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Genetic Evaluation and Path Analysis in Garlic

Garlic (*Allium sativum* L.) is an important crop grown and used as a spice or condiment throughout India. Among bulb crops, it is another foreign exchange earner for India as a good quantity of garlic is exported every year. Therefore, for planned breeding programme to improve compound bulb yield potential, information on the nature and magnitude of variation in the available material, association of characters with yield and among themselves and the extent of environmental influence on these traits is necessary. Further, if the number of variables is more, it becomes essential to measure the contribution of various variables to the observed correlation and partition the correlation coefficient into components of direct and indirect effects. With the above objectives in mind, an experiment was taken up to determine the extent of genetic variability, correlation coefficient and path coefficient analysis of the components of bulb yield. The trial was laid out with nine cultivars of garlic having diverse origin in a randomized block design with three replications at College Farm during winter, 1978. The cloves or segments were dibbled at spacing of 15 cm from row to row and 7.5 cm within the rows. Observations were recorded on ten random plants in each replication for six characters (Table I). Statistical analyses were carried out according to standard techniques.

The analysis of variance, mean, genotypic and phenotypic variance, genotypic coefficient of variability (GCV) and phenotypic coefficient of variability (PCV), heritability in broad sense (h^2) and genetic advance are presented in Table I. Analysis of variance revealed that the differences between strains were highly significant for all the traits studied. In general, GCV and PCV were of the same magnitude which clearly indicated the absence of environmental influence on these traits. Similar findings were earlier reported by Paramasivan and Rajasekaran (1980) in green gram. However, maximum GCV was observed for clove weight and leaves/plant. The GCV alone is not sufficient for the determination of amount of heritable variation. But Johnson *et al.* (1955) have suggested that h^2 estimates along with genetic advance will be more useful in selecting the best individuals. In the persent investigation all the traits revealed fairly high h^2 values and high genetic advance (except for leaf length). Such association may be attributed to the action of additive genes (Panse, 1957). Leaf length also showed high h^2 and moderate genetic advance, indicating that selection may also help in inproving the character.

In general, correlations at genotypic level were slightly higher than those at phenotypic (Table II). This indicates that in spite of strong inherent association between various character pairs studied, the environment may modify the full expression of the genotypes

(Nandpuri *et al.* 1973). Bulb weight/plant was positively and highly correlated with clove weight, leaf length, plant height, leaves/plant and number of cloves/bulb. In addition, high and positive intercorrelationship was observed between yield components both at genotypic and phenotypic levels. Thus, it can be inferred that selection based on any one of these characters either alone or in combination, will result in identifying the strains with high yield. These results are in agreement with the findings of Suthanthirapandian and Muthukrishnan (1980) for one or more of these component characters in onion. Since the mutual relationships of component characters might vary both in magnitude and direction and tend to vitiate the association of bulb yield with yield attributes, it is necessary to partition the genetic correlation into direct and indirect effects of each character. Hence path analysis was also done (Table II in parentheses).

Path analysis showed that clove weight and leaf length had high direct positive effect on bulb weight and their indirect contribution *via* each other indicated that if other factors are held constant, an increase in these traits will be reflected in an increased bulb weight. The number of leaves/plant also had a positive direct effect but of very low manitude. However, its indirect effect *via* clove weight and leaf length was positively high. Sree Rangasamy *et al.* (1980) have also reported that leaves/plant have direct on yield of plant. Conversely, plant height and number of cloves/bulb had negative direct effect, but showed positive correlations with yield. The positive associations of these traits were due to their indirect contribution through leaf length, which were highly heritable had the highest influence direct and indirect, on bulb weight, and, are hence important traits for selection. The contribution of residual factor accounted for the characters was neligible.

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TABLE I Analysis of variance and genetic parameters for different characters in garlic

Source	DF	Plant height (cm)	Leaf Length (cm)	Leaves/ plant	No. of cloves/ bulb	Clove weight (g)	Bulb weight/ plant (g)
Rep.	2	0.015	0.003	0.006	0.011	0.024	0.004
Strain	8	270.740**	33.571**	8.967**	72.074**	1.213**	71.778**
Error	16	0.018	0.064	0.009	0.012	0.014	0.004
Mean		56.25	25.96	10.15	23.76	1.76	29.11
Variance							
Genotypic		90.24	11.19	2.98	24.02	0.40	23.92
Phenotypic		90.26	11.25	2.99	24.04	0.42	23.93
CV (%)							
Genotypic		16.89	12.89	27.03	20.62	36.00	16.80
Phenotypic		16.89	12.92	27.06	20.63	36.66	16.80
Heritability (%)		99.98	99.43	99.67	99.92	95.24	99.96
G. A.		19.57	6.87	3.56	10.09	1.29	10.07
GA as percentage of mean		34.79	26.46	35.07	42.47	73.30	34.59

** Significant at 1% level.

TABLE II Correlation coefficients and genotypic path coefficient analysis (in parantheses) for different characters in garlic.

Character		Plant height	Leaf Length	Leaves/ plant	No. of cloves/ bulb	Clove weight	Bulb Weight/ plant
Plant height	G		0.931	0.679	0.707	0.830	0.813
	P		0.928**	0.678*	0.707*	0.815**	0.812**
		(—0.454)	(0.671)	(0.007)	(—0.034)	(0.622)	
Leaf length	G			0.675	0.690	0.860	0.917
	P			0.673*	0.689*	0.849**	0.914**
		(—0.422)	(0.721)	(0.007)	(—0.033)	(0.644)	
Leaves/plant	G				0.856	0.820	0.763
	P				0.854**	0.808**	0.761*
		(—0.308)	(0.487)	(0.010)	(—0.041)	(0.614)	
No. of cloves/ bulb	G					0 792	0.730
	P					0.778*	0.730*
		(—0.321)	(0.498)	(0.009)	(—0 048)	(0.593)	
Clove Weight	G						0.964
	P						0.945**
		(—0.377)	(0.621)	(0.008)	(—0.038)	(0.749)	

Residual effect = 0.0127

Bold figures are direct effects.