

Correlation and Path Analysis for Seed Yield in Soybean [*Glycine max* (L.) Merrill]

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ABSTRACT

Seed yield is a complex character governed by several contributing characters. Hence, character association was studied in the present investigation to assess the relationship among yield and its components for enhancing the usefulness of selection criterion to be followed while developing varieties. Correlation and path analysis were made for 14 characters in 70 genotypes of soybean. The seed yield per plant had highly significant and positive correlation with biological yield per plant, number of pods per plant, number of clusters per plant, days to flowering and plant height. Path coefficient analysis revealed that biological yield per plant, number of pods per plant, harvest index, number of branches per plant and number of clusters per plant had appreciable positive direct effect on seed yield per plant.

Keywords: Soybean [*Glycine max* (L.) Merrill], Correlation, Path analysis

INTRODUCTION

Soybean ranks first among the oilseeds in the world. In International market soybean oil trading is next only to palm oil. The crop contributes for nearly 25% of the world's total oil and fats production. Soybean is member of papilionaceae family and believed to have originated in North Eastern China. The major soybean producing states in India are Madhya Pradesh, Rajasthan and Maharashtra. Soybean is also grown in Uttar Pradesh, Karnataka,

Gujarat, Orissa, Punjab, Himachal Pradesh and Sikkim. The fundamental goal in any crop improvement programme is to increase the yield of the crop. The character seed yield has a complex gene action. Many factors affecting the yield must be considered and evaluated with regard to their contribution to yield. Some biometrical techniques such as correlation, path analysis provide information about the relative contribution of various component traits towards economic yield.

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Correlation measures the mutual relationship among various plant characters and helps in determining the yield components on which indirect selection can be based for improvement in yield. Path analysis splits the correlation coefficient into the measures of direct and indirect effects and determines the direct and indirect contribution of various characters towards yields.

MATERIALS AND METHODS

The present investigation was carried out at the Sagdividi Farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif* 2019-20. The weather during the growing season was favourable for normal growth and development of crop. The experimental material consisted of 70 diverse genotypes of soybean were sown on 8th August, 2019 in a randomized block design with three replications. Each genotype was sown in a single row plot of 2.0 m length with a spacing of 45 cm × 15 cm. The genotypes were randomly allotted to the plots in each replication. All the recommended agronomical practices along with necessary plant protection measures were followed timely for the successful raising of the crop. The observations were recorded on these five randomly selected plants in each replication and in each genotype for 14 characters *viz.*, days to flowering, days to maturity, number of branches per plant, plant height, number of pods per plant, number of seeds per pod, number of clusters per plant, number of pods per cluster, pod length, seed yield per plant, 100-seed weight, biological yield per plant, harvest index and oil content. But in case of days to flowering and days to maturity observations were counted on plot basis. The phenotypic and genotypic correlation coefficients of all the characters were worked out as per Al-Jibouri et al. (1958). The path coefficient analysis was carried-out as per the method suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation coefficients:

The genotypic and phenotypic correlations among the yield and yield contributing

characters in soybean are presented in Table 1. In the present investigation, most of the character pairs recorded higher values of genotypic correlations than their corresponding phenotypic correlations. 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 environmental factors.

The positive genotypic association has been reported between seed yield per plant and biological yield per plant (Chandel et al., 2014; Parmar et al., 2014; Dubey et al., 2015 and Ghanbari et al., 2018); number of pods per plant (Shinde et al., 1996; Ramana et al., 2000; Mukhekar et al., 2004; Aditya et al., 2011; Parmar et al., 2014; Silva et al., 2015; Chavan et al., 2016 and Painkra et al., 2018); number of clusters per plant (Gohil et al., 2003 and Chandel et al., 2017); days to flowering (Ramana et al., 2000; Mukhekar et al., 2004; Malik et al., 2007 and Chandel et al., 2017) and plant height (Shinde et al., 1996; Ramana et al., 2000; Gohil et al., 2003; Mukhekar et al., 2004; Chandel et al., 2005 and Malik et al., 2007).

The days to flowering had highly significant and positive association with plant height, number of clusters per plant, number of pods per plant and biological yield per plant at genotypic and phenotypic levels. The days to maturity exhibited significant and positive association with plant height at both genotypic and phenotypic levels. Plant height exhibited highly significant and positive association with number of pods per plant, number of clusters per plant and biological yield per plant. Number of pods per plant exhibited highly significant and positive association with biological yield per plant and number of clusters per plant. Number of clusters per plant also exhibited highly significant and positive relationship with biological yield per plant at genotypic and phenotypic levels. Similarly, 100-seed weight also had highly significant but negative association with biological yield per plant at genotypic and phenotypic level. Similar relationship has been reported earlier by Chavan et al. (2016); Ghanbari et al. (2018) and Painkra et al. (2018).

Path analysis:

The genotypic correlation coefficients calculated for different pairs of characters were subjected to genotypic path coefficient analysis for partitioning these values into the direct and indirect effects. The characters which had shown significant genotypic correlation with seed yield per plant were considered for path coefficient analysis. The results obtained for direct and indirect effects of different characters on seed yield per plant are presented in Table 2.

The genotypic path coefficient analysis revealed that the number of pods per plant and biological yield per plant exhibited high and positive direct effects on seed yield per plant. Similar result has been reported for number of pods per plant by Gohil et al. (2003); Datta et al. (2005); Kumar et al. (2005); Arshad et al. (2006); Gaikwad et al. (2007); Malik et al. (2007); Baraskar et al. (2015); Jain et al. (2015); Silva et al. (2015) and Dubey et al. (2018). Similar result for biological yield per plant reported by Kumar et al. (2005); Baraskar et al. (2015) and Jain et al. (2015).

These traits turned out to be major components of seed yield for direct selection. The number of branches per plant and harvest index exhibited low and positive direct effect towards seed yield per plant. Similar results were obtained by Kumar et al. (2005); Gaikwad et al. (2007) and Akram et al. (2016). The residual effect (0.2067) was of low magnitude suggesting that the majority of the yield attributes have been included in the path analysis.

Days to flowering, plant height, number of pods per cluster and 100-seed weight expressed negative direct effects of very low magnitude on seed yield per plant. However, among these four characters, days to flowering and plant height had highly significant and positive association at genotypic level with seed yield, because of the cumulative minor positive indirect effect via rest of the characters. Plant height had negative direct effect on seed yield also reported by Shrivastava et al. (2001) and Chavan et al. (2016).

Table 1: Estimates of genotypic (r_g) and phenotypic (r_p) correlation coefficients among 14 characters in soybean

Characters		Days to flowering	Days to maturity	No. of branches/plant	Plant height (cm)	No. of pods/plant	No. of seeds/pod	No. of clusters/plant	No. of pods/cluster	Pod length (cm)	100-seed weight (g)	Biological yield/plant (g)	Harvest index (%)	Oil content (%)
Seed yield per plant (g)	r_g	0.4420**	0.2118	0.2089	0.3520**	0.8790**	0.2206	0.6900**	0.1415	0.0985	-0.3608**	0.9444**	0.3811**	-0.0610
	r_p	0.4296**	0.2100	0.1474	0.3494**	0.8718**	0.1661	0.6702**	0.1051	0.0968	-0.3597**	0.9265**	0.2817*	-0.0584
Days to flowering	r_g		0.2014	0.1789	0.5573**	0.4825**	0.2171	0.5554**	0.0318	-0.0424	-0.4385**	0.4373**	0.1532	-0.2369*
	r_p		0.1976	0.1087	0.5384**	0.4683**	0.1692	0.5299**	0.0091	-0.0453	-0.4288**	0.4239**	0.0980	-0.2270
Days to maturity	r_g			0.0915	0.2782*	0.1441	0.1060	-0.0482	-0.1838	-0.0110	-0.1339	0.1916	0.1265	-0.0020
	r_p			0.0616	0.2752*	0.1450	0.0808	-0.0428	-0.1454	-0.0136	-0.1341	0.1879	0.0933	-0.0046
No. of branches per plant	r_g				0.1306	0.0090	0.0791	0.1353	-0.2819*	-0.1570	-0.0031	0.1299	0.1414	-0.1195
	r_p				0.0875	0.0089	0.0559	0.1047	-0.1001	-0.0932	0.0006	0.1026	0.0917	-0.0756
Plant height (cm)	r_g					0.5064**	0.0724	0.3874**	0.1083	0.0265	-0.4147**	0.3185**	0.2964*	-0.4379**
	r_p					0.5020**	0.0520	0.3766**	0.0793	0.0260	-0.4118**	0.3122**	0.2178	-0.4209**
No. of pods per plant	r_g						0.1660	0.6884**	0.3102**	0.0564	-0.3638**	0.8545**	0.2588*	-0.1963
	r_p						0.1368	0.6706**	0.2363*	0.0531	-0.3618**	0.8324**	0.1870	-0.1919
No. of seeds per pod	r_g							0.0534	-0.1732	0.0417	0.0750	0.1606	-0.1022	0.0130
	r_p							0.0248	-0.0836	0.0170	0.0504	0.1233	-0.0313	0.0263
No. of clusters per plant	r_g								0.1724	0.0565	-0.3886**	0.6567**	0.2300	-0.2067
	r_p								0.1288	0.0494	-0.3773**	0.6243**	0.1638	-0.2039
No. of pods per cluster	r_g									0.2711*	-0.1640	0.2162	-0.0565	-0.1335
	r_p									0.2047	-0.1237	0.1727	-0.0607	-0.0823
Pod length (cm)	r_g										-0.1054	0.0314	0.2870*	-0.1801
	r_p										-0.1022	0.0309	0.2145	-0.1676
100-seed weight (g)	r_g											-0.3428**	-0.1449	-0.0409
	r_p											-0.3381**	-0.1065	-0.0402
Biological yield per plant (g)	r_g												0.2708*	-0.0248
	r_p												0.1919	-0.0112
Harvest index (%)	r_g													-0.1960
	r_p													-0.1473

*,** Significant at 5% and 1% levels, respectively.

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

Characters	Days to flowering	Days to maturity	No. of branches per plant	Plant height (cm)	No. of pods per plant	No. of seeds per pod	No. of clusters per plant	No. of pods per cluster	Pod length (cm)	100-seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Oil content (%)	seed yield per plant (g)
Days to flowering	-0.0483	-0.0097	-0.0086	-0.0269	-0.0233	-0.0105	-0.0268	-0.0015	0.0020	0.0212	-0.0211	-0.0074	0.0114	0.4420**
Days to Maturity	0.0084	0.0418	0.0038	0.0116	0.0060	0.0044	-0.0020	-0.0077	-0.0005	-0.0056	0.0080	0.0053	-0.0001	0.2118
No. of branches per plant	0.0202	0.0103	0.1128	0.0147	0.0010	0.0089	0.0153	-0.0318	-0.0177	-0.0003	0.0147	0.0160	-0.0135	0.2089
Plant height (cm)	-0.0470	-0.0234	-0.0110	-0.0843	-0.0427	-0.0061	-0.0327	-0.0091	-0.0022	0.0350	-0.0268	-0.0250	0.0369	0.3520**
No. of pods per plant	0.1806	0.0539	0.0034	0.1895	0.3742	0.0621	0.2576	0.1161	0.0211	-0.1362	0.3198	0.0969	-0.0735	0.8790**
No. of seeds per pod	0.0157	0.0077	0.0057	0.0052	0.0120	0.0723	0.0039	-0.0125	0.0030	0.0054	0.0116	-0.0074	0.0009	0.2206
No. of clusters per plant	0.0466	-0.0040	0.0113	0.0325	0.0577	0.0045	0.0838	0.0145	0.0047	-0.0326	0.0551	0.0193	-0.0173	0.6900**
No. of pods per cluster	-0.0018	0.0103	0.0158	-0.0061	-0.0174	0.0097	-0.0097	-0.0560	-0.0152	0.0092	-0.0121	0.0032	0.0075	0.1415
Pod length (cm)	-0.0023	-0.0006	-0.0084	0.0014	0.0030	0.0022	0.0030	0.0145	0.0535	-0.0056	0.0017	0.0154	-0.0096	0.0985
100-seed weight (g)	0.0199	0.0061	0.0001	0.0189	0.0165	-0.0034	0.0177	0.0075	0.0048	-0.0455	0.0156	0.0066	0.0019	-0.3608**
Biological yield per plant (g)	0.2394	0.1049	0.0711	0.1744	0.4677	0.0879	0.3595	0.1184	0.0172	-0.1877	0.5474	0.1482	-0.0136	0.9444**
Harvest index (%)	0.0178	0.0147	0.0164	0.0344	0.0301	-0.0119	0.0267	-0.0066	0.0333	-0.0168	0.0314	0.1161	-0.0228	0.3811**
Oil content (%)	-0.0073	-0.0001	-0.0037	-0.0135	-0.0060	0.0004	-0.0064	-0.0041	-0.0055	-0.0013	-0.0008	-0.0060	0.0307	-0.0610

*,** Significant at 5% and 1% levels, respectively. (Residual effect = 0.2067)

CONCLUSIONS

Highly significant and positive genotypic and phenotypic correlations of seed yield per plant were observed with biological yield per plant, number of pods per plant, number of clusters per plant, days to flowering and plant height were considered as useful selection criteria. Higher values of genotypic correlations than their corresponding phenotypic correlations were recorded by most of the character pairs. 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 environmental factors. The genotypic residual effect was of low magnitude suggesting that the majority of the yield attributes have been included in the study of path analysis. The results of path coefficient analysis revealed that for improvement of seed yield in soybean through selection programme, more emphasis should be given to biological yield per plant, number of pods per plant, number of clusters per plant, harvest index and number of branches per plant.

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