages was recorded in genotype SL 688. At pod initiation stage all the genotypes showed decrease in leaf area index due to remobilization of assimilates towards sink and the plant parts entering senescence phase. Among medium maturing group genotypes, the genotype SL 983 recorded higher leaf area index upto flowering stage and it was at par with genotype SL 744. Upto flower initiation stage, leaf area index showed increment in all the genotypes and lowest leaf area index recorded in genotype SL 1123. In late maturing group genotypes, mean leaf area index values were higher at flower and pod initiation stages then early-and medium- maturing group genotypes thereby showing more photosynthate production, partitioning and accumulation towards sink. However, the genotype SL

958 showed highest leaf area index upto flowering stage and thereafter decreased towards pod initiation stage, while, lower leaf area index recorded in genotype DS 12-13. Panwar *et al.* (18) reported that in greengram, both leaf area and leaf area index attained the maximum values at 45 DAS and started declining thereafter till harvest. Basuchaudhari (2) found that the seed yield is associated with high leaf area index in soybean.

Plant height (cm)

The data on plant height (Table1) indicated significant differences among the genotypes of early, medium and late maturing groups. In early maturity group, the genotype EC 457161 recorded significantly higher plant height followed by genotype EC 457286 and lower was recorded in genotype SL 688. Among medium group, the genotype SL 744 had reached maximum plant height followed by genotype SL 983 and minimum plant height was recorded in genotype SL 955. While, in late maturing group, the genotype SL 958 recorded highest plant height followed by genotype DS 12-5 and lowest was recorded by genotype DS 12-13. Kumar (10) has also reported that plant height is influenced by the interaction between the environmental variables and genetic make up of the plant.

Number of pods per plant

The number of pod is an important factor to be considered during selection of desirable genotypes. The variations in number of pods in present investigations were found to be highly significant due to divergent genotypes. The number of pods ranged from 57.02 to 107.30 per plant (Table 1). Among early maturing group genotypes, the genotype EC 457161 recorded significantly higher number of pods per plant. Significantly lower number of pods per plant was recorded by genotype SL 688. While among medium maturing group genotypes, SL 983 recorded higher number of pods per plant followed by SL 744 and lower number of pods per plant was recorded in SL 525. However, in late maturing group genotypes, the genotype SL 958 recorded higher number of pods per plant and lower was recorded in genotype SL 900. These results get sufficient validation from the findings of Malik *et al.*, (13) Molhotra (16), Jagtap and Mehetre (8), and Mehmet *et al.* (14).

Seed weight (g)

Seed weight is an important yield parameter and vary from genotype to genotype. In the present study 100-seed weight (g) ranged from 10.0 to 12.60 g (Table 1). Among early maturing group genotypes, the genotype EC 457161 recorded higher seed weight and lower was recorded in genotype SL 688. While among medium maturing group genotypes, the genotype SL 983 recorded significantly higher 100 seed weight and genotype SL1123 recorded significantly lower seed weight. In late maturing group genotypes, the genotype SL 958 recorded higher seed weight and it was found to be statistically at par with genotype DS 26-14 and lowest was recorded in genotype DS 12-13.Chand *et al.* (4) and Taware *et al.* (20) also reported the similar results.

Harvest index

Harvest index reveals the efficiency of translocation of assimilates towards economic parts and therefore, harvest index and seed yield are closely related. Among early maturing genotypes, the genotype EC 457161 recorded significantly higher harvest index and lower harvest index was recorded in SL 795 (Table 1). Among medium maturing group genotypes, the genotype SL 983 recorded higher harvest index which was at par with genotype SL 744. Significantly lower harvest index was recorded in genotype SL 955. In late maturing group genotypes, the genotype SL 958 recorded significantly higher harvest index and lower was recorded in genotype SL 900.

Seed yield (g/plant)

The data on seed yield per plant (Table 1) differed significantly between the early, medium and late maturing genotypes. In early maturing genotypes, the genotype EC457161 recorded significantly higher seed yield per plant which was at par with genotype EC 457286. A lower seed yield per plant recorded in genotype SL 688. Among medium maturity group genotypes, the genotype SL 983 recorded higher seed yield per plant followed by genotype SL 744 and minimum seed yield was recorded in genotype SL 1123. However, in late maturity genotypes, the genotype SL 958 produced higher seed yield followed by genotype DS 26-14 and lower seed yield was recorded in genotype DS 12-13. The differences could be caused by high day and night temperature differences in the region, different impacts of very high summer temperatures on growth periods of plants and may be due to the fact that the genotypes of different maturity groups. The findings seem to support of Beyyava *et al.* (3) and Gizlenci *et al.* (6).

Seed yield (Kg ha^{-1})

Seed yield, being complex trait, is highly influenced by various environmental factors including

Table 1 : Comparative performance of different maturity date genotypes of soybean for yield and yield attributes.

Groups	Genotypes	Plant height (cm)	No. of pods/plant	100-seed weight (g)	Harvest index (%)	Yield/plant (g)
Early	SL 688	51.83	79.34	10.97	30.87	11.06
	SL 778	61.91	99.41	11.53	37.37	13.78
	SL 795	55.37	79.81	11.67	30.04	10.63
	EC 457161	71.36	108.51	12.07	37.67	15.91
	EC457286	65.86	100.71	11.38	42.37	15.11
	MEAN	**61.27**	**93.56**	**11.52**	**35.66**	**13.30**
Medium	SL 525	70.31	74.24	11.89	33.11	15.44
	SL 744	78.73	92.67	11.56	38.77	16.03
	SL 955	66.71	92.67	10.67	35.11	13.38
	SL 983	70.17	105.64	12.59	38.04	16.22
	SL1123	73.57	81.54	9.98	35.44	10.94
	MEAN	**71.90**	**89.35**	**11.34**	**36.09**	**14.40**
Late	SL900	80.87	57.01	12.39	27.11	11.03
	SL 958	82.84	101.77	12.32	35.34	17.24
	DS 12-5	82.13	96.17	11.48	39.44	15.34
	DS 12-13	64.31	82.37	11.04	32.53	14.31
	DS 26-14	67.12	88.41	11.21	36.84	15.34
	MEAN	**75.46**	**85.15**	**11.69**	**34.25**	**14.65**
	LSD (0.05%)	**7.23**	**3.95**	**1.09**	**3.18**	**2.89**
	CV	**6.21**	**2.64**	**4.90**	**5.37**	**12.25**

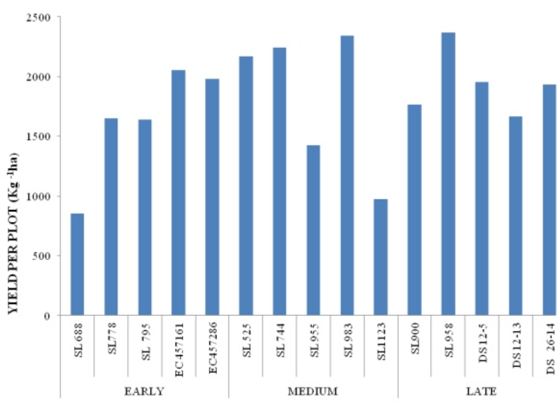

Figure. 3 : Comparative study of diverse genotypes for yield attribute.

biotic and abiotic factors. It is also interplay of various morphological characters which either favour or worsen the final yield. In present investigation seed yield per plot in kg per hectare was measured. Seed yield (Fig 3) was found to be highly significantly different due to different maturing group soybean genotypes. Among early maturing group genotypes, the genotype EC 457161 recorded significantly higher seed yield and significantly lowest was recorded in genotype SL 688. While among in medium maturing group genotypes, the genotype SL 983 recorded higher seed yield and it was found to be at par with genotype SL 744. Significantly lower seed was recorded in genotype SL 1123 followed by SL 955. However, in late maturing genotypes, the genotype SL 958 recorded significantly higher seed yield and lower was recorded in genotype DS 12-13. It was further observed that the genotypes with highest seed weight and more pod numbers had produced higher yield. The findings of Molhotra (16), Malik *et al.* (13), and Mehmet *et al.* (14) also are in accordance with these results.

From the foregoing discussion, it is clear that among various yield components, leaf area, leaf area index, 100- seed weight and harvest index are the most important traits for yield determination in soybean as all these parameters exhibited a significant positive association with seed yield, irrespective of the nature of genotypes and the growing conditions.

Conclusion

After evaluation of 15 different maturity groups of soybean genotypes, it is concluded that in early maturing genotypes EC 457161, medium SL983 and late SL 958 are superior in term of yield production as well as in other important morphological traits and yield components. Finally, genotype SL 958 at late maturity date seems to be more effective in getting higher grain yields. It is, therefore suggested that this genotype must be brought forward for testing across the various zones of the Punjab.

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