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CORRELATIONS AND PATH-COEFFICIENT ANALYSIS OF COMPONENTS OF SEED YIELD IN SOYBEANS

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ABSTRACT

Twenty-four genotypes of soybeans (*Glycine max* (L.)Merr) were grown in a randomised complete block experiment. Genotypic and phenotypic correlation coefficients were calculated for 12 characters. Phenotypic correlation coefficients were generally lower than genotypic coefficients. While no character was phenotypically correlated with seed yield, days to maturity, nodulation, number of flowers per plant, height at harvest, shattering and 300-seed weight were genotypically correlated with seed yield. The genotypic correlation coefficients with seed yield of selected eight characters were partitioned into direct and indirect causes. Nodulation and number of flowers per plant had the largest positive direct effects on seed yield with its largest indirect effect through height at flowering and reduction in nodulation, respectively. The study indicated that since no one character was absolutely important for seed yield, selection should be based on simultaneous consideration of various characters.

Key Words: **Correlation coeffficients, *Glycine max* (L.) Merr, yield analysis**

RÉSUMÉ

Vingt quatre génotypes desoja *(Glycine max* (L.) merr) ont éte cultivés en essai de bloc complet randomisé. Les coefficients de corrélation génotypiques et phénotypiques étaient calculés pour 12 caractères. Les coefficients phénotypiques étaient généralement moins élevés que les coefficients génotypiques. Alors qu'aucun caractère n'étaient corrélé phénotypiquement avec le rendement en graines, la durée de maturité, la nodulation, le nombre de fleurs par plante, la hauteur au moment de la récolte, dehiscence et le pois de 300-graines étaient génotypiquement corrélé avec le rendement en graines. Les coefficients de corrélation génotypiques et le rendement en graines de huit caractères sélectionnés étaient groupés en causes directes et indirectes. La nodulation et le nombre de fleurs par plantes avaient les plus important effets positifs directs sur le rendement des graines avec respéctivement comme effets indirects importants la hauteur à la floraison et la réduction en nodulation. L'étude a montré qu'aucun caractère n'était seul absolument vital pour le rendement des graines, par conséquant, la sélection devrait être faite en prenant en considération les différents caracterères simultanément.

Mots Clés: **Coefficients de corrélation, *Glycine max* (L.) Merr, rendement**

INTRODUCTION

Soybean *(Glycine max* (L.) Merr) is valuable for its high oil and protein content and is commonly used in both human and animal diets. It is, however, characterised by low seed yield, partly because of lodging and pod shattering, in addition to other production constraints.

Selection for seed yield, which is a polygenic trait, often leads to changes in other characters. Therefore, knowledge of the relationship between seed yield and other characters is desirable to be able to choose the appropriate selection programme during breeding. Correlation studies enable the breeder to know the strength of relationship between various characters as well as the magnitude and direction of changes expected during selection. Correlation and path-coefficient analyses would assist in the choice of characters whose selection would result in the improvement of a complex character such as yield.

Sharma and Juneja (1971) reported that seed yield in soybean was positively correlated with number of branches per plant, number of pods per plant and days to flowering. Sengupta and Sen (1972) observed that, although number of branches per plant and number of pods per plant were positively correlated, yield was not correlated with number of branches per plant. Diaz *et al.* (1983) noted that tall plants often tended to produce high yield, while Gonzales *et al.* (1984) concluded that pod weight was the most appropriate character for indirect selection.

The objective of this study was to determine the component characters whose selection would lead to improvement in seed yield of some Nigerian soybean varieties.

MATERIALS AND METHODS

Shortly before planting, the field was treated with basal fertilizer applied at the rate of 7.5 kg N ha^{-1}, 81.6 kg P ha^{-1} and 7.5 kg K ha^{-1}. Four litres of Galex and one litre of Grammaxone in appropriate volume of water was sprayed per hectare to control weeds. Subsequent weed control was done manually as necessary.

Twenty four soybean genotypes were grown during the rainy season of 1991 at the University of Agriculture, Abeokuta in a randomised complete block experiment with three replications. Each plot consisted of four rows and the inner two rows were utilized for all observations except shattering which was observed on the outer rows. Characters evaluated were days to maturity, nodulation, number of leaves per plant, height at harvest, number of pods per plant, number of branches plant, per number of flowers per plant, pod length, number of seeds per pod, seed yield, 300-seed weight and shattering.

Phenotypic and genotypic correlation coefficients were calculated from mean values of the characters according to Miller *et al.* (1958). Path-coeffiecient analysis was based on the procedure of Dewey and Lu (1959).

RESULTS AND DISCUSSION

The genotypic and phenotypic correlation coefficients among various characters evaluated are presented in Table 1. Seed yield showed significant positive genotypic correlation with days to maturity, number of flowers per plant, height at harvest and seed yield, suggesting that seed yield could be improved by selecting for these characters. Yield was negatively correlated with nodulation and shattering, indicating that high yielding varieties did not nodulate well and were prone to shattering. Days to maturity was positively correlated with number of flowers per plant and 300-seed weight, but negatively correlated with nodulation. This suggested that late maturing varieties produced more flowers and heavy seeds but did not nodulate well. Similarly, nodulation was positively correlated with height at harvest and shattering but negatively correlated with 300-seed weight. Also number of leaves per plant had positive genotypic correlation with number of pods per plant, number of branches per plant and number of flowers per plant. Since the leaves were borne on the branches, the relationship between number of leaves and number of branches was not unexpected. Furthermore, the positive relationship between number of leaves and number of flowers suggested that photosynthetic products of the leaves might have influenced flower initiation and formation. Number of pods per plant was positively correlated

TABLE 1. Genotypic and phenotypic correlation coefficients among twelve soybean characters

	Seed yield	Days to maturity	Nodulation	No. of leaves plant⁻¹	No. of pods plant⁻¹	No. of branches plant⁻¹	No. of flowers plant⁻¹	Pod length	Seeds pod⁻¹	Height at harvest	Shattering	300 seed weight
Days to maturity	G	0.4310*										
	P	0.2317										
Nodulation	G	-0.4330*	-0.4989*									
	P	-0.1279	-0.3148									
Number of leaves plant⁻¹	G	0.0734	0.0587	-0.0877								
	P	0.0444	0.0586	-0.0583								
Number of pods plant⁻¹	G	0.1734	-0.1170	0.1285	0.7481**							
	P	0.0898	0.1145	0.0915	0.7306**							
Number of branches	G	0.1439	-0.1009	0.3564	0.6815**	0.7068**						
	P	0.1087	-0.0912	0.2201	0.6400*	0.6453*						
Number of flowers plant⁻¹	G	0.4483*	0.4431*	0.1034	0.4384*	0.6436**	0.5258*					
	P	0.1839	0.4200*	0.0199	0.4178*	0.6093*	0.4510*					
Pod lengths	G	-0.3787	-0.0945	0.0544	-0.2696	0.3281	-0.2733	-0.2613				
	P	-0.2096	0.0687	0.0003	-0.1939	0.2209	-0.2062	-0.2311				
Seeds pod⁻¹	G	0.0559	0.0784	0.07161	-0.1958	0.1527	-0.0993	-0.0008	0.1321			
	P	0.0276	0.1354	0.0666	-0.3282	0.3187	-0.1529	-0.0621	0.2777			
Height at harvest	G	0.4335*	-0.2717	0.51477	0.3125	0.5392*	0.1730	0.5298*	-0.4817*	-0.1276		
	P	0.1543	-0.1787	0.1645	0.2179	0.3034	0.1189	0.3141	-0.0380	0.0959		
Shattering	G	-0.4060*	0.2032	0.4374*	0.0006	-0.2044	0.2117	-0.1328	-0.1198	-0.0316	-0.3717	
	P	-0.1807	0.1961	0.2867	0.0002	-0.1964	0.0224	-0.1261	-0.0927	-0.0680	-0.2281	
300 Seed weight	G	0.5293*	0.6397*	0.5196*	-0.3258	-0.4992*	-0.4622*	0.1333	-0.1075	0.0703	-0.4228*	0.0937
	P	0.2634	0.5127	0.3701	-0.2541	-0.3419	-0.3291	-0.871	0.1072	0.1072	0.1053	-0.2281

*; ** = Significant at 5 and 1 percent levels, respectively.
G & P are genotypic and phenotypic correlation coefficients, respectively.

with number of branches per plant, number of flowers per plant and height at harvest, but negatively correlated with 300-seed weight. On the other hand, number of branches per plant was positively correlated with number of flowers per plant but negatively correlated with 300-seed weight. Number of flowers per plant was positively correlated with height at harvest, suggesting that tall plants will ordinarily produce more flowers which could eventually result in more pods. Similarly, 300-seed weight was negatively correlated with height at harvest.

The phenotypic correlation coefficients were generally low. No character showed any significant phenotypic correlation with seed yield, suggesting that those characters that showed genotypic correlation with seed yield would be of limited use in direct selection for seed yield, since selection is usually based on phenotypic expression of the trait. However, days to maturity exhibited positive phenotypic correlation with number of flowers per plant and 300-seed weight, suggesting that these characters could be directly selected for when high yield is the objective. Similarly, number of leaves per plant was positively and phenotypically correlated with number of pods per plant, number of branches per plant and number of flowers per plants. Number of pods per plant were phenotypically correlated with number of branches per plant and number of flowers per plant. Also number of branches per plant and number of flowers per plant were significantly correlated phenotypically. Generally the magnitude of genotypic correlation coefficients were in most cases higher than the corresponding phenotypic coefficients.

The direct and indirect effects of the characters on seed yield are presented in Table 2. Path-coefficient analysis showed that number of flowers per plant had the largest positive direct effect on seed yield with it's largest indirect effect through reduction in nodulation. Nodulation also had a fairly large positive direct effect on seed yield with its largest indirect effect through height at harvest. Days to maturity, height at harvest and shattering had negative direct effects on seed yield inspite of their significant positive genotypic correlation with seed yield. This highlights the inadequacy of selecting only on the basis of inter-

TABLE 2. Direct and indirect effects of some characters on seed yield in soybeans

Character	Direct effect on seed yield	Indirect effect on seed yield through								Genotype correlation coefficient
		Days to maturity	Nodulation	No. of branches plant^{-1}	No. of flowers plant^{-1}	No. of seeds pod^{-1}	Height at harvest	Shattering	300 seed weight	
Days to maturity	-3.04	-	-1.46	0.26	2.54	-0.06	1.07	-0.13	1.26	0.43*
Nodulation	2.92	1.52	-	-0.92	-0.56	-0.05	2.01	0.29	-1.04	-0.43*
Number of branches plant^{-1}	-2.57	0.30	1.05	-	2.99	0.08	-0.67	-0.14	-0.91	0.14
Number of flowers plant^{-1}	5.64	1.34	-2.92	-1.36	-	0.01	-2.09	0.09	-0.26	0.45*
Number of seeds pod^{-1}	-0.77	-0.24	0.20	0.26	-0.06	-	0.51	0.02	0.14	0.06
Height at harvest	-3.95	0.82	1.49	-0.44	2.98	0.10	-	0.24	0.83	0.43*
Shattering	-0.65	0.61	1.28	0.54	-0.73	0.02	1.46	-	0.18	0.41*
300 seed weight	1.97	-1.92	-1.52	1.18	-0.73	0.05	1.66	-0.06	-	0.53**
Residual factors =	2.97									

character correlation alone. Path-coefficient analysis revealed that the adverse effects of days to maturity and height at harvest on seed yield was largely masked by the indirect effects on number of flowers per plant, while that of height at harvest on seed yield was largely masked by number of flowers per plant. Similarly, nodulation had negative correlation with seed yield but had positive direct effect on seed yield. Even the number of flowers per plant that had the largest direct effect on seed yield had its largest indirect effect through reduction in nodulation. Given the relationship of the various characters with seed yield, it is obvious that no one single character was absolutely important for seed yield. Yield is a complex terminal outcome of growth to which there are diverse and interrelated developmental tracks. Ariyo (1991) had earlier observed, in okra, that characters might have not only additive effects, they could also have multiplicative effects. Therefore in selecting for high yield, several characters should be taken into consideration simultaneously. Although some characters were correlated, it is most likely that they had more complex relationship with each other which could not be explained in a linear relationship. It appears that nodulation, number of flowers per plant and 300-seed weight are important characters to be considered during selection. But a selection index comprising of both vegetative and reproductive characters would produce better results and is recommended. A balanced view of all the characters in question is of paramount importance in selecting for quantitative characters like seed yield.

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