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Genetic Variability, Partial Regression, Co-Heritability Studies and their Implication in Selection of High Yielding Potato Genotypes

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Partial regression coefficient, genotypic and phenotypic variabilities, heritability, co-heritability and genetic advance were studied in 15 Potato varieties of exotic and local origin. Both genotypic and phenotypic coefficients of variations were high for scab and rhizoctonia incidence percentage. Significant partial regression coefficient for emergence percentage indicated its relative importance in tuber yield. High heritability (Broadsense) estimates coupled with high genetic advance for plant height, number of stems per plant and scab percentage revealed substantial contribution of additive genetic variance in the expression of these traits. Hence, the selection based on these characters could play a significant role in their improvement. The dominance and epistatic variance was more important for character expression of yield ha^{-1}, emergence and rhizoctonia percentage. This phenomenon is mainly due to the accumulative effects of low heritability and low to moderate genetic advance. The high co-heritability coupled with negative genotypic and phenotypic covariance revealed that selection of varieties having low scab and rhizoctonia percentage resulted in more potato yield.

Key words: *Solanum tuberosum*, Coefficient of variability, Heritability, Regression.

Introduction

Information on the genetic components of variance for different traits of economic importance in potato is scanty. However, some investigators studied genetic components in mini-tubers. Mendoza (1980), Thompson *et al* (1983) and Thompson & Mendoza (1984) advocated contribution of non-additive genetic variance for potato yield. Landeo *et al* (2001) advocated low heritability and additive variance for tuber yield whereas Gopal *et al* (1994) estimated high heritability for tuber yield. Sharma and Katoch (1998) observed non-additive genetic component predominant in expression of stems/plant, main stem, leaves per plant and tuber yield whereas additive component was predominant for main stem height. In the present study an attempt was made to find out genotypic, phenotypic variances and covariances, heritability and co-heritability genetic advance and partial regression for developing a selection criterion in potato. The partial regression coefficient is more powerful statistic than simple regression coefficient (b) when number of variables are more than single pair.

Materials and Methods

The studied material comprised of 15 (8 local and 7 exotic) potato varieties. These varieties were planted in a Randomized Complete Block Design with three replications at Potato Research Station, Sialkot during 1999-2000, keeping row to row distance 70cm and plant to plant 20cm on 6x2.8m plot. Recommended dose of fertilizer N-250, P-125 and K-125 kg ha^{-1} was applied in two instalments. A total of 10 irrigations were applied when ever required. The disease and insects were controlled with Dithan-M-45 and Methamedophos equally. The data during growing period were recorded for emergence in percentage (recorded 20-days after planting as standard). While the observations for the traits i.e., plant height in cm, number of stems per plant, number of compound leaves per plant were noted, 75 days after planting as standard. At harvesting (120 days after planting) incidence percentage of tuber diseases rhizoctonia (*Rhizoctonia solani* Kuhn) and common scab (*Streptomyces scabies* Waksman & Henrici) was recorded. The data on disease incidence were recorded following general instructions for trial and guide to data collection by National programme of germ-plasm screening under Pakistan Swiss Potato Development Project (PSPDP), Islamabad (Anonymous 1995). The total tuber yield including all three grades in metric tones per hectare were also recorded.

The data was recorded subject to analysis of variance and covariance by Steel and Torrie (1980). The heritability, genotypic and phenotypic coefficient of variance and expected genetic advance were calculated by the method proposed by Hanson *et al* (1956), Burton (1952) and Johnson *et al* (1955). Partial regression coefficient, its standard error, genotypic and phenotypic covariances and co-heritability estimates were computed following Singh and Chaudhary (1979).

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Results and Discussion

The mean squares due to genotypes indicated the significant variability for different characters among the varieties under investigations. The existence of very high magnitude of genetic variability was also evidenced through high values of genotypic coefficient of variation for majority of characters. A relative comparison of the magnitude of genotypic coefficient of variation for different characters revealed that the maximum amount of variability was observed for plant height followed by scab percentage. The low genetic coefficient of variation was observed for emergence percentage and yield. The presence of moderate genetic variability was indicated for remaining characters (Table 1). Data presented in Table 1 also divulged that only emergence percentage had significant partial regression coefficient which indicated its imperative importance in selection of high yielding potato genotypes. High heritability estimates coupled with high genetic advance as percentage of mean for plant height, number of stems per plant and scab percentage indicating substantial contribution of additive genetic variance in the expression of these characters. High to low heritability estimates coupled with medium to low genetic advances as percentage of mean in yield ha^{-1}, emergence percentage and rhizoctonia percentage indicated greater contribution of dominance and epistatic variance in the expression of those characters. The results are in accordance with Mendoza (1980), Thompson & Mondoza (1984), Sharma & Katoch (1998) and Thompson *et al* (1983) who observed the role of non-additive (dominance & epistasis) genetic variance for potato yield. The high genotypic coefficient of variance followed by high heritability and genetic advance observed for scab percentage and plant height suggested the probability of larger response to selection and hence greater chance for improvement in these characters.

Data given in Table 2 revealed high co-heritability estimate coupled with positive genotypic and phenotypic covariance for potato yield ha^{-1} with emergence percentage, plant height, number of stems per plant and number of leaves per plant, indicating the selection for high emergence percentage more height, more number of stems per plant and leaves per plant, proved conducive for increased potato yield. The high coheritability coupled with negative genotypic and phenotypic covariance of yield ha^{-1} with scab and rhizoctonia percentage revealed that selection for low scab and rhizoctonia percentage brought about more tuber yield.

Negative genotypic and phenotypic covariance coupled with high co-heritability of emergence percentage, plant height and number of leaves per plant with rhizoctonia percentage suggested that the varieties having high emergence percentage, tall plant and more number of leaves per plant had low rhizoctonia percentage. The positive covariances coupled with high co-heritability of rhizoctonia percentage with number of stem per plant and scab percentage advocated that varieties with more number of stem and high scab percentage were more susceptible to rhizoctonia.

Scab percentage showed positive genotypic, phenotypic covariance and high co-heritability with plant height, number of stems and leaves per plant. It indicated that varieties having tall plant, higher stem number and leaves per plant had less scab percentage.

Number of leaves per plant showed positive genotypic, phenotypic covariances and high co-heritability with emergence percentage, plant height and stems per plant. The high co-heritability along with positive and high genotypic and phenotypic covariance was also observed for emergence percentage with plant height and number of stems per plant. These indicated that varieties having good emer-

Table 1

Genetic parameters of variation of different characters in potato

Parameters	Genotype mean squares	Partial regression	S.E. of P regression	δ^2 g	δ^2 p	GCV	PC V	H^2B	Genetic advance
Emergence %	347.3**	0.413**	0.109	101.3	144.7	11.92	14.25	0.70	17.5
Plant height	1190.7*	-0.012	0.5	396.1	398.6	26.18	26.26	0.99	45.8
Stem no./plant	1.6*	-0.941	6.3	0.51	0.62	25.68	28.11	0.83	40.9
Leaves no./ plant	425.6**	0.100	0.293	141.4	142.8	21.78	21.89	0.99	38.0
Scab %	936.9**	-0.06	0.19	303.5	330.0	135.6	141.4	0.92	228.3
Rhizoctonia %	39.6**	0.73	1.17	8.8	12.8	85.2	102.7	0.69	124.1
Yield/ha	142.4**	-	-	31.9	53.5	16.6	21.5	0.60	22.5

Genotype mean squares are from ANOVA; ** Significant at 1% probability level.

Table 2

Co-heritability, genotypic covariance and phenotypic co-variance of different parameters in potato

Parameters		Plant height	Stem per plant	Leaves per plant	Scab %age	Rhizoctonia %age	Yield M.T./ha
Emergence %	Co δ^2 g	74.00	2.03	15.74	5.18	-6.65	38.78
	Co δ^2 p	73.31	2.79	14.18	-5.47	-3.68	46.88
	Coh^2	1.01	0.73	1.11	-0.95	1.81	0.83
Plant height	Co δ^2 g	-	-4.16	63.86	62.80	-6.51	24.64
	Co δ^2 p	-	-4.18	63.99	62.85	-6.53	22.81
	Coh^2	-	0.99	0.99	0.99	0.99	1.08
Stem per plant	Co δ^2 g	-	-	2.01	2.48	0.78	1.19
	Co δ^2 p	-	-	1.99	2.37	0.86	1.31
	Coh^2	-	-	1.01	1.05	0.91	0.91
Leaves/plant	Co δ^2 g	-	-	-	20.66	-5.69	12.44
	Co δ^2 p	-	-	-	20.90	-5.69	10.80
	Coh^2	-	-	-	0.99	1.0	1.15
Scab %	Co δ^2 g	-	-	-	-	20.92	-4.19
	Co δ^2 p	-	-	-	-	24.72	-1.89
	Coh^2	-	-	-	-	0.86	2.22
Rhizoctonia %	Co δ^2 g	-	-	-	-	-	-7.24
	Co δ^2 p	-	-	-	-	-	-5.36
	Coh^2	-	-	-	-	-	1.35

gence percentage had more number of stem and compound leaves.

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