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Agrobiodiversity of potato (*Solanum tuberosum* L.) in Kashmir valley

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Abstract : Four local germplasm lines of potato (*Solanum tuberosum* L.) were evaluated at Experimental Farm of Division of Olericulture SKUAST-K Shalimar Srinagar during *Kharif* 2009. The analysis of variance revealed highly significant differences among genotypes for most of the traits. Different germplasm lines exhibited maximum values for different parameters studied. No single line exhibited maximum values for all the traits. The morphological features of tubers of Gulmarg Special being shallow tuber eyes, smooth tuber surface, flat tuber shape, yellowish light brown tuber skin colour and white flesh colour; of Hirpora being deep tuber eyes, smooth tuber surface, round tuber shape, reddish pink tuber skin colour and yellowish flesh colour; of Gurez Local being very deep tuber eyes, corrugated tuber surface, round tuber shape, deep red tuber skin colour and yellowish flesh colour while of Pahalgam Local being medium deep tuber eyes, smooth tuber surface, round tuber shape, yellowish light brown tuber skin colour and yellowish flesh colour. The PCV and GCV were high for all the traits under study except plant height, petiole length, tuber length, tuber diameter, average tuber weight and dry matter content of tubers. Heritability (bs) was high for all the traits under study except petiole length (very low heritability) and tuber diameter (moderate heritability). The values of genetic gain were moderate to high for all the traits except petiole length, tuber diameter and dry matter content of tubers. The characters that exhibited high heritability and moderate to high genetic gain *viz.*, plant height, number of shoots plant⁻¹, average shoot weight, number of nodes plant⁻¹, stem thickness, tuber length and average tuber weight indicate the predominance of additive gene effect, hence simple selection could be effective for crop improvement.

Key words : Characterization, Genetic variability, PCV, GCV, Heritability, Genetic gain, Potato, Genetic resources

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Potato (*Solanum tuberosum* L.) is one of the most valuable non cereal food crops grown in different parts of the world. It is a unique crop which can supplement the food needs of the countries like India, because of the fact that potato is a versatile, carbohydrate rich, contributing maximum dry-matter, protein and other nutrients per unit area and per unit time. Moreover in many developing countries and especially in urban areas, rising levels of income are driving a nutrition transition towards more energy dense foods and prepared food products. As a part of that transition, demand for potato is increasing. Kashmir valley which falls in the temperate zone, has a marked variation in temperature, precipitation and varied topography which offers a congenial habitat

for genetic diversity in various agri-horticultural crops including potato. A discussion on the plant genetic resources of potato (*Solanum tuberosum* L.) in Kashmir can generate a way to reduce the shrinking bio diversity. Inventorization and documentation of the crop is a pre requisite for long term conservation and planned breeding programme. The present article on the native genetic resource (Gulmarg Special, Hirpora, Pahalgam Local, Aadoo Local, Gurez Local, Tulail Local, Budnambal Local) of potato focuses mainly the traditional varieties that are being grown in this region with the exceptionally good quality and disease resistance traits that has suited through ages to the local consumers although the introduced varieties (Kufri Jyoti, Kufri Giriraj, Kufri

Badshah, various hybrids of SM and HB series) developed by Central Potato Research Institute, Shimla (H.P) have added more to the gene pool of the crop. We ardently hope that this article / contribution will serve as important research documentation and fulfill the long felt need to have the current status of native genetic diversity scenario in potato consolidated in a well presented and scientifically and authentic perspective.

RESEARCH METHODS

The present investigation was carried out at Experimental Field of Division of Olericulture, SKUAST-K, Shalimar during *Kharif* 2009. Local germplasm lines of potato *viz.*, Gulmarg Special, Hirpora (red skinned), Gurez Local and Pahalgam Local were grown in RBD with three replications. The plot size was 2.4 x 1.8 m (4.32 m²) and each plot consisted of five rows following a spacing of 60cm x 20 cm. All the recommended cultural operations were followed to raise a healthy crop. Five plants per plot in each replication were selected from the middle of the row to record parameters *viz.*, plant height (cm), number of shoots per plant, number of compound leaves per plant, number of nodes plant⁻¹, shoot weight (g), petiole length (cm), stem thickness (cm), tuber length (cm), tuber diameter (cm), number of tubers plant⁻¹, tuber weight (g), yield plant⁻¹ (g), yield (q ha⁻¹), T.S.S (° Brix), dry matter content (%), tuber surface, tuber shape, tuber colour flesh colour. Mean values for all the characters formed the data for analysis of variance and estimation of other genetic parameters. The data collected were scrutinized as per Panse and Sukhatme (1967) for confirming the level of significance. The mean data for the design (RBD) were statistically analyzed. The phenotypic and genotypic variance were calculated using the method suggested by Johnson *et al.* (1955) for the single environment. Heritability in broad sense was estimated in both single and data pooled over environments as per the procedure presented by Burton and Devane (1953) and genetic advance as per cent of mean as suggested by Johnson *et al.* (1955).

RESEARCH FINDINGS AND DISCUSSION

The analysis of variance exhibited significant differences among the local germplasm lines of potato in respect of most of the characters studied. The mean performance and characterization of important morphological features of local germplasm lines of potato are presented in Table 1. The data generated revealed that maximum plant height (cm) was recorded by Gurez Local (63.67) followed by Gulmarg Special (62.67), Hirpora (53.33) and minimum by Pahalgam Local (50.67).

Maximum number of shoots plant⁻¹ was recorded by Gulmarg Special (7.5) followed by Hirpora (4.67) while Gurez Local and Pahalgam Local each recorded 1.33 average number of shoots plant⁻¹. Number of nodes plant⁻¹ were maximum in Hirpora (16.67) followed by Gurez Local (14.67), Pahalgam Local (10.67) and Gulmarg Special (8.79). Petiole length (cm) was maximum in Pahalgam Local (3.13) followed by G. Special (2.73), Hirpora (2.67) and minimum by Gurez Local (2.47). Maximum value for stem thickness was recorded in G. Special (0.72 cm) followed by Gurez local (0.71 cm), Hirpora (0.51) and minimum by Pahalgam Local (0.49). Maximum tuber length and tuber diameter was recorded by Gulmarg Special (being predominantly elongated and flat; flat diameter was taken estimation 8.03 cm and 5.27cm, respectively) followed by Hirpora (5.63 and 5.20 cm, respectively), Pahalgam Local (5.27 and 4.83cm, respectively) and Gurez Local (4.13 cm and 3.83 cm, respectively). Maximum average number of tubers plant⁻¹ were recorded with Gulmarg Special (5.90) followed by Gurez Local and Pahalgam Local (5.93 each) while minimum by Hirpora (4.43). Maximum average tuber weight (g) was recorded with Gulmarg Special (65.33) followed by Gurez Local (54.83), Hirpora (54.00) while minimum by Pahalgam Local (52.83). Average tuber yield plant⁻¹ and average tuber yield (q ha⁻¹) were recorded with Gulmarg Special (385.44 and 321.19, respectively) followed by Gurez Local (319.85 and 266.44, respectively), Pahalgam Local (308.57 and 257.04, respectively) and minimum by Hirpora (239.27 and 199.27, respectively). The morphological features of tubers of Gulmarg Special being shallow tuber eyes, smooth tuber surface, flat tuber shape, yellowish light brown tuber skin colour and white flesh colour; of Hirpora being deep tuber eyes, smooth tuber surface, round tuber shape (while very large sized tubers assume elongated shape), reddish pink tuber skin colour and yellowish flesh colour; of Gurez Local being very deep tuber eyes, corrugated tuber surface, round tuber shape, deep red tuber skin colour and yellowish flesh colour while of Pahalgam Local being medium deep tuber eyes, smooth tuber surface, round tuber shape, yellowish light brown tuber skin colour and yellowish flesh colour. The genetic parameters *viz.*, mean, range, PCV, GCV, heritability (bs) and genetic gain are presented in Table 2. The coefficient of phenotypic and genotypic variability ranged from 4.84 for dry matter content of tubers to 81.48 for number of shoots plant⁻¹ and 1.35 for average tuber yield plant⁻¹ to 79.64 for number of shoots plant⁻¹, respectively. The PCV and GCV were high for all the traits under study except plant height, petiole length, tuber length, tuber diameter, average tuber weight, dry matter

content of tubers, average tuber yield plant⁻¹ and average tuber yield (q ha⁻¹). Parallelism between the magnitudes of PCV and GCV was observed for all the traits under study (except petiole length and tuber diameter) revealing relative stability of these traits to environmental fluctuations. The GCV does not offer full cope to estimate the variation that is heritable and, therefore, the estimates of heritability becomes necessary as a criterion of effective selection. Heritability (bs) was high for all the traits under study except petiole length, average tuber yield plant⁻¹

and average tuber yield (q ha⁻¹) (very low heritability) and tuber diameter (moderate heritability). The high heritability values suggest the major role of genetic constitution in the expression of these characters and such traits are dependable from breeding point of view and selection based on phenotypic expression could be relied upon. The estimate of heritability along with genetic gain is more reliable than heritability alone for producing the effect of selection according to Johnson *et al.* (1955). The values of genetic gain were moderate to high for all

Table 1 : Mean performance and characterization of important morphological features of local germplasm lines of potato (*Solanum tuberosum* L.) under Kashmir conditions

Sr. No.	Characters	Gulmarg special	Hirpora	Gurez local	Pahalgam local	CV (%)	C.D. (P=0.05)
1.	Plant height (cm)	62.67	53.33	63.67	50.67	2.24	2.57
2.	Number of shoots plant ⁻¹	7.5	4.67	1.33	1.33	17.26	1.27
3.	Average shoot weight (g)	54.49	32.37	28.75	19.32	3.59	2.42
4.	Number of nodes plant ⁻¹	8.79	16.67	14.67	10.67	6.12	1.55
5.	Petiole length (cm)	2.73	2.67	2.47	3.13	16.09	0.88
6.	Stem thickness (cm)	0.72	0.51	0.71	0.49	8.19	0.99
7.	Tuber length (cm)	8.03	5.63	4.13	5.27	8.95	1.03
8.	Tuber diameter (cm)	5.27	5.20	3.83	4.83	13.16	1.25
9.	No. of tubers plant ⁻¹	5.90	4.43	5.83	5.83	9.21	1.10
10.	Average tuber weight (g)	65.33	54.00	54.83	52.80	3.47	3.94
11.	Av. tuber yield plant ⁻¹ (g)	385.44	239.27	319.85	308.57	7.86	48.52
12.	Av. tuber yield (q ha ⁻¹)	321.19	199.27	266.44	257.04	7.86	16.51
13.	Dry matter of tuber (%)	23.83	26.27	25.23	24.30	2.48	1.23
14.	Tuber eyes	Shallow	Deep	Very deep	Medium deep		
15.	Tuber surface	Smooth	Smooth	Corrugated	Smooth		
16.	Tuber shape	Flat	Round	Round	Round		
17.	Tuber skin colour	Yellowish light brown	Reddish Pink	Deep red	Yellowish light brown		
18.	Flesh colour	White	Yellowish	Yellowish	Yellowish		

Table 2 : Estimation of general mean, range, coefficient of variation, heritability (bs) and genetic gain in different traits of potato (*Solanum tuberosum* L.) under Kashmir conditions

Sr. No.	Characters	Mean	Range	PCV	GCV	h(bs)	Genetic gain
1.	Plant height (cm)	57.59	53.33-63.66	11.52	11.30	96.21	22.83
2.	Number of shoots plant ⁻¹	3.71	1.33-7.50	81.48	79.64	95.51	160.33
3.	Average shoot weight (g)	33.73	19.32-54.49	44.24	44.09	99.33	90.53
4.	Number of nodes plant ⁻¹	12.70	8.78-16.66	28.85	28.19	95.49	56.75
5.	Petiole length (cm)	2.75	2.46-3.13	16.59	4.15	6.26	2.14
6.	Stem thickness (cm)	0.61	0.49-0.71	21.23	19.58	85.09	37.23
7.	Tuber length (cm)	5.77	4.1-8.03	29.37	27.97	90.70	54.88
8.	Tuber diameter (cm)	4.78	3.8-5.26	19.51	11.55	43.50	15.69
9.	No. of tubers plant ⁻¹	5.50	4.43-5.90	14.96	11.79	62.13	19.15
10.	Average tuber weight (g)	56.74	52.83-65.33	10.57	9.98	89.18	19.42
11.	Av. tuber yield plant ⁻¹ (g)	313.28	239.22-385.44	7.85	1.35	2.31	0.041
12.	Av. tuber yield (q ha ⁻¹)	260.99	199.27-321.19	7.85	1.59	2.56	0.0025
13.	Average tuber weight (g)	62.93	54.26-79.53	16.63	16.59	99.50	34.09
14.	Dry matter content of tubers (%)	24.91	23.83-26.26	4.84	4.15	73.68	7.34

the traits except petiole length, tuber diameter and dry matter content of tubers while extremely low for average tuber yield plant⁻¹ and average tuber yield (q ha⁻¹). The values of genetic gain ranged from 0.0025 for average tuber yield (q ha⁻¹) to 160.33 for number of shoots plant⁻¹. The characters that exhibited high heritability and moderate to high genetic gain viz., plant height, number of shoots plant⁻¹, average shoot weight, number of nodes plant⁻¹ stem thickness, tuber length and average tuber weight indicate the predominance of additive gene effect, hence simple selection could be effective for crop improvement. Various workers have reported their findings like Sidhu and Pandita (1979) and Singh and Singh (1987).

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