CORRELATION COEFFICIENTS AND PATH ANALYSIS IN SOYBEAN (*Glycine max* L. MERRILL)

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ABSTRACT

The present investigation was carried out in soybean to measure the correlation coefficients and path coefficients using 70 diverse genotypes of soybean. The experiment was laid-out in a Randomized Block Design with three replications at the Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh during kharif 2012. The observations were recorded for 15 different characters including seed yield per plant. Genotypic correlations were higher than their respective phenotypic correlations for most of the characters, indicating that strong intrinsic associations are reduced at phenotypic level due to environment and genotype x environment interaction components. Seed yield per plant was found to be significantly and positively correlated with number of clusters per plant, number of pods per plant, biological yield per plant and harvest index at both the genotypic and phenotypic levels. Path coefficient analysis revealed that the highest direct and positive effect on seed yield per plant was exhibited by biological yield per plant followed by harvest index, days to 50 per cent flowering. Number of clusters per plant, number of seeds per pod and 100-seed weight also noted positive and direct effect in lower magnitude on seed yield per plant as well as indirect effects through other traits.

KEY WORDS: Correlation coefficients, path analysis, soybean.

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is considered as one of the important pulses and oilseed crops, because of high nutritional value, 43.2 per cent protein and 18-25 per cent edible oil North Eastern (Manchuria) region of the China is believed to be the center of origin and diversification center of the cultivated soybean.

Seed yield is influenced by the interaction of different factors including environment. Type and nature of association is usually determined by studying correlation coefficients. It is an established fact that seed yield is a complex character for which direct selection is not much effective and correlation studies alone would be misleading. In order to obtain a clear picture of the contribution of each of such componential characters in the total genetic architecture of yield, path analysis could be employed for this purpose. The present investigation therefore was undertaken to estimate correlations and their direct and indirect effects on seed yield to make the selection effective for increasing seed yield in soybean.

MATERIALS AND METHODS

The present investigation was carried out to measure the correlation coefficients and path coefficients using 70 diverse genotypes of soybean. The experiment was laid-out in a Randomized Block Design with three replications at the Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh during *kharif* 2012. The observations were recorded for 15 different characters, *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per plant, number of pods per cluster, pod length (cm), number of seeds per pod, seed yield per plant (g), 100-seed weight (g), biological yield per plant (g), harvest index (%), protein content (%) and oil content (%) on five randomly selected plants in each entry and replication (except for days to 50 % flowering and days to maturity, where the observations were recorded on plot basis) and their mean values were used for statistical analysis. The correlation coefficient analysis was carried out as per the methods of Al-Jibouri *et al.*, (1958), while path analysis was carried out according to Dewey and Lu (1959) by partitioning the genotypic correlation coefficients into direct and indirect effects.

RESULT AND DISCUSSION

Correlation coefficients

The study of genotypic correlation coefficient indicated the extent of relationship between different variables. This relationship among yield contributing characters as well as their association with yield provides information for exercising selection pressure for bringing genetic improvement in seed yield. The results of correlation coefficient analysis are presented in Table 1. In general, the values of genotypic correlation were higher than their corresponding phenotypic correlation in the present investigation. This indicated that though there was high degree of association between two variables at genotypic level, its phenotypic expression was deflated by the influence of environment. It has also indicated that there was an inherent relationship between the characters studied which is in agreement with the conclusions of Peluzio *et al.* (2005), Faisal *et al.*, *(*2007), Sirohi *et al.* (2007), Karnwal and Singh, (2009) and Khan *et al.* (2011). The phenotypic correlation coefficients of seed yield per plant with biological yield per plant, harvest index, number of primary branches per plant and days to 50 per cent flowering were higher than their genotypic correlation coefficients, which might be due to the non-genetic causes probably environment influenced the value of phenotypic correlation.

Seed yield per plant was found to be significantly and positively correlated with number of clusters per plant, number of pods per plant, biological yield per plant and harvest index at both the genotypic and phenotypic levels. Such positive genotypic interrelationship between seed yield per plant and these attributes has also been reported by Karnwal and Singh (2009), Mehmet *et al.* (2009), Malik *et al.* (2011), Machikowa and Laosuwan (2011), El-Badawy and Mehasen (2012) and Sarutayophat (2012). They can serve as marker/indicator characters for improvement in seed yield. Days to flowering had positive and highly significant association with number of primary branches and negative and non-significant with biological yield at both levels was of an important component in identifying and deciding

the duration of crop. Thus, it indicated that flowering time was an important indicator of increase the number of primary branches per plant and decreasing the biological yield per plant. These results are in line with the earlier findings of Sirohi *et al*. (2007), Faisal *et al.* (2007), Ramteke *et al.* (2010) and Machikowa and Laosuwan (2011).

Characters like number of clusters per plant, number of pods per plant, number of pods per cluster and biological yield per plant was also positively and significantly correlated with each other. This means that increasing in one character would ultimately increase another one and thereby increase in seed yield. Similarly, strong and positive associations among harvest index, biological yield per plant and seed yield per plant, also indicated great possibility while selecting for any of them for crop improvement.

The results, thus, revealed that number of clusters per plant, number of pods per plant, biological yield per plant and harvest index were the important attributes, which contributed towards higher yield. Therefore, more emphasis should be given to these components during selection for higher yield. .

Path coefficient analysis

The path coefficient analysis revealed that the highest and positive direct effect on seed yield per plant was exhibited by biological yield per plant followed by harvest index, days to 50 per cent flowering, days to maturity and number of clusters per plant. Thus, these characters turned out to be the major components of seed yield. Such positive and high direct effects for these variables have also been reported by Iqbal *et al*. (2003) and Machikowa and Laosuwan (2011). Number of pods per plant, number of pods per cluster and number of primary branches per plant had low negative direct effect, but these traits supplemented positive and direct effect on seed yield per plant *via* other yield contributing traits. Similar results were obtained by Bizeti *et al.* (2004), Arshad *et al.* (2006), Mehmet *et al*. (2009) and El-Badawy and Mahasen (2012). The residual effect on seed yield per plant was low. It indicated that traits under study were enough to know the effect of seed yield.

It was apparent from the path analysis that maximum direct effects as well as appreciable indirect influences via other traits were exerted by biological yield per plant and harvest index. Number of clusters per plant, number of seeds per pod and 100-seed weight also noted positive and direct effect in lower magnitude on seed yield per plant as well as indirect effects through other traits. Hence, they may be considered as the most important yield contributing characters and due emphasis should be placed on these components, while breeding for high yielding types in soybean.

CONCLUSION

From the present study, it can be seen that seed yield per plant was found to be significantly and positively correlated with number of clusters per plant, number of pods per plant, biological yield per plant and harvest index at both the genotypic and phenotypic levels. Path coefficient analysis revealed that the highest direct and positive effect on seed yield per plant was exhibited by biological yield per plant and harvest index. Therefore, due emphasis is given on these traits while breeding for high yielding types in soybean.

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Table 1: Phenotypic (r_p) and genotypic (r_g) correlation coefficients among fifteen characters in soybean

Characters		Days to Maturity	Plant Height (cm)	Number of Primary Branches Per Plant	Number of Clusters Per Plant	Number of Pods Per Plant	Number of Pods Per Cluster	Pod Length (cm)	Number of Seeds Per Pod	100 - Seed Weight (g)	Biological Yield Per Plant (g)	Harvest Index (%)	Oil Content (%)	Protein Content (%)	Seed Yield Per Plant (g)
Days to 50 Per Cent Flowering	r_p	0.045	0.100	0.220**	0.070	0.100	0.002	0.110	-0.016	-0.011	-0.154*	0133	0.077	0.134	-0.041
	r_g	-0.120	0.201	0.434**	0.273**	0.188**	0.231**	0.118	-0.151	0.388**	-0.264**	0.276**	-0.043	0.066	-0.004
Days to Maturity	r_p		0.163*	-0.058	0.067	0.080	-0.029	0.079	0.085	0.228**	-0.043	0.114	0.063	0.133	0.060
	r_g		0.480**	-0.055	0.513**	0.261**	-0.101	0.184**	0.221**	-0.376**	0.044	0.380**	1.068**	0.980**	0.432**
Plant Height (cm)	r_p			0.066	0.133	0.149*	0.074	0.145*	0.063	0.017	-0.047	0.103	0.117	0.152*	0.055
	r_g			0.077	0.208**	0.167*	0.257**	0.233**	0.095	0.044	-0.063	0.140*	0.380**	0.335**	0.081
Number of Primary Branches Per Plant	r_p				0.110	-0.044	0.166*	-0.133	0.038	0.032	-0.074	0.068	0.010	-0.033	-0.032
	r_g				0.170*	-0.050	0.506**	-0.266**	0.107	0.024	-0.081	0.093	0.063	-0.096	-0.016
Number of Clusters Per Plant	r_p					0.582**	0.185**	0.019	-0.036	0.200**	0.447**	0.270**	0.156*	0.020	0.806**
	r_g					0.653**	-0.217**	0.052	-0.080	-0.457**	0.452	0.230**	0.736**	0.280**	0.825**
Number of Pods Per Plant	r_p						0.090	-0.063	-0.175*	-0.040	0.297**	0.110	0.139*	-0.028	0.433**
	r_g						0.001	-0.102	-0.232**	-0.266**	0.300**	0.101	0.490**	-0.061	0.448**
Number of Pods Per Cluster	r_p							0.144*	-0.045	0.254**	0.113	-0.056	0.034	-0.138*	0.070
	r_g							-0.125	-0.201**	-0.712**	0.148*	-0.351**	0.585**	-0.064	-0.204**
Pod Length (cm)	r_p								0.136*	-0.040	-0.039	0.098	-0.095	0.014	0.061
	r_g								0.048	-0.170*	-0.016	0.163*	0.372**	0.091	0.173*
Number of Seeds Per Pod	r_p									0.017	-0.017	0.004	0.127	0.139*	-0.064
	r_g									0.073	-0.110	-0.000	0.250**	0.690**	-0.113
100- Seed Weight (g)	r_p										-0.052	0.127	-0.081	-0.003	0.080
	r_g										-0.500**	0.091	0.130	0.051	-0.487**
Biological Yield Per Plant (g)	r_p											-0.604**	0.075	-0.011	0.635**
	r_g											-0.651**	0.195**	0.032	0.607**
Harvest Index %	r_p												-0.045	-0.004	0.215**
	r_g												-0.032	0.036	0.190**
Oil Content (%)	r_p													0.036	0.047
	r_g													0.538**	0.230**
Protein Content (%)	r_p														0.018
	r_g														0.190**

, ** Significant at 5 per cent and 1 per cent levels of significance, respectively

Table 2: Genotypic path coefficient analysis showing direct (diagonal and bold) and indirect effect of different characters on seed yield in soybean

Character	Days to 50 Per Cent Flowering	Days to Maturity	Plant Height (cm)	Number of Primary Branches Per Plant	Number of Clusters Per Plant	Number of Pods Per Plant	Number of Pods Per Cluster	Pod Length (cm)	Number of Seeds Per Pod	100 - Seed Weight (g)	Biological Yield Per Plant (g)	Harvest Index (%)	Oil Content (%)	Protein Content (%)	Genotypic Correlation With Seed Yield
Days to 50 Per Cent Flowering	**0.115**	-0.009	0.001	-0.02	0.014	-0.016	-0.01	-0.001	-0.005	0.004	-0.335	0.26	0.001	-0.002	-0.003
Days to Maturity	-0.014	**0.077**	0.003	0.003	0.026	-0.022	0.005	-0.001	0.008	-0.004	0.056	0.356	-0.024	-0.035	0.434**
Plant Height (cm)	0.023	0.037	**0.006**	-0.003	0.01	-0.014	-0.012	-0.001	0.003	0.001	-0.08	0.132	-0.009	-0.012	0.081
Number of Primary Branches Per Plant	0.05	-0.004	0.001	**-0.045**	0.009	0.004	-0.023	0.002	0.004	0.001	-0.103	0.088	-0.001	0.004	-0.014
Number of Clusters PerPlant	0.031	0.039	0.001	-0.008	**0.050**	-0.054	0.01	0.001	-0.003	-0.005	0.574	0.216	-0.016	-0.01	0.825**
Number of Pods Per Plant	0.022	0.02	0.001	0.002	0.033	**-0.083**	0.001	0.001	-0.008	-0.003	0.377	0.095	-0.011	0.002	0.448**
Number of Pods Per Cluster	0.027	-0.008	0.002	-0.023	-0.011	0.001	**-0.045**	0.001	-0.007	-0.008	0.188	-0.331	-0.013	0.023	-0.205*
Pod Length (cm)	0.014	0.014	0.002	0.012	0.003	0.009	0.006	**-0.006**	0.002	-0.002	-0.021	0.154	-0.008	-0.003	0.176*
Number of Seeds Per Pod	-0.017	0.017	0.001	-0.005	-0.004	0.019	0.009	0.001	**0.035**	0.001	-0.139	0.001	-0.006	-0.025	-0.114*
100-Seed Weight (g)	0.044	-0.029	0.001	-0.001	-0.023	0.022	0.032	0.001	0.003	**0.011**	-0.629	0.086	-0.003	-0.002	-0.488**
Biological Yield Per Plant (g)	-0.03	0.003	0.001	0.004	0.023	-0.025	-0.007	0.001	-0.004	-0.005	**1.268**	-0.614	-0.004	-0.001	0.608**
Harvest Index (%)	0.032	0.029	0.001	-0.004	0.011	-0.008	0.016	-0.001	0.001	0.001	-0.826	**0.942**	0.001	-0.001	0.193*
Oil Content (%)	-0.005	0.082	0.002	-0.003	0.037	-0.041	-0.026	-0.002	0.009	0.001	0.248	-0.031	**-0.022**	-0.02	0.229**
Protein Content (%)	0.008	0.075	0.002	0.004	0.014	0.005	0.029	-0.001	0.024	0.001	0.041	0.035	-0.012	**-0.036**	0.189*

, ** Significant at 5 per cent and 1 per cent levels of significance, respectively ***Residual effect: 0.157***

[MS received: January 8, 2014] ***[MS accepted: February 4, 2014]***