CORRELATION OF HARVEST INDEX WITH AGRONOMIC CHARACTERS AND THEIR HERITABILITY IN SOYBEAN(*GLYCINE MAX* (L.) MERR.)*)

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Abstract

Studies on harvest index with phenotypic and genotypic correlations and path coefficient analysis were conducted in an indroduced of ten lines and one variety Galunggung as a check of soybean of diverse origin. The flowering time, length of anthesis, maturity, nodes and pods-number, plant-height, 100-seed weight had the heritability value at more than 0.50 followed by the coefficient of genetic variability value at more than 10 percent. The harvest index or percentage of dry matter that was channeled to bean production had significantly genotypic correlation with the days to maturity, the number of nodes and the fresh weight of biomass per plant. It was directly affected by the fresh weight of biomass per plant. Galunggung had the highest seed weight per plant and harvest index. AGS 129, AGS 143 and AGS 167 had days to maturity significantly more earlier than Galunggung. However, they had harvest index not significantly different to Galunggung, therefore need be further examined.

Introduction

A knowledge of genetic variability and association between yield and other important traits in soybean is helpful in selecting a suitable plant type.

The improvement of crops is dependent on the magnitude of genetic variability and the extent to which the desirable characters are heritable. Environment seems to play an important role in the expression of different characters. Yield is a complex quantitative character, governed by a large number of genes and is greatly affected by environmental fluctuation; hence the selection of superior genotype based on yield as such, is not effective.

Association of plant characters and yield, thus, assumes special importance as the basis for selecting desired strains. Estimate of genetic association along with the phenotypic correlations, not only display a clear picture of the extent of inherent association but also indicate how much of the phenotypically expressed correlation is influenced by the environment.

Futhermore, the relationship between yield components can be analysed by the method of path coefficients. Hence, the prime requirement for a plant breeder is to have information on the direct or indirect influence of these characters on yield. Also some basic information on the range of phenotypic variation, heritability of agronomic characters and correlations among them.

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Soybean is an old crop in Indonesia. However, information on the yield components under the environmental conditions in the country is lacking.

The present investigation was therefore undertaken to assess the importance of various yield components in soybean. Experiments have revealed that in soybean certain agronomic characters, such as days to flowering, days to maturity, plant height, plant weight, branch number and pod number, leaf area index, harvest index, susceptibility to lodging, seed weight and path coefficient are significantly correlated with yield performance.

For the study of these above characters the work of Johnson et al, (1955), Anand and Torrie (1963), Know and Torrie (1964), Gopani and Kabaria (1970), Lal and Faziul Haque (1971, 1972), Singh and Stoskopf (1971), Malhotra et al., (1972), Pandey and Torrie (1973), Yap and Lee (1975), Bhatt (1976), Buzzel and Buttery (1977), Pandey et al, (1977), Johnson and Major (1979), Sharma (1979, 1980), Lantican (1980), Soetarso (1981), are worth mentioning.

Materials and Methods

A planting was made on July 26, 1983 of ten lines were received from AVRDC Legumes Program and one variety Galunggung as a check in a Randomized Complete Block Design (RCBD) with four replications. The list of lines or varieties is presented in Table 1. Plot size consisted of 4 rows, six meters long, with spacing of 5 × 40 centimeters. A plant per hill was maintained to make a population density of about 500,000 plants per hectare. Fertilizer application was at 45 kg. each of N, P_2O_5 and K_2O per hectare and was spread around each hill during planting time.

Control of insect pests was made with the application of Furadan 3G during the early stage of plant development and supplemented with alternate spraying with Azodrin, Thiodan, Hopcin at weekly intervals. Hand weeding was done twice, one in four weeks after planting, the other after flowering (60 days after seeding).

Irrigation water was applied at two weeks intervals up to pod filling stage.

Table 1. **The selected soybean lines or varieties used in the experiment at the ATRD Experiment Station, 1983 dry season.**

Pedigree or Acc. No.		Cross or No.	
AGS 19	Shih Shih	X	SRF 400
AGS 65	66-D-20	X	CH ≠ 2
AGS 66	Forrest	X	Shih Shih
AGS 79	KS 514	X	Palmetto
AGS 124	Clark	X	CH ≠3
AGS 129	Shih Shih	X	SRF 400
AGS 143	Selected from KS 725		
AGS 160	PI 227224	X	AGS 2
AGS 162	Clark 63	X	64-4
AGS 167	64-4	X	64-62
GALUNGGUNG	Davros	X	T.K. 5

Five plants were selected at random in the two center rows of each replication, and detailed observations were recorded on quantitative characters viz. days to first flowering, period of flowering, days to maturity, plant height, number of nodes per plant, number of pods per plant, 100-seed weight, seed yield per plant and harvest index.

Genetic constants were calculated by adopting standard statistical procedures described by Hayes, Immer and Smith (1942), Burton and de Vane (1953), Kemthorne (1973) and Gomez (1976). Heritability, genetic advance, simple correlation and path coefficient were calculated according to the formula suggested by Hayes, Immer and Smith (1942), Allard (1960), Li Ching Chun (1972), Kempthorne (1973), Gomez (1976), Knight (1977) and Singh & Chaudary (1979).

Results and Discussions

Climatic Conditions During the Experiment

The conditions after planting were really so dry up to flowering stage. Unfortunately during the pod filling stage up to physiological maturity stage those plants were destroyed by a strong wind and flood which started from October, 4, until November ends. The rainfall in those months amounted 193.70 mm and 323.00 mm on October and November respectively.

Agronomic Characters

Important agronomic data on flowering, maturity period, plant-height, nodes and pods — number, seed-weight, 100 seed weight and harvest index is presented in Table 2. The phenotypic and genotypic correlations among the nine quantitative characters studied are presented in Table 3.

Path diagram at genotypic level showing the extent of direct and indirect influence of eight important characters upon harvest index were also determined (Figure 1).

Table 2 shows that some lines having earlier flowering than Galunggung. Flowering date had high heritability value at 0.9 followed by the coefficient of genotypic variability at 10.81. The earliest flowering date was showed by AGS 124 and the latest was AGS 162.

Length of anthesis had heritability value at 0.96 with the coefficient of genotypic variability at 20.58. The shortest length of anthesis was showed by AGS 167 at 9.30 days and the longest was AGS 129 at 25.00 days.

Days to maturity varied from 83.80 for the early to 98.00 days for the late maturity lines. Days to maturity had heritability value at 0.97 with the coefficient of genotypic variability at 13.31. Four lines having earlier harvest time compared to Galunggung, and these were : AGS 66, AGS 129, AGS 143, and AGS 162.

In terms of plant-height, three lines having shorter plant-height compared to Galunggung, and these were; AGS 66, AGS 129 and AGS 162. Plant height was significantly effected by line or variety. Plant height had heritability value at 0.71 followed by the coefficient of genotypic variability at 15.88.

Among the lines, AGS 65 showed the highest mean plant height at 56.20 centimeters followed by AGS 124 and AGS 143 at 56.10 and 55.30 centimeters respectively.

Nodes-number had heritability value at 0.55 followed by the coefficient of genotypic variability value at 19.80. AGS 66 gave the lowest nodes-number at 15.00 and AGS 65 had the highest nodes-number at 28.70.

In terms of pods-number per plant, no intruduced lines did go beyond Galunggung. Pods-number had heritability value at 0.60 with the coefficient of genotypic variability 20.60.

Among the lines, AGS 167 gave the highest mean seed weight at 15.23 grams/100-seed followed by AGS 129 and 19 at 15.19 and 14.09 grams respectively. 100-seed weight and heritability value at 0.83 followed by the coefficient of genotypic variability value at 12.93.

In terms of seed-weight per plant no introduced lines did go beyond Galunggung. Seed-weight per plant had heritability value at 0.45 with the coefficient of genotypic variability value at 26.48. Galunggung gave the highest seed-weight per plant at 12.69 grams.

Actual harvest index had heritability value at 0.44 followed by the coefficient of genotypic variability value at 9.44.

Some lines having siginificantly lower harvest index compared to Galunggung, and these were; AGS 66, AGS 124, AGS 160 and AGS 162. Among the lines, AGS 19 gave the highest actual harvest index at 38.57.

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Table 2. **Flowering, length of anthesis, maturity period, plant-height, node-number, pod number, 100-seed weight, seed weight per plant and actual harvest index of eleven soybean lines/varieties grown at the ATRD Kalitirto Station, 1983 dry season.**

Line / variety	Ave. Flowering in days	Ave. length of Anthesis in days	Ave. Maturity period in days	Ave. Plant height (in cm)	Ave. Node number per plant	Ave. Pod number per plant	Ave. 100-seed weight (g)	Ave. seed weight per plant (g)	Ave. Actual Harvest Index
Ags 19	31,5 ab	19,0 c	92,0 e	46,1 bc	18,5 ab	33,0 ab	14,09 c	7,15 ab	38,57 c
Ags 65	38,3 e	20,8 de	98,0 g	56,2 e	28,7 d	44,5 cd	13,81 c	8,25 b	35,08 bc
Ags 66	33,0 c	17,0 b	83,8 a	29,3 a	15,0 a	43,0 bcd	10,88 ab	5,02 ab	25,55 a
Ags 79	40,0 g	19,0 c	91,0 d	44,8 bc	19,9 ab	45,3 d	9,96 a	6,51 ab	36,54 bc
Ags 124	30,8 a	21,3 e	90,0 c	56,1 e	16,5 ab	33,9 abc	11,74 b	5,60 ab	32,56 b
Ags 129	32,0 b	25,0 f	88,5 b	41,5 b	17,6 ab	33,7 abc	15,19 d	7,22 ab	35,89 bc
Ags 143	40,0 g	20,0 cd	89,0 b	55,3 de	22,3 bc	39,9 abcd	13,30 c	6,27 ab	35,66 bc
Ags 160	34,0 d	17,0 b	93,0 f	48,4 bcd	18,0 ab	40,4 bcd	13,23 c	8,05 ab	32,69 b
Ags 162	40,3 g	17,3 b	88,5 b	43,1 b	15,4 a	30,4 a	12,01 b	4,67 a	31,50 b
Ags 167	39,8 fg	9,3 a	90,0 c	47,8 bcd	18,8 ab	41,1 bcd	15,23 d	7,37 ab	36,29 bc
Galungung	39,0 ef	20,0 cd	90,0 c	51,1 cde	25,6 cd	63,4 e	11,91 b	12,69 c	38,70 c
G C V	10,81	20,58	13,31	15,88	19,80	20,60	12,93	26,48	9,44
H	0,97	0,96	0,97	0,71	0,55	0,60	0,83	0,.5	0,44
LSD 5%	0,90	1,10	0,93	6,09	5,12	9,80	1,10	3,01	5,38
C V	1,73	4,02	0,71	10,21	18,07	16,60	5,93	29,22	10,74

Means followed by the same letters are not significant at the 5% level by DMRT.

Characters		Harvest Index	Flowering Date	Length of Anthesis	Maturity Period	Pods Number	100-seed weight	Branches Number	Nodes Number	Non Productive Nodes Number	Plant Height of Flowering	Plant Height of Harvest	Stem and Pods Dry weight	Fresh Weight of Biomass per plant
Seed Weight per plant	G	.356	.214	.099	.424	.814**	.200	.638*	.780**	.256	.639*	. 8*	.970	.970*
	P	.950	.131	.057	.310	.800**	.131	.445	.560	.064	.452	.334	.930**	.840**
Harvest Index	G		.320	.130	.684*	.210	.430	.315	.635*	. 33	.583	.630*	.570	.670*
	P		.270	.160	.450	.350	.340	.180	.430	.170	.264	.525	.440	.420
Flowering Date	G			.350	.150	.330	.150	.755*	.493	.422	.716*	.150	.357	.242
	P			.430	.151	.560	.112	.630	.374	.330	.660*	.475	.303	.195
Length of Anthesis	G				.163	.074	.102	.472	.156	.059	.340	.220	.016	.062
	P				.111	.061	.091	.390	.272	.036	.300	.004	.008	.047
Maturity Period	G					.099	.311	.424	.753*	.863**	.423	.730*	.432	.699*
	P					098	.287	.296	.540	.731*	.375	.596	.325	.550
Pods Number	G						.327	.714*	.440	.146	.750*	.074	.805*	.666*
	P						.215	.900**	.750*	.065	.520	.530	.991**	.897**
100-seed weight	G							.130	.150	.223	.090	.216	.014	.211
	P							.334	.131	.002	.077	.225	.080	.191
Branches Number	G								.770*	.480	.902*	.293	.770*	. 72*
	P								.190	.380	.662*	.283	.633*	.616
Nodes Number	G									.856**	.707*	.690*	.870*	.920**
	P									.530	.476	.500	.680	.730*
Non Productive Nodes Number	G										.620*	.690*	.387	.578
	P										.456	.480	.204	.312
Plant height at Flowering	G											.520	.706*	.701*
	P											.280	.598	.592
Plant height at Harvest	G												.501	.594
	P												.454	.500
Stem and Pods Dry weight	G													.960
	P													.930*

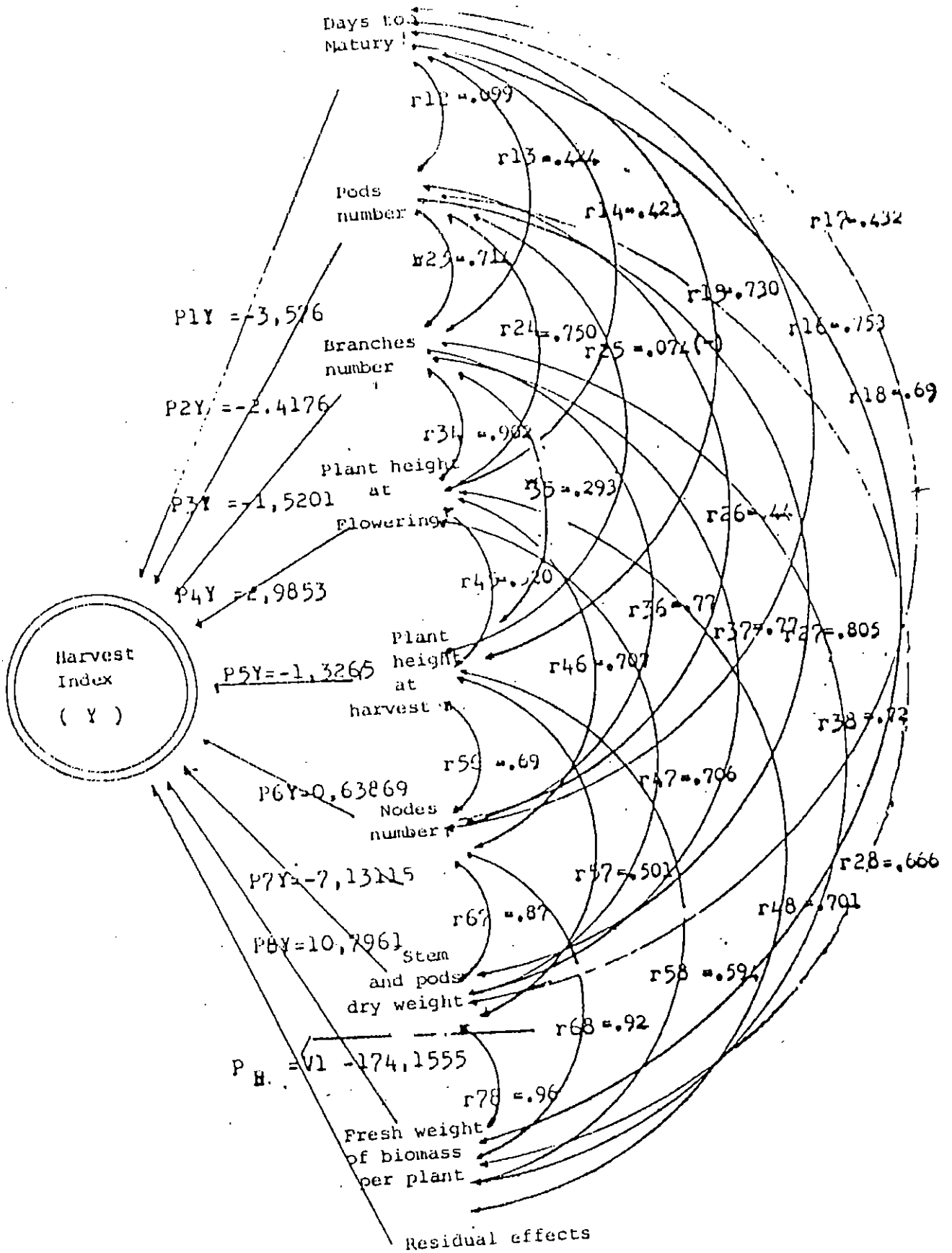

Figure 1. **Path analysis in soybean**

The single arrowedlines indicate the path coefficients and double arrowedlines the correlation coefficients between the characters

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