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Studies on Genetic Variability for Yield and its Components in Indian Beans *Dolichos lablab* var. lignosus.

by

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A wealth of variability is the prime requirement for improvement of any crop. Amongst the pulses, beans (*Dolichos lablab* var. lignosus.) is consumed in a large quantity all over the country as a dry pulse as well as a vegetable when green. This crop possesses a wide range of variability that can be tapped for evolving high yielding types but practically no information is available regarding the range of phenotypic variation in some of its important yield contributing agronomic characters. The present investigation was undertaken with a view to ascertaining the actual and relative variability present in some yield contributing characters, to determine the heritable component of the actual variability and to obtain information on the phenotypic and genetic correlations between different characters so that the pulse breeders can get some idea regarding the behaviour of these characters and use them while planning for the improvement of this crop.

Materials and Methods: From a collection of bean varieties maintained on the Pulse Research Station, Junagadh, twenty established varieties covering most parts of India were selected for this study. These 20 cultivars were planted in a randomised block design with 4 replications. Each variety in a replication was grown in a two-row plot, each row was 3m long consisting 20 plants spaced 15 cm apart within the row and spacing between two rows was 45 cm. The crop was fertilized with 20 kg N+40 kg P_2O_5/ha as basal dressing and irrigated as and when required. The plants in the experiment were sprayed with insecticides and fungicides to prevent them from attack of insects and diseases which could confound the expression of genetic potential for different agronomic traits studied.

Five randomly selected plants per variety in a replication were tagged to record observations on different characters and subject to statistical analysis. The characters measured were, (i) weight of seeds per planting, (ii) number of pods per plant, (iii) number of seeds per plant, (iv) number of fruit bearing branches per plant and (v) weight of 100 seeds in g. All of these characters were measured after the crop was harvested.

Results and Discussion: The means, ranges, mean squares for the varieties and phenotypic, genotypic, and the error components of variance are presented in Table 1. The various variance components were subsequently utilized for

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TABLE 1. *Means, ranges, estimated mean squares and various variance components for different characters in beans*

Character	Mean	Range	Mean square for varieties	Variance components		
				Pheno	Geno	Error
Seed yield per plant g	14.19	2 6 - 37.4	151 07**	55.66	31 74	24.12
Number of pods	25.32	6.8 - 62 8	453.02**	163 07	89.98	73.09
Number of seeds	80.11	12.1 -198.8	4342.25**	1536.18	935 36	600.82
Number of branches	3.48	2 2 - 5.8	1.43**	0 64	0.26	0.38
Weight of 100 seeds g	17.79	10.76- 29.89	47.87**	15.77	10.70	5.07

** denotes significant at 1 percent level

computing the genetic coefficient of variation, heritability estimates and the expected genetic gain from one cycle of selection.

A wide range of gross variation was noticed in all the characters. The significant mean squares for all characters indicated that the genotypes studied differed significantly for yield as well as for other yield components like number of pods, number of seeds, number of branches, and weight of 100 seeds. However, the magnitude of phenotypic variation does not reveal the relative amounts of heritable (genetic) and non-heritable (non-genetic) components of variation, and this needs to be ascertained with the help of some genetic parameters, such as, genetic coefficient of variation, heritability estimates and the genetic advance expected from one cycle of selection at a selection pressure of top 5 percent individuals of the population (Table 2).

TABLE 2. *Genetic coefficient of variation (CVg), heritability estimates (H%) and expected genetic advance (Gs) for yield and yield components*

Character	CVg	H%	Gs as percent of mean	Mean
Seed yield per plant g	39.67	56.8	61.24	14.19
Number of pods	37.44	55.1	57.07	25.32
Number of seeds	38.18	60.9	61.35	80.11
Number of branches	14.65	40.6	19.32	3.48
Weight of 100 seeds g	18.31	68.0	30.92	17.79

The genetic coefficient of variation was estimated using the formula by Burton (1952) as : $CVg = \frac{\sigma^2 g}{\bar{X}} \times 100$. The weight of seeds, number of pods and number of seeds per plant showed to have a large genetic variability compared to the number of branches and 100 seed weight. This parameter indicates the range of variability existing in the material for particular characters and helps

to compare the amount of genetic or heritable variation present in other characters. However, it is not possible to determine the amount of heritable variation and this relative amount of heritable portion of variation was ascertained by heritability estimates in a broad sense suggested by Hanson *et al.*, (1956): $H\% = \frac{\sigma^2 g}{\sigma^2 p} \times 100$.

All characters except the number of branches per plant indicated comparatively high heritability values and the 100 seed weight showed highest heritability estimates as is commonly observed. The highly heritable characters are of great importance to a plant breeder as he can base his selection for such characters on phenotypic performance more reliably. A heritability estimate along with the genetic gain expected is still a better index than heritability alone in predicting the gains expected from selecting the best individuals of the population. The expected genetic gain resulting from selection of top 5% individuals from the population was estimated using the formula suggested by Johnson *et al.*, (1955): $Gs = k.\ CVg.\ \sqrt{H}$

A high genetic advance was noticed for the weight of seeds, number of pods and number of seeds per plant, whereas the gain expected for the number of branches and 100 seed weight was comparatively low inspite of the latter character having high heritability estimate. Thus a high heritability does not necessarily mean an increased genetic advance. Johnson *et al.*, (1955) also observed that if the heritability is mainly due to non-additive genetic effects, the resultant genetic gain would be low, but if the heritability is chiefly due to the additive gene action, a greater amount of genetic advance may be expected. In this study, the number of pods and number of seeds per plant showed high heritability as well as greater genetic advance which can mean that these two characters are governed largely through the additive effects of the genes.

Correlation Studies

Since no information is available on the apparent and genetic correlations between various yield components as well as with yield, an attempt was made to study these aspects in this collection. For the purpose of computing various correlation coefficients the formula suggested by Al-Jibouri *et al.*, (1958) was adopted as: $r\ x_1.x_2 = \frac{\text{convariance } x_1 x_2}{\sqrt{\text{variance } x_1 \times \text{variance } x_2}}$. The error, phenotypic and genetic variance and covariance components were computed using the standard method of analysis of variance and covariance. The pertinent correlation coefficients are presented in Table 3.

In general, the genetic correlation coefficients were greater than the phenotypic and environmental coefficients among all the characters indicating

TABLE 3. *Phenotypic (P), genetic (G), and environmental (E) correlation coefficients of some yield contributing characters in beans*

Character		Number of pods	Number of seeds	Number of branches	100 seed weight
Seed yield	(P)	+0.773**	+0.908**	+0.401	+0.319
	(G)	+0.978**	+0.894**	+0.686**	+0.339
	(E)	+0.520*	+0.948**	+0.015	+0.297
Number of pods	(P)		+0.949**	+0.449*	−0.083
	(G)		+1.000**	+0.830**	−0.127
	(E)		+0.807**	+0.110	+0.182
Number of seeds	(P)			+0.411	−0.022
	(G)			+0.774**	−0.085
	(E)			+0.549*	+0.110
Number of branches	(P)				−0.251
	(G)				+0.300
	(E)				−0.418

** and * denotes significant 't' values at 1 and 5 per cent respectively.

that though there is a strong association between various characters, the phenotypic expression is influenced by the environment. The number of pods, number of seeds, number of branches and 100 seed weight were positively correlated with the yield per plant. The phenotypic as well as genetic correlation between the number of seeds and the number of pods per plant with yield were highly significant and quite high which meant that yield is largely a function of these characters. The genetic correlation of branches with yield was high and significant which indicated the importance of this character, though indirectly, in influencing the yield. The number of seeds was closely associated with the number of pods and the perfect genetic correlation coefficient between these two characters is not surprising since the former is completely dependent on the latter, however, this value is reduced in phenotypic expression owing to the influence of environment. The genetic association between the number of branches and the number of pods and seeds per plant was quite high and positive which reflected that the number of branches is a valuable index for effective selection towards higher yield.

The 100 seed weight was negatively correlated with the number of pods and seeds per plant as may be expected because more pods or seeds per plant would tend to reduce the size of the seeds, however, this character contributed towards total yield and the correlation though poor was positive.

From the heritability estimates, expected genetic gain and correlation coefficients it becomes obvious that the number of pods per plant and thereby the seeds per plant is the main character contributing towards the yielding potential of a bean plant, however, the number of branches should not be overlooked as a helpful phenotypic index for selection. The wealth of variability available in the germ plasm existing in this crop offers good prospects for its improvement in near future.

Summary: In a study to measure the genetic variability in 20 cultivars covering a wide genetic base in beans (*Dolichos lablab* var. lignosus) a wide range of phenotypic variability was observed in yield and some yield contributing characters, *viz.* number of pods, number of seeds, number of branches and 100 seed weight. The genetic coefficient of variation, heritability estimates and the expected genetic gain in these characters revealed that a large portion of the apparent variability was genetic and highly heritable. Sufficiently large amount of genetic advance was expected in the number of pods, number of seeds and yield *per se* per plant.

The phenotypic, genetic and environmental correlation coefficients were computed in the material studied. In general the genetic correlation coefficients were found to be higher. The number of pods, number of seeds and the number of branches per plant showed strong and positive association with yield. The number of pods and seeds per plant showed very strong and positive correlation among themselves.

These findings indicated that the number of pods per plant along with the number of branches would be an ideal criteria effective selection for yield in beans.

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