PATH ANALYSIS IN POTATO

T. ARA[1], A. HAYDAR[2], M. A. ISLAM[3] , M. A. S. AZAD[4] AND E. H.KHOKAN[5]

[1-5]Department of Botany, University of Rajshahi, Rajshahi-6205, Bangladesh.

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ABSTRACT

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The experiment was conducted at Botanical Research Field at Rajshahi University, Rajshahi, Bangladesh during the rabi crop season of 2007-2008. Ten characters were included in the present investigation to study the variability and correlation coefficient path analysis in potato. The range of variation was pronounced in most of the characters, which indicates that the characters were quantitative in nature and are under polygenic control. High estimates of coefficients of variability, heritability and genetic gain (GA %) for FWP, MSN and FWT that these characters are largely controlled by additive gene action and that straight selection for them would be effective. Yield/plant had a significant positive correlation with PH, NLP and FWT depicted that the characters, namely TFWP have high and positively correlatively towards yield/plant and could be considered as selection criteria in potato breeding program. But path coefficient analysis describes that main shoot number, number of leaves/plant, and fresh tuber weight have high and direct contribution towards final tuber fresh weight/plant could be considered as selection criteria in potato breeding program.

Keywords: Genetic variability, correlation coefficient, Variability, Potato

INTRODUCTION

Potato *(Solanum tuberosum* L.*)* is one of the most important horticultural and economical food crops in Bangladesh as well as many countries of the world. It is an important vegetable crop in Bangladesh. In Bangladesh the tuber yield of potato is very low (7.54 t/ha) compared to other tropical countries (BBS, 2007). Its area and production are increasing day by day in declaring in 2008, the International Year of Potato, the UN general assembly seeks to focus world attention on the role of potato in defeating hunger and poverty (Hossain, 2008). To feed this ever growing human of people there is a need to increase productivity in potato; tuber yield is the cumulative effect of many component characters individually contributing towards yield. Yield is the result of interactions among several characters which are greatly influenced by environmental factors. Information on the nature and magnitude of variability present in a population owing to genetic and non genetic causes is an important prerequisite for initiating any systematic breeding program. As yield is the main object of a breeder, so it is important to know the relationship between various characters that have direct and indirect effect on yield. The knowledge of association of quantitative characters, especially the yield and its attributes provide an idea of association that could be effectively utilized in selecting the desired characters in segregating population. The objective of the present study was therefore, carried out to study the variability, heritability, genetic advance, correlation and path coefficient among ten quantitative characters in 48 genotypes of potato.

MATERIALS AND METHODS

The genetic material consisting of 48 potato genotypes (such as., Carlita, Radeo, Akria, Multa, Voyager, Eldina, Felcina, Asterix, Febula, Petronese, Marrabel, Futuri, Courage, Innovator, Martin, Raja, Fontany, Granula, Balaka, Ultra, Lura, Remarka, Quiency, Cardinal, Durby, Diamont, Callwhite, Belini, Senori, Victoria, Blondy, Prelude, Atlas, Cheiftain, Banana, Blue mountain, All red, Vanilla, Russet burbank, Gaforgown, Shaita white, Shaita red, Shepodi, Chipita, Indurcani, Lalpakri, Challisha and Hagrai) were grown at Botanical Research Field at Rajshahi University, Rajshahi, Bangladesh during the rabi crop season of 2007-2008. The experimental was laid out in a Randomized Complete Block Design with three replications. The field size for the experiment was 20×12 m. Whole experiment field was divided into three blocks and the size of each block was 3 m × 20 m. Each replication comprised one block. There were 48 rows in each replication. At the final land preparation recommended doses of manure and fertilizers (Anonymous, 1997) viz., 10 tons of cow dung, 326-217-250 kg of urea, triple super phosphate and murate of potash per hectare were used. The potato tubers were planted during first week of November for three years. Intercultural operations like weeding, irrigation, mulching and earthing up were performed as and when necessary. Indofile M-45 (0.2%) was sprayed at 15 days interval commencing from 30 days after planting for prevention of fungal disease. Ten potato plants were selected at randomly in each replication and observations were recorded for plant height at 50 days after plantation (PH50DAP), plant height at 60 days after plantation (PH60DAP), plant height at 70 days after plantation (PH70DAP), fresh weight /plant at 70 days after plantation (FWP70DAP), fresh weight /plant at 80 days after plantation (FWP80DAP), main shoot number/plant (MSNP), number of tubers/plant (NTP), number of leaves/plant (NLP), tuber fresh weight/plant at 80 days after plantation (TFWP80DAP) and tuber fresh weight at 90 days after plantation (TFWP90DAP). Genotypic (GCV) and phenotypic co-efficient of variation (PCV), heritability in broad sense (h^2b), genetic advance as % of mean (GA %), genotypic (r_g) and phenotypic (r_p) correlation coefficients and path analysis were done following the formulae used by Singh and Choudhury (1985). The above calculations were done for all studied characters.

RESULTS AND DISCUSSION

Estimates of different statistical and genetic parameters like genotypic and phenotypic variance, genotypic and phenotypic coefficient of variability, heritability (h^2b) and genetic advance as percentage of mean (genetic gain) for ten characters under study are presented in Table 1. Maximum genotypic variance was found for tuber fresh weight at final harvest (25787.392) followed by fresh weight/plant (4831.089) and tuber fresh weight at 80 days (5378.778) while the same was minimum for fresh weight at 70 days (3.653). Phenotypic variance was also maximum for these characters (25393.379, 5008.922 and 5511.452). Genotypic and phenotypic coefficients of variation were maximum for tuber fresh weight at 80 days (62.748, 62.564) while it was minimum for number of leaves/plant (16.271 and 13.859).

Table 1. Estimates of statistical and genetic parameters for ten characters of 48 potato genotypes

Characters	Components of variation		Coefficients of variation			Genetic parameters
	δ^2p	δ^2g	PCV	GCV	h2b	GA%
1. PH30DAP	146.626	144.608	36.296	36.046	98.624	156.621
2. PH40DAP	683.380	669.927	27.562	27.289	98.031	67.352
3. PH50DAP	4769.226	4733.623	35.348	35.216	99.253	76.201
4.FWP70DAP	5008.922	4831.089	22.498	22.095	96.450	18.576
5. FWP80DAP	4.041	3.653	57.551	54.717	90.395	34.138
6. MSN	6.955	6.043	62.460	58.220	86.885	3201.40
7. NTP	17.048	15.678	43.848	42.048	91.961	882.158
8.NLP	11.767	8.538	16.271	13.859	72.558	44.635
9.FWT80DAP	5511.452	5378.775	68.344	67.517	97.593	81.772
10.FWT90DAP	25393.379	25787.392	62.748	62.564	99.414	57.031

The PCV was higher than corresponding GCV for most of the characters denoting environmental factors influencing their expression. Mondal (2003) obtained higher genotypic and phenotypic coefficients of variation for average tuber weight/plant tuber yield/plant and tubers number/plant in potato Bhardwaj *et al.* (2005) observed that fruit firmness, yield/plant and size of stem endscar recorded comparatively high estimates of phenotypic and genotypic coefficients of variation and habitability, genetic advance as percentage of mean in tomato. Kamruzzahan *et al.* (2000) observed higher GCV and PCV for number of flowers, number of fruits and fruit weight in tomato. The heritability (h^2b) ranged from 72.558 – 99.414. High heritability was observed for tuber fresh weight at 90 days (99.414) and plant height at 50 days 99.253) suggested that selection for these characters are effective and improvement is made through phenotypic selection. Tuber number/plant and tuber fresh weight and plant height were high heritability estimates associated with high genetic advance as percentage of mean values indicates the presence of additive gene effects. Heritability estimates with genetic advance as percentage of mean are more useful in predicting yield under phenotypic selection than heritability alone according to Mondal (2003) in potato. In the present investigation, main shoot number, fresh weight at 50 days, plant height and tuber fresh weight at 90 days had higher GCV and PCV, high h^2b values and GA% which indicates that these three characters were most vital in the selection for yield improvement.

Correlation

In the majority of the characters the GCV,s we higher than the corresponding PVC,s (Table-2), suggesting that the character association had not been largely effected by environment in such cases. Tuber fresh weight/plant yield showed significant positive correlations with plant height and number of leaves/plant at genotypic and phenotypic level. The findings of Dayal (1984), Mondal (2003) and Haydar (2007) are in agreement with this result. Bhardwaj *et al.* (2005) reported that significant positive correlation of yield/plant with fruit firmness, size of stem endscar and fruit shape index at genotypic level in tomato. The correlation study suggested that the important characters like plant height, fresh weight/plant and number of leaves/plant showed positive association with fresh weight of tuber at 80 days after planting i.e. increases of plant height and number of leaves/plant showed positive association reflects tuber yield increase. On the other hand, positive associations with plant height and leaves numbers indicate that vegetative fresh and vigorous plant stature with more tuber produces more yield. Thus, the characters number of leaves/plant and plant height are the important tuber yield attributes to be estimated in the selection criteria for yield improvement.

Table 2. Genotypic (g) and phenotypic (P) correlation coefficients for different pairs of characters in potato

Characters		2	3	4	5	6	7	8	9	10
PH 30DAP	G	0.958**	0.584	0.547	0.312	0.034	0.069	0.684	0.648	0.713**
	P	0.945**	0.577*	0.532	0.297	0.028	0.069	0.589*	0.637*	0.707**
PH40DAP		G	0.526	0.489	0.303	0.004	0.043	0.640*	0.551*	0.640*
		P	0.517	0.474	0.284	0.005	0.037	0.546*	0.537*	0.632*
PH50DAP			G	0.982**	0.088	-0.022	0.017	0.368	0.427	0.632*
			P	0.967**	0.084	-0.020	0.019	0.309	0.420	0.628*
FWP70DAP				G	0.078	-0.015	0.032	0.340	0.412	0.605*
				P	0.080	-0.014	0.039	0.278	0.400	0.589*
FWP80DAP					G	0.650	0.695*	0.176	0.163	0.260
					P	0.571	0.641*	0.127	0.153	0.246
MSN						G	0.946**	0.025	0.096	0.123
						P	0.844**	0.001	0.082	0.114
NTP							G	0.095	0.086	0.082
							P	0.057	0.090	0.080
NLP								G	0.594*	0.681*
								P	0.498	0.585
FWT80DAP									G	0.807**
									P	0.794**

**= Significant at 5%, ** = Significant at 1%*

Path Analysis

Path coefficient analysis (Table 3) revealed that main shoot number showed highest (0.716) positive direct effect followed by fresh weight/plant at 80 days after planting (0.464) and number of leaves /plant (0.341). Higher values of direct effect of main shoot number on fresh weight/plant after 90 days after planting were the reflection of significant positive correlation of these characters with fresh tuber yield were the reflection of significant positive correlation of these characters with tuber yield per plant. Similar results were also reported by Haydar (2007). This result suggests that while using these characters as a criterion for selection, other causal characters must be considered simultaneously.

Table 3: Path coefficient analysis showing direct and indirect effects of yield components on tuber yield of potato of at genotypic level

Characters	1	2	3	4	5	6	7	8	9	r_g with FWT
1. PH30DAP	**-0.133**	0.071	0.156	0.051	-0.042	0.024	-0.057	0.233	0.301	0.713**
2. PH40DAP	-.128	**0.074**	0.140	0.046	-0.040	0.003	-0.035	0.218	0.256	0.640*
3. PH50DAP	-0.078	0.039	**0.267**	0.091	-0.012	-0.016	-0.014	0.125	0.198	0.632*
4.FWP70DAP	-0.073	0.036	0.262	**0.093**	-0.010	-0.011	-0.026	0.116	0.191	0.605*
5. FWP80DAP	-0.042	0.022	0.024	0.007	**-0.0133**	0.466	-0.569	0.060	0.076	0.260
6. MSN	-0.005	0.000	-0.006	-0.001	-0.087	**0.716**	-0.774	0.009	0.044	0.123
7. NTP	-0.009	0.003	0.005	0.003	-0.092	0.678	**-0.819**	0.032	0.040	0.082
8.NLP	-0.091	0.047	0.098	0.032	-0.023	0.018	-0.078	**0.341**	0.276	0.681*
9.FWT80DAP	-0.086	0.041	0.114	0.038	-0.022	0.068	-0.070	0.202	**0.464**	0.807***
10.FWT90DAP										

Residual effect=0.373

The genotypic residual effect (0.373) indicated that the characters studied contributed to main shoot number of the yield. It is suggested that maximum emphasis should be given on the above characters in selecting potato with higher fresh tuber yield. Correlation and path coefficient analysis reveled that main shoot number, leaves number and plant height were the most important yield contributing characters. Therefore, selection based on these characters would give better response to the improvement of fresh tuber yield in potato.

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