Indian J. Genet., 71(1): 74-77 (2011)

Short Communication

Variability and association studies for morphological and biochemical traits in potato (*Solanum tuberosum* L.)

Shashi Kamal*,[1]

Department of Vegetable Science, College of Agriculture, G.B.P.U.A.&T., Pantnagar 263 145

(Received: June 2010; Revised: December 2010; Accepted: January 2011)

Potato (*Solanum tuberosum* L.) is one of the most important food crops after rice, wheat and maize. This world-crop has historically contributed to securing the food and nutrition and avoiding poverty and hunger. In the emerging global economic order in which agricultural crop production is witnessing a rapid transition to agricultural commodity production, potato is appearing as an important crop, poised to sustain and diversity food production in this new millennium. The identification of genotypes with high variability and heritability for agro-morphological characters is the pre-requisites of breeding programme. Partitioning of variance into various components provides information regarding breeding value and nature and magnitude of variability in the expression of a particular trait. The polygenic characters and its components are highly influenced by environment and become difficult to know whether the variability is heritable or environmental. Therefore, the present investigation is carried out to gather information on magnitude of variability in potato under two different environments.

Twenty five genotypes of potato (*Solanum tuberosum* L.) obtained from CPRI, Shimla were evaluated in *Tarai* region of Uttarakhand during *rabi* 2004-05 and 2005-06 to estimate variability in general performance of genotypes for tuber yield and yield contributing characters. The experiment was laid out in randomized block design with three replications. The crops of each genotype was raised in 9.0 m^2 plot having five rows and tubers were planted at 60 x 20 cm distance apart by supplementing with 20 tonnes FYM and, 160, 100 and 120 kg N, P and K per hectare, respectively. The tubers germination was 95-97 per cent. Data recorded on five tagged plants for different traits in each plot were analysed individually as well as pooled using software SPAR I developed by IASRI, New Delhi to study the coefficients of variances, heritability, genetic advance and character correlation. Potato tubers quality parameters like dry matter content (%), total soluble solids (^{O}B), ascorbic acid (mg/100g), vitamin A (I.U.) and protein content (%) were recorded following standard procedure suggested by Ranganna [1].

Variability studies

Genetic variability in twenty five genotypes of potato during the present investigation has been studied through analysis of variance and coefficients of variation (Table 1). The calculated values of PCV ranged from 1.93 (days-to-50%-emergence) to 24.45 (vitamin A), and GCV values ranged from 1.83 also for (days-to-50%-emergence) to 23.66 (vitamin A). These results indicated that the material under study provide ample scope for improvement through selection in these characters. Broad sense heritability values ranged from 38.05 to 98.84 per cent protein content specific gravity. Pooled data on the above-said metric traits, indicated that J/92-3146 could be utilized to improve plant height, leaf area and tuber weight, simultaneously. Likewise, Kufri Chipsona-2 can be used for high dry matter content, specific gravity and plant height. Genotypic and phenotypic variances were highest for tuber yield per

*Corresponding author's e-mail: skkvkdhakrani@gmail.com
[1]Present address: Krishi Vigyan Kendra, Dhakrani 248 142, Dehradun, Uttarakhand
Published by Indian Society of Genetics & Plant Breeding, F2, First Floor, NASC Complex, PB#11312, IARI, New Delhi 110 012
Online management by indianjournals.com

plant followed by tuber weight and vitamin A suggesting ample variability for improvement through selection for these traits. High magnitudes of genotypic and phenotypic coefficients of variation (GCV and PCV) were observed for vitamin A followed by tuber weight, number of stems per plant and protein content in tuber. Similar findings have also been revealed by various studies for number of tubers [2], number of shoots [3] and plant height [4]. Lower values of GCV and PCV for total soluble solids, number of stems per plant, number of tuber per plant, number of leaves per stem and specific gravity revealed very less opportunities for selection to improve the population for these traits directly.

Heritability and genetic advance

Analysis of data registered high heritability for protein content, vitamin A, total soluble solids, dry matter content, leaf area and days-to-50%-emergence. For the characters showing high heritability, the selection of superior genotypes on the basis of phenotypic performance will be effective. These results are in agreement with the findings of other workers [5]. In pooled analysis also, the above characters showed superiority for genetic advance. Days-to-50-per cent emergence, dry matter content, number of stems per plant, number of leaves per stems, plant height, number of tubers per plant, total soluble solids, ascorbic acid, vitamin A and protein content exhibited low genetic advance. Several workers have reported moderate to high genetic advance in potato for plant height, tuber weight, number of tubers per plant and tuber yield per plant [2]. Moderate to high estimates of heritability accompanied by low GCV and genetic gain were observed for days to 50 per cent emergence, number of stems per plant, number of leaves per stem, plant height, number of tubers per plant, total soluble solids, ascorbic acid, vitamin A, dry matter content, specific gravity of tuber and protein. It may be inferred that these characters were conditioned by non-additive gene action and simple selection would not be rewarding directly for improvement.

Phenotypic and genotypic association

Pooled analysis for the correlation coefficients among the various traits (Table 2) revealed that tuber yield exhibited maximum and significantly positive genotypic and phenotypic correlation with average tuber weight (0.736 and 0.678) and number of tubers per plant (0.557 and 0.482). Negative and significant correlation at genotypic level was found for plant height with protein content (–0.428) in tuber. Among component traits significantly affecting tuber yield, number of stems per plant showed positive and significant correlation with number of leaves per stem (0.749 and 0.482). Positive correlation of tuber yield has also been reported with plant height [6], number of stems per plant [7], number of leaves per stem and leaf area [8] and number of tubers per plant [2]. Among the characters, plant height

Table 1. Analysis of variance for yield and yield contributing characters in potato

Characters	Coefficient of variation (%)			Heritability (%)	Genetic advance (GA)
	Genotypic	Phenotypic	Environmental		
1. Days-to-50%-emergence	1.83	1.93	4.17	80.11	1.85
2. Stems/plant	16.20	19.05	10.03	72.26	1.29
3. leaves/stem	9.72	12.07	7.16	64.81	2.32
4. Leaf area(cm^2)	22.53	24.14	8.68	87.07	50.79
5. Plant height (cm)	10.83	14.50	9.64	55.78	8.97
6. Tubers/plant	12.64	15.66	9.24	65.17	1.40
7. Tuber yield (q/ha)	14.26	19.42	13.18	53.91	15.47
8. Average tuber weight (g)	18.80	21.73	10.88	74.90	79.13
9. Specific gravity (g/cm^3)	10.96	17.77	13.99	38.05	1.45
10. Dry matter content (%)	14.36	15.31	13.1	87.98	4.60
11. Total soluble solids (^0B)	8.67	8.81	2.77	90.10	1.04
12. Ascorbic acid (mg/100g)	13.02	17.81	12.14	53.49	4.25
13. Vitamin A(I.U.)	23.66	24.45	6.17	93.62	17.23
14. Protein content (%)	15.64	15.74	1.68	98.84	0.46

Table 2. Pooled genotypic (r_g) and phenotypic (r_p) correlation coefficients among the characters in potato

Characters		2	3	4	5	6	7	8	9	10	11	12	13	14
1. Days-to-50%-emergence	r_g	-0.277	-0.153	0.383	0.097	0.213	0.060	0.066	0.074	0.194	0.321	0.132	-0.033	0.153
	r_p	-0.224	-0.121	0.336	0.025	0.133	0.078	0.049	0.062	0.198	0.171	0.119	-0.040	0.144
2. Stems/plant	r_g		0.749**	0.211	0.031	0.402*	-0.160	-0.368	-0.059	-0.089	-0.007	-0.075	-0.118	0.056
	r_p		0.482*	0.128	0.017	0.289	-0.119	-0.221	-0.027	-0.065	-0.092	-0.036	-0.082	0.042
3. Leaves/stem	r_g			0.135	0.220	0.171	-0.269	0.260	0.157	-0.303	0.103	-0.014	-0.136	0.139
	r_p			0.121	0.321	0.114	-0.099	0.204	0.131	-0.253	0.161	-0.047	-0.089	0.038
4. Leaf area(cm^2)	r_g				0.068	0.155	0.107	-0.322	-0.386	-0.123	0.126	-0.389	-0.387	0.053
	r_p				0.051	0.162	0.073	-0.211	-0.338	-0.108	0.045	-0.369	-0.357	0.077
5. Plant height (cm)	r_g					0.012	0.358	-0.075	-0.155	-0.111	-0.239	-0.181	-0.428*	0.312
	r_p					0.089	0.182	-0.057	-0.108	-0.106	-0.154	-0.132	-0.291	0.213
6. Tubers/plant	r_g						-0.162	-0.495*	-0.424*	-0.411*	-0.008	-0.124	0.099	0.557**
	r_p						-0.228	-0.315	-0.249	-0.305	-0.030	-0.081	0.082	0.482*
7. Average tuber weight (g)	r_g							0.077	-0.130	-0.090	-0.095	-0.277	-0.147	0.736**
	r_p							0.104	-0.140	-0.129	-0.018	-0.178	-0.108	0.678**
8. Specific gravity (g/cm^3)	r_g								0.490*	0.108	-0.034	-0.215	-0.176	-0.369
	r_p								0.273	0.137	-0.052	-0.136	-0.114	-0.178
9. Dry matter content (%)	r_g									0.571**	-0.022	-0.358	0.225	-0.293
	r_p									0.504*	-0.006	-0.328	0.206	-0.341
10. Total soluble solids (%)	r_g										-0.264	-0.142	-0.051	-0.336
	r_p										-0.126	-0.131	-0.046	-0.307
11. Ascorbic acid (mg/100g)	r_g											-0.537**	-0.094	0.059
	r_p											-0.399*	-0.073	0.031
12. Vitamin A(I.U.)	r_g												-0.035	-0.172
	r_p												-0.035	-0.132
13. Protein content (%)	r_g													-0.062
	r_p													-0.049
14. Yield (q/ha)	r_g													
	r_p													

* and ** indicate significance at 5% and 1% levels, respectively.

exhibited positive correlation with all growth characters. Among the quality traits protein content showed negative correlation with all growth and quality characters except number of tubers per plant.

In conclusion, it can be noted that the genotypes taken for study had wide range of variation for morphological and biochemical characters, so there is more scope for improvement of these characters. Average weight of tuber and number of tubers per plant were the most important characters to maximize the yield potential. Improvement in potato yield should be done through simple selection procedure for above mentioned traits.

Acknowledgement

Author is thankful to the Director, Experiment Station, GBPUA&T, Pantnagar for providing necessary facilities to conduct the experiment.

References

1. **Ranganna S.** 1986. Handbook of analysis and quality control for fruits and vegetable products. Tata McGraw Hills Publishing Co. Ltd., New Delhi.
2. **Luthra S. K.** 2001. Heritability, genetic advance and character association in potato. J. Indian Potato Assoc., **28**: 1-3.
3. **Dixit D., Mital R. K., Chaubey C. N. and Singh P.** 1994. Variability, correlations and selection indices in potato (*Solanum tuberosum* L.). Haryana J. Hort. Sci., **23**: 168-172.
4. **Sandhu S. K. and Kang G. S.** 1998. Genetic analysis in germplasm of *andigena* potatoes (*Solanum tuberosum* ssp. *andigena*). Crop Improv., **25**: 181-185.
5. **Sharma Y. K.** 1999. Studies of genetic variability and performance of true potato seed populations. Crop Res., **18:** 412-418.
6. **Uniyal S. P. and Mishra A. C.** 2003. Response of potato to soil moisture and temperature as affected by different mulches. J. Indian Potato Assoc., **30**: 315-317.
7. **Patel P. B., Patel N. H. and Patel R. N.** 2002. Correlation and path analysis of some economic characters in potato. J. Indian Potato Assoc., **29**: 163-164.
8. **Kumar R. and Kang G. S.** 2000. Path-coefficient and stability analysis studies in *andigena* potaoes. Indian J. Agric. Sci., **70**: 158-162.