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VARIABILITY AND COHERITABILITY ESTIMATES FOR PHYSIOLOGICAL AND ECONOMIC ATTRIBUTES IN SOYBEAN

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ABSTRACT

Twenty six divergent genotypes of soybean (*Glycine max* (L.) Merrill.) were used to estimate the variability and coheritability for physiological and economic attributes. The variability in vegetative and reproductive phases and 100-seed weight appeared mainly due to genotypic differences. High heritability estimates were recorded for vegetative and reproductive phases, crop growth rate, and 100-seed weight. Both additive and nonadditive gene effects were important in the inheritance of net assimilation rate, crop growth rate, 100-seed weight, biological yield/plant, and seed yield/plant, whereas nonadditive gene effect was found important for remaining traits. Bioloigical yield and pods/plant, harvest index and duration of reproductive phase exhibited substantial coheritability estimates with seed yield.

Key words: Variability, coheritability, physiological attributes, economic attributes.

In recent years, genetics of economic attributes has received a lot of attention in soybean, however, information on physiological traits is extremely limited. The increasing knowledge of the physiological basis of yield and adaptation will continue to improve our ability to more accurately identify the suitable parents [1]. Hence, it is imperative to study the extent of genetic variability and interrelationship of heritable and nonheritable variations in physiological and economic attributes simultaneously for effective selection. The genetic correlations which might arise from linkages or pleiotropic effects of genes do not take into consideration the environmental variances. Coheritability, on the other hand, which refers to joint transmission of different character pairs, is a better genetic parameter for improving selection efficiency as it permits the study of simultaneous changes in different characters. coheritability estimates obtained in soybean, rice and oat [2–4] were helpful in production of high yielding genotypes. The present investigation has been

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undertaken to estimate variability and coheritability for various physiological and economic traits in 26 diverse genotypes of soybean.

MATERIALS AND METHODS

Twenty six soybean lines were grown in randomized block design with three replications. Each plot had four rows 3.0 m long, 37.5 cm apart, and the plants within the rows spaced at 5.0 cm. From each plot, five competitive plants of middle rows were identified 50 and 75 days after sowing to estimate net assimilation rate (NAR) and crop growth rate (CGR) [5, 6]. Five competitive plants from each plot were tagged to record observations on six quantitative traits of direct economic value. The durations of vegetative and reproductive phases were expressed as number of days from germination to flower initiation, and from flowering to maturity of plants on plot basis, respectively.

The data were subjected to analysis of variance [7]. The genotypic and phenotypic coefficient of variances (PCV, GCV) were estimated as per [8]. Broadsense heritability and expected genetic advance (GA) as percentage of mean at 5% selection intensity were estimated using the procedure of [9]. Coheritability was estimated following [10].

RESULTS AND DISCUSSION

GENETIC PARAMETERS

It is evident (Table 1) that all the traits, except seeds/pod, exhibited wide range of variability. The PCV had higher estimate than corresponding GCV for all the characters. The little differences between PCV and GCV for duration of vegetative phase, reproductive phase, and 100-seed weight indicated that the variability was primarily due to genotypic differences. On the other hand, environmental influences were predominant for the remaining traits. Therefore, selection based on the length of vegetative phase, reproductive phase, and 100-seed weight is expected to be effective, while for other traits selection must be performed carefully considering environmental factors.

The heritability estimates obtained were high for vegetative phase, reproductive phase, CGR and 100-seed weight; moderate for NAR, biological yield and seed yield, and low for pods/plant, seeds/pod and HI. Our findings are in agreement with earlier reports for 100-seed weight [2], pods/plant and HI [11].

High heritability alone does not guarantee large gain from selection unless sufficient genetic advance (GA) attributable to additive gene action is present. High heritability coupled with moderate GA observed for CGR and 100-seed weight, moderate heritability with moderate GA for NAR and biological yield/plant, and moderate heritability with high

Table 1. **Genetic parameters of variation for physiological and economic attributes in soybean**

Character	Range	Mean	PCV (%)	GCV (%)	Herita-bility (%)	GA as % of mean
Vegetative phase, days	28.3–41.7	36.5	9.5	9.1	92.4	18.0
Reproductive phase, days	51.3–66.3	58.5	7.3	6.4	78.0	11.7
Net assimilation rate, $mg/cm^2/day$	0.2–0.5	0.3	28.8	22.8	62.5	35.5
Crop growth rate, $g/m^2/day$	12.8–28.8	19.9	23.5	19.9	71.2	34.9
Pods/plant	14.7–50.0	31.6	36.1	25.1	48.4	35.9
Seeds/pod	1.5–2.7	2.0	17.2	11.5	44.7	15.8
100-seed weight, g	6.8–13.1	10.7	16.3	15.9	95.3	32.1
Harvest index, %	27.1–43.0	36.2	14.8	8.9	35.7	10.9
Biological yield/plant, g	9.5–27.1	18.8	28.0	23.0	67.1	38.7
Seed yield/plant, g	3.0–11.2	6.9	36.5	29.5	65.6	49.2

GA for seed yield/plant revealed the importance of both additive and nonadditive gene effects. High heritability was combined with low GA for vegetative and reproductive phases, low heritability with moderate GA for pods/plant, and low heritability with low GA for seeds/pod and HI, which indicates the importance of nonadditive gene effect.

COHERITABILITY

The coheritability estimates for different character pairs (Table 2) had the same sign as genotypic correlations but of lower magnitude than the latter. These results are in agreement with the findings of Bedard et al. [10]. Smaller magnitude of coheritability estimates are expected due to high magnitude of environmental variances. This ultimately results in poor response to selection of correlated variable. Thus the estimates of coheritability indicate the efficiency of selection of character pairs and further shows that it would also depend upon the material chosen.

The coheritability estimates (Table 2) of character combinations of various physiological and economic attributes with seed yield revealed that biological yield/plant, pods/plant, HI and reproductive phase had higher coheritability with the estimates for yield. This suggests that selection for either of these attributes may result in simultaneous selection for other coinherited characters [10]. High coheritability estimates of biological yield/plant, pods/plant and HI with seed yield/plant have been earlier reported [2, 11]. Coheritability of CGR was negative with seed yield/plant. Vegetative phase, NAR, seeds/pod and

Table 2. Estimates of coheritability and correlation coefficient for different pairs of physiological and economic attributes of soybean

Character	Reproductive phase	Net assimilation rate	Crop growth rate	Pods per plant	Seeds per pod	100-seed weight	Harvest index	Biological yield	Seed yield
Vegetative phase	0.10 (0.13)	0.26 (0.45)	0.15 (0.23)	0.05 (0.11)	0.06 (0.15)	0.01 (0.01)	0.01 (0.04)	0.00 (0.01)	0.02 (0.03)
Reproductive phase		−0.04 (−0.08)	−0.09 (−0.17)	0.11 (0.30)	−0.01 (−0.02)	0.21 (0.28)	0.11 (0.42)	0.10 (0.20)	0.15 (0.29)
Net assimilation rate			0.20 (0.45)	−0.07 (−0.22)	−0.05 (−0.18)	0.26 (0.43)	0.00 (0.02)	0.00 (0.01)	0.00 (0.00)
Crop growth rate				−0.05 (−0.14)	−0.02 (−0.08)	−0.06 (−0.08)	−0.07 (−0.26)	0.16 (0.34)	−0.16 (−0.35)
Pods per plant					0.00 (0.00)	−0.10 (−0.21)	0.10 (0.60)	0.29 (0.90)	0.27 (0.86)
Seeds per pod						−0.19 (−0.45)	0.10 (0.66)	0.05 (0.19)	0.10 (0.33)
100-seed weight							0.06 (0.19)	0.03 (0.04)	0.05 (0.08)
Harvest index								0.19 (0.81)	0.20 (0.88)
Biological yield									0.43 (0.98)

*Values in parentheses are correlation coefficients.

100-seed weight also had low coheritability values with seed yield. Hence the direct selection, on the basis of these traits, will not be effective for improvement of seed yield of soybean.

Substantial positive coheritability values were observed for vegetative phase with NAR and CGR, reproductive phase with pods/plant and HI, NAR with CGR and 100-seed weight, CGR with biological yield/plant, pods/plant with biological yield/plant, and HI with biological yield/plant. Negative coheritability estimate of seeds/pod was considerable only with 100-seed weight.

Coheritability estimates of different character pairs based on linkage is evanescent and reverses its sign with crossing over. Such coheritability estimates are low unless linkage between them is tight. In general, as the sign and magnitude of coheritability estimates obtained were satisfactory, selection for several economic traits can be carried out simultaneously. The present study thus indicates that soybean yield could be improved through selection and breeding by giving emphasis on biological yield, harvest index, reproductive phase and pods/plant.

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