INTERRELATIONSHIP OF DIFFERENT CHARACTERS AND THEIR EFFECTS WITH YIELD IN SOYBEAN (*GLYCINE MAX*. L. MERILL)

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Abstract: A study of the genetic variability, some genetic characters, character association and path coefficient analysis between yield and its contributing characters of six different soybean genotypes were conducted to select the best parents for undertaking a breeding programme. The genotypes exhibited a wide range of variability for all the characters studied. All the characters except 100-seed weight were also displayed high heritability. High genetic advance was observed for plant height, days to 50 per cent flowering and seed yield. Seed yield had significant positive genotypic and phenotypic correlation with days to maturity whereas plant height showed negative correlation with seed yield. Path coefficient analysis revealed that days to maturity showed positive direct effect with seed yield. Hence, the results suggested that selection should be based on later maturing genotypes for harvesting maximum yield.

Keywords: genetic variability, correlation, direct & indirect effects, yield, soybean.

Introduction: Soybean which is known as miracle bean or golden bean is one of the most important leguminous and oilseed crops of India but also for the world. It has high oil (18 %-22 %) and protein content (38 %-42 %). Soybean occupied prime position in the world in oil production (57 %) in global trade markets among the major oilseed crops(Pandey *et al.*2008). The increased demand for oil and protein stimulated soybean production mainly by land expansion, with very modest growth in its productivity. India has an area of 8 % of the world area (9.62 m ha), but figures with the lower productivity (1124 kg ha^{-1}) against the world average of 2380 kg ha^{-1}. Soybean grown in an area of 9.62 m ha producing 10.82 m t with the productivity of 1124 kg ha^{-1} during *kharif* 2008 in India. Madhya Pradesh generally called as soybean state of India, contributes to the extent of 70 per cent with respect to area and 64 per cent to production. It is leading state in soybean production both in terms of area and productivity, contributing 5.0 m ha and 1090 kg ha^{-1}, respectively (Anonymous 2009).

Materials And Methods:

Six different hopeful lines (contributed in Advance Varietal Trials-I of All India Coordinated Research Project) of soybean namely; JS 20-09, NRC-76, RKS-45 including three checks namely; Bragg used as national check, JS 93-05 used as zonal check for early maturing types and JS-335 used as zonal check for medium duration maturing type were studied. The experiment was carried out during *kharif* season of 2009 adopting randomized complete block design (RCBD) with four replications at Research Farm of Zonal Agriculture Research Station-Ujjain falls in the central zone of India. Each line was sown in 12 rows of 5 meter row-length keeping 45 cm as inter-row spacing. The recommended package of practice was applied to raise a good crop.

Observations were recorded on days to 50 per cent flowering {DTF (50%): d}, days to maturity (DTM:d), 100-seed weight (SI:g) and seed yield (SY: kg ha^{-1}) on whole plot basis whereas one single character *i.e.* plant height (PH:cm) was recorded on ten randomly selected plants basis.

The data were analysed according to the RCBD and mean values for each character were subjected to analysis. The analysis of variance (ANOVA) was prepared as per statistical method described by Panse and Sukhatme (1967). The genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) were estimated as per Burton (1952). Heritability in broad sense (h^2_{bs}) and genetic advance as per cent of mean (GA) were calculated as per procedure of Johnson *et al.*(1955) cited in Singh and Chaudhary (1979). The correlation coefficients among different characters were carried out as per method suggested by Fisher (1918) calculated with the OP STAT program. The direct and indirect effects of characters were carried out by path coefficient analysis was performed by examining seed yield as a dependent variable for major contributors to seed yield.

Results and Discussion: On the basis of statistical analysis ANOVA revealed highly significant differences among the genotypes for all the characters studied indicating significant amount of variability among the genotypes for all the characters showing the ample scope for improvement in these characters. Similar findings were reported earlier by Malik *et al.*(2006 & 2007), Arshad *et al.*(2006), Bhushan *et al.*(2006) and Shahidul Islam *et al.*(1996) in soybean.

Genetic parameters of yield and their components are given in Table 1. According to the mean values of days to 50 per cent flowering, days to maturity, plant height, 100-seed weight and seed yield were 43 d, 95 d, 53.1 cm, 12.2 g and 2420 kg ha^{-1}, respectively. In

general, the estimates for phenotypic coefficient of variation (PCV) for all the characters were higher than their respective genotypic coefficient of variation (GCV) and both the parameters were followed the same trend. Similar results were reported earlier by Bhushan *et al* .(2006). Genotypic coefficient of variations were relatively greater in plant height (18.99%), seed yield (13.90 %) and days to 50 per cent flowering (13.88 %), while it was smaller for days to maturity (3.88 %) and 100-seed weight (3.73 %). Phenotypic coefficient of variation were highest for plant height (21.05 %) followed by seed yield (14.83 %), days to 50 per cent flowering (13.97 %), 100-seed weight (5.51 %), while it was least for days to maturity (4.06 %). Broad sense heritability ranged from 45.7 % to 98.7 %. The heritability values were recorded high for most of the characters due to low genotypic variances indicating less environmental influence and possible governance of these characters were seems to be additive gene action. These results were in accordance with the findings of Bhushan *et al.*(2006). Days to 50 per cent flowering and seed yield [Jain and Ramgiry (2000)] indicated high heritability as well as high genotypic coefficient of variation. In this manner, crop improvement, in terms of these characters could be possible by simple selection because high heritability coupled with high genotypic variation revealed the presence of an additive gene effect. On the other hand, low heritability coupled with low genotypic coefficient of variation was observed for plant height indicated the character was highly influenced by environmental effect and selection will be relatively more efficient in days to 50 per cent flowering, seed yield and plant height.

Correlation Coefficient Analysis: The seed yield exhibited a highly significant positive correlation with days to maturity (Table 2). These results suggested that any positive increase in such character will accelerate the boost in seed yield. These results were in accordance with those reported by Chettri *et al.*(2006), Ramana *et al.* (2000), Bangar *et al.* (2003). Significant and negative relationships were found for plant height (Rajasekaran *et al.* (1980), Kalaimagal (1991)) and 100-seed weight [Rajasekaran *et al*. (1980), Jagtap & Choudhary (1993), Shinde *et al.* (1996), Thorat *et al.* (1999).] with seed yield. The high positive correlation between days to 50 per cent flowering and 100-seed weight, plant height and 100-seed weight indicated that cultivars with delayed to flowering coupled with higher plant height contribute to seed yield.

The main purpose of plant breeder is to achieve an increase in soybean yield. Yield and its components are polygenic traits, which are strongly influenced by the environment and other factors both known and yet to be identified. To this end, emphasis should be given to the development of soybean lines with longer days to maturity and dwarf type coupled with high 100-seed weight to improve seed yield.

Path Coefficient Analysis: The estimation of correlation coefficient reveals only the relationship between yield and yield components but do not show the direct and indirect effects of different yield components on yield *per se*. Path coefficient analysis was carried out in the present experiment to know the direct and indirect effect of different characters and depicts the relative importance of each factor on seed yield. The path coefficients were partitioned into direct and indirect effects by using seed yield as a dependent variable. The direct and indirect effects of different characters were given in table 3.

The path coefficient analysis based on seed yield as a dependent variable revealed that days to maturity showed highest positive direct effect (0.5757) as earlier reported by Arshad *et al.*(2006) and Chettri *et al.*(2006) whereas days to flowering, plant height and 100-seed weight exhibited negative direct effect on seed yield.

The path coefficient analysis indicated that the highest positive correlation of seed yield was recorded with days to maturity and its direct effect on seed yield was also positive (0.5757).

Based upon path coefficient and correlation analysis it may thus, be concluded that selection prospectus for high seed yield seemed to be through days to maturity.

Conclusion: In all characters studied phenotypic coefficient of variation and genotypic coefficient of variation showed almost equal value indicated that characters were not influenced by environmental effects. According to the results of the correlation analysis seed yield was significantly and positively correlated with days to maturity. Path coefficient analysis of seed yield indicated that days to maturity exerted the greatest direct effect. This trait had major contributions to seed yield, and hence can increase the success of breeding studies of soybean in the Malwa region of the Madhya Pradesh of India.

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Table 1: Genetic parameters of different attributes in soybean.

Parameter /Character		Days to 50 % flowering	Days to maturity	Plant height (cm)	100-seed weight(g)	Seed yield (kg/ha)
Mean		43	95	53.1	12.2	2420
Range :	**Min.**	37	90	39	12.0	1737
	Max.	49	99	67	13.0	2753
M.S. (lines)		144.342**	55.841**	439.819**	1.067*	580089.63**
GCV(%)		13.88	3.88	18.99	3.73	13.90
PCV(%)		13.97	4.06	21.05	5.51	14.83
h^2_{bs}		98.7	91.4	81.5	45.7	87.9
Genetic advance		12.27	7.27	18.96	0.63	23.30
GA as % of mean		28.41	7.64	35.32	5.19	26.86

*,**: significant at p=0.05 and p=0.01 level of probability, respectively.

Table 2: Genotypic and phenotypic correlation coefficients among different attributes in soybean.						
Character	**G/P level**	**Days to 50 % flowering**	**Days to maturity**	**Plant height (cm)**	**100-seed weight (g)**	**Seed yield (kg/ha)**
Days to 50 % flowering	**G:**	1.000				
	P:	1.000				
Days to maturity	**G:**	0.181	1.000			
	P:	0.173	1.000			
Plant height (cm)	**G:**	0.363	-0.244	1.000		
	P:	0.326	-0.247	1.000		
100-seed weight(g)	**G:**	0.729**	0.091	0.874**	1.000	
	P:	0.514*	-0.029	0.448*	1.000	
Seed yield (kg/ha)	**G:**	-0.127	0.743**	-0.585**	-0.464*	1.000
	P:	-0.133	0.620**	-0.438*	-0.309	1.000

*,**: significant at p=0.05 and p=0.01 level of probability respectively.

Table 3: Direct and indirect effects among different attributes in soybean.					
Character	**Days to 50 % flowering**	**Days to maturity**	**Plant height (cm)**	**100-seed weight (g)**	**Correlation with Seed yield (kg/ha)**
Days to 50 % flowering	**-0.0583**	0.0998	-0.0649	- 0.0892	- 0.127
Days to maturity	-0.0101	**0.5757**	0.0492	0.0050	0.743**
Plant height (cm)	-0.0190	-0.1425	**-0.1987**	- 0.0777	- 0.585**
100-seed weight (g)	-0.0299	-0.0167	-0.0890	**-0.1734**	-0.464*

*,**: significant at p=0.05 and p=0.01 level of probability respectively.

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