Journal of Tropical Agriculture 39 (2001) : 17-20

GENETIC VARIABILITY, INTER-RELATIONSHIP AND PATH ANALYSIS IN ONION

B. K. Mohanty[1]
Orissa University of Agriculture and Technology, Regional Research Station, Bhawanipatna 766001, Orissa, India

Abstract: Genetic variability, interrelationship and path coefficients were studied in onion involving 12 varieties. Moderate to high estimates of heritability, GCV and genetic gain were recorded for neck thickness, weight of bulb and number of leaves/plant which could be improved by simple selection. The phenotypic and genotypic association of bulb yield was significantly positive with plant height, number of leaves/plant, diameler and weight of bulb but significantly negative with neck thickness. Path analysis showed that number of leaves/plant had high positive direct effect on yield. Other characters also exerted high positive indirect effect through this trait on yield suggesting to give emphasis on such trait independently or in combination with thin neck trait while imposing selection for amenability in bulb yield of onion.

Key words: Genetic variability, interrelationship, onion, path coefficient.

INTRODUCTION

Information on the nature and extent of genetic variability and degree of transmission of traits is of paramount importance in enhancing the efficiency of selection. However, knowledge of correlations among various characters and their relative contribution to yield is useful for multiple trait selection. The present investigation was undertaken to assess the magnitude of genetic variability and heritability of important economic characters, interrelationships among themselves and their direct and indirect effect on yield in a collection of onion (*Allium cepa* L.) varieties.

MATERIALS AND METHODS

The experiment was laid out in a randomized block design with four replications at the Regional Research Station, Bhawanipatna during rabi, 1995-96. Twelve varieties of onion collected from various sources were tested. Eight week old healthy seedlings of each variety were transplanted on flat beds during the first week of December at a spacing of 15 cm x 10 cm in a plot of 3.0 m x 3.0 m. Recommended package of practices (Anon, 1973) were adopted to raise a successful crop. Ten plants were selected at random in each plot to record the observations on plant height, number of leaves/plant, neck thickness, diameter and weight of bulb. The yield was taken on plot basis. The mean data were analysed to work out the variance components and coefficients of variation following Burton (1952). The heritability in broad sense and expected genetic advance were computed as per Johnson *et al.* (1955). The correlation coefficients were determined according to Miller *et al.* (1958) and the path coefficients were calculated as suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The mean square estimates were significant for all the characters indicating sufficient diversity among the varieties. The range of variation and genetic parameters estimated are presented in Table 1. The range was maximum (30.29 - 35.53 t ha^{-1}) for bulb yield followed by weight of bulb, plant height and number of leaves /plant and minimum (0.52 - 1.12 cm) for neck thickness followed by diameter of bulb. The characters showing wide range of variation provide ample scope for efficient selection.

The phenotypic coefficient of variation (PCV) was high (26.71%) for neck thickness and number of leaves/plant (24.06%), while it was moderate for weight of bulb (15.71%), plant height (14.96%) and diameter of bulb (10.66%) and low for bulb yield (5.99%). High genotypic coefficient of variation (GCV) was marked for neck thickness (24.14%), whereas it was moderate for number of leaves/plant (19.00%) and weight of bulb (14.12%), which reflected greater genetic variability among the accessions and respon-

[1]Address for correspondence: Plot No. 3114, Samantarapur, Bhubaneswar 751002, Orissa

siveness of the attributes for making further improvement by selection. The magnitude of GCV was low for the remaining traits.

The PCV was higher than the respective GCV for all the characters denoting environmental factors influencing their expression to some degree or other. Wide difference between PCV and GCV for number of leaves/plant, plant height, diameter of bulb, yield and neck thickness depicted their susceptibility to environmental fluctuation. Narrow difference between PCV and GCV for weight of bulb implied its relative resistance to environmental alteration.

The heritability in broad sense ranged from 31.0 to 81.7 per cent. High values of heritability were obtained for neck thickness (81.7%), weight (80.8%) and diameter of bulb (55.1%), while it was moderate for other attributes which clarified that they were least affected by environmental modification and selection based on phenotypic performance would be reliable. The genetic advance as percentage of mean (genetic gain) varied from 3.82 to 45.12 per cent. High estimates of genetic gain were realised for neck thickness (45.12%) and number of leaves/plant (44.27%), whereas it was moderate for weight of bulb (39.63%), which explained that hey could be uplifted to a large extent. Rest of the characters acquired low genetic advance as per cent of mean.

Moderate to high values of heritability, GCV and genetic gain were observed for neck thickness, weight of bulb and number of leaves/plant which might be attributed to additive gene action regulating their expression and phenotypic selection for their amelioration could be brought about by simple methods like mass selection (Panse, 1957). Moderate to high estimates of heritability coupled with low GCV and genetic gain were noticed for diameter of bulb, plant height and bulb yield. It may be inferred that these characters were governed by non-additive gene action and high genotype-environment interaction. The heritability is being exhibited due to favourable influence of environment rather than the genotype and simple selection will not be rewarding. However, they could be improved by development of hybrid varieties or isolation of transgressive segregates in heterosis breeding programme. The present result corroborated the report of Patil *et al.* (1986) except bulb weight and yield, which expressed low heritability values but contradicted that of Sidhu *et al.* (1986) who detected low heritability estimates for all the traits except bulb diameter and yield.

The estimates of phenotypic and genotypic correlation coefficients (Table 2) revealed that the genotypic correlations were of higher magnitude than the corresponding phenotypic ones for all the character combinations, thereby establishing strong inherent relationship among the attributes studied. The interrelationship of bulb yield was significantly positive with plant height, number of leaves/plant, diameter and weight of bulb and significantly negative with neck thickness at phenotypic and genotypic levels. Direct relationship between yield and vegetative growth represented by plant height and number of leaves/plant might be assigned to photosynthetic factors (Patel *et al.*, 1985). The associations among plant height, number of leaves/plant, diameter and weight of bulb were positive and significant at both the levels. Neck thickness showed negative and significant phenotypic and genotypic correlations with plant heights diameter and weight of bulb. The findings are in consonance with the observations of Patel *et al.* (1985), Sidhu *et al.* (1986) and Pal *et al.* (1988) but deviate from that of Soni *et al.* (1993) for neck thickness which furnished significantly positive association with bulb yield, diameter and weight of bulb.

The phenotypic and genotypic path coefficient studies (Table 3) elucidated that number of leaves/plant had the maximum positive direct effect on bulb yield which was counter balanced by its negative indirect effects via diameter and weight of bulb. However, its high positive indirect effect through neck thickness was responsible for its strong positive correlation with bulb yield. Plant height displayed a negative direct effect on yield. Its positive indirect effects via number of leaves/plant and neck thickness after dilution by its negative indirect effects through diameter and weight of bulb resulted

Table 1. Range, mean, phenotypic and genotypic coefficients of variation, heritability (broad sense) and genetic advance for quantitative characters in onion

Characters	Range	Mean	PCV	GCV	Heritability, %	GA	GA as % of mean
Plant height (cm)	30.25-42.62	36.71±2.19	14.96	9.01	36.2	4.10	11.27
No. of leaves/plant	7.30-16.90	10.30±2.07	24.06	19.00	41.0	4.56	44.27
Neck thickness (cm)	0.52-1.12	0.82±0.05	26.71	24.14	81.7	0.37	45.12
Diameter of bulb (cm)	4.55-6.47	5.56±0.20	10.66	7.91	55.1	0.67	12.05
Weight of bulb (g)	40.15-80.72	58.16+3.04	15.71	14.12	80.8	23.05	39.63
Bulb yield (t ha^{-1})	30.29-35.53	33.31+0.83	5.99	3.34	31.0	12.74	3.82

Table 2. Phenotypic (P) and genotypic (G) correlation coefficients among various characters in onion

Characters		No. of leaves/plant	Neck thickness	Diameter of bulb	Weight of bulb	Bulb yield
Plant height	P	0.357*	-0.473"	0.611**	0.463"	0.302*
	G	0.798"	-0.909"	0.955"	0.980"	0.951"
No. of leaves/plant	P		-0.224	0.380"	0.444"	0.320*
	G		-0.351*	0.631"	0.760"	0.673"
Neck thickness	P			-0.578"	-0.721"	-0.387**
	G			-0.879"	-0.859"	-0.748"
Diameter of bulb	P				0.530"	0.397"
	G				0.767"	0.863"
Weight of bulb	P					0.452"
	G					0.921**

*Significant at 5% level, ** Significant at 1% level

Table 3. Direct (diagonal) and indirect (off diagonal) effects at phenotypic (p) and genotypic (G) levels of various component characters on bulb yield of onion

Characters		Plant height	No. of leaves/plant	Neck thickness	Diameter of bulb	Weight of bulb	Correlation with bulb yield
Plant height	P	-0.001	0.046	0.040	0.104	0.113	0.302
	G	-0.002	0.828	1.321	-0.495	-0.697	0.951
No. of leaves/plant	P	-0.001	0.128	0.019	0.065	0.109	0.320
	G	-0.002	1.032	0.511	-0.327	-0.541	0.673
Neck thickness	P	0.001	-0.029	-0.084	-0.099	-0.176	-0.387
	G	0.002	-0.362	-1.454	0.456	0.611	-0.748
Diameter of bulb	P	-0.001	0.049	0.048	0.171	0.130	0.397
	G	-0.002	0.651	1.278	-0.519	-0.546	0.863
Weight of bulb	P	-0.001	0.057	0.060	0.091	0.245	0.452
	G	-0.002	0.784	1.248	-0.398	-0.712	0.921

Residual effect: P = 0.349, G = 0.224

of bulb resulted in its strong positive association with yield. The genotypic path described that diameter and weight of bulb manifested high negative direct effect on yield. Their high positive indirect effects via number of leaves/plant and neck thickness appeared to be the cause of their strong positive correlation with yield. Neck thickness registered a negative direct effect on yield and a strong negative association with yield indicating that thin neck trait was associated with improvement in bulb yield. The above findings illustrated that number of leaves/plant was the most important component in selection for higher bulb yield of onion followed by neck thickness.

The estimates of direct and indirect effects were more pronounced in genotypic path than the phenotypic path. This analysis confirmed that number of leaves/plant produced high positive direct effect on bulb yield. Indirect effect of other characters through this trait also contributed predominantly towards the bulb yield. Thus, number of leaves/plant should be envisaged independently or in combination with thin neck trait to circumvent the bulb yield of onion. However, Pal *et al.* (1988) have reported that selection based on weight and diameter of bulb would be useful for edification in bulb yield of onion.

The unexplained variations in phenotypic and genotypic paths were 0.349 and 0.224 respectively. It predicted that 65.1 and 77.6 per cent variation in bulb yield at phenotypic and genotypic level respectively had been determined. It further portrayed the occurrence of some more factors, not considered in this study, contributed to the bulb yield of onion.

REFERENCES

Anonymous. 1973. *Package of Practices for Major Crops.* Orissa University of Agriculture and Technology, Bhubaneswar, pp. 84-85

Burton, G. W. 1952. Quantitative inheritence in grasses. *Proc. 6th. Int. Gr. Ld. Cong.* 1 : 277-283

Dewey, D.R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed reduction. *Agron, J.* 51 : 515-518

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimates of genetic and environmental variability in soybean. *Agron. J.* 47 : 314-318

Miller, P. A., Williams, J. C., Robinson. H. F. and Comstock, R. E. 1958. Estimates of genotypic and environmental variances and covariances in upland cotton and their implications in selection. *Agron. J.* 50 : 124-131

Pal, N., Singh, N. and Choudhury, B. 1988. Correlation and path coefficient studies in onion. *Indian J. Hon.* 45 : 295-299

Panse, V. G. 1957. Genetics of quantitative characters in relation to plant breeding. *Indian J. Genet.* 17 : 318-328

Patel, R. R., Prasad, M. and Sharma, R. P. 1985. Studies on the interrelationships between bulb yield and important plant characters of onion. *Veg. Sci.* 12 : 7-10

Patil, J. D., Desele, G. Y. and Kale, P. N. 1986. Genetic variability studies in onion. *J. Maharastra agric. Univ.* 11 : 281-283

Sidhu, A. S., Singh, S. and Thakur, M. R. 1986. Variability and correlation studies in onion. *Indian J. Hon.* 43 : 260-264

Soni, D. S., Saraf, R. K. and Upadhyay, P. C. 1993. Association analysis among different characters in onion. *Punjab Veg. Grower.* 28 : 3-5