www.ThePharmaJournal.com
The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 331-333

www.thepharmajournal.com
Received: 28-11-2021
Accepted: 30-12-2021

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Genetic variability, heritability and advance in processing hybrids of potato (*Solanum tuberosum* L.)

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Abstract
The present study was conducted under AICRP-Potato at the Research cum Demonstrational Farm, Department of Vegetable Science, College of Agriculture, IGKV, Raipur (C.G.) during *Rabi* season of 2020-21. The experiment, consisting of 09 genotypes of potato was laid under Randomized Complete Block Design (RBD) with three replications. Data collected on tuber yields and its components was studied for Genetic variability, heritability and advance in 75 DAP. The analysis of variance revealed that mean sum of squares was significant for most of the characters except dry weight of tuber plant-1 (0.710) and fresh weight of shoots plant-1 (1352.630). The heritability estimates in broad sense was recorded high for the characters *viz*., plant emergence percentage (87.0 per cent), seed weight t ha-1 (82.9 per cent), tuber girth (80.5 per cent), harvest index percentage (77.3 per cent) and fresh weight of tubers plant-1 (70.4 per cent. The moderate genetic advance was obtained for characters namely, fresh weight of tubers plant-1 (28.69 per cent), process grade tuber yield t ha-1 (28.22 per cent) and number of tubers plant-1 (25.35 per cent). The presence of moderate genetic advance suggests that both the additive and non-additive variance is operating in these traits.

Keywords: heritability, processing hybrids, potato, *Solanum tuberosum* L.

Introduction
Potato (*Solanum tuberosum* L., 2n=48) is the third most consumed crop globally behind rice and wheat. It belongs to the family Solanaceae and genus *Solanum*. It is originated in the Andes Mountains of Peru and Bolivia of South America (Anonymous, 2013) [1]. It is an annual herbaceous plant grown in every country in the world. It is called as "King of vegetables". The potato is an annual herbaceous and autogamous crop. It is propagated through both vegetative and botanical seed (TPS). Breeders can develop genetic variety by sexual propagation and the production of 'true' seed, and as a clonal crop, they can utilize both additive and non-additive variation (Huaman, 1986 and Mishra, 2016) [7, 10]. In India, potato processing is a very important component of agro-processing (Chengarappa, 2004). The amount of reducing sugars in the potato is responsible for the colour formation of the fried products. Potato dry matter content is an important raw material property for potato processing because it affects processing yield as well as the texture of the final potato products. The days to harvest also affect the processing quality of potato produce *viz.*, dry matter content, sugar content, reducing sugars, phenolic compounds and specific gravity (Marwaha and Sandhu, 2002) [9]. The purpose of this study was to determine the nature and extent of variability in potato genotypes for tuber quality, yield, and yield-related variables using genetic parameters such as phenotypic and genotypic coefficients of variation, as well as an estimate of heritability in the broad sense.

Materials and Methods
The present investigation has been undertaken at Research cum Demonstration Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). It is located at 21.6°N latitude and 81.26°E longitude at altitude of 289.56 meters above the MSL. Average annual maximum and minimum temperatures are 32.7 °C and 10.3 °C, respectively. The soil of the experimental field was clay-loam.

Nine potato genotypes were used for this study. The experiment was arranged in a randomized complete block design with three replications. Each genotype was planted on a 3.6 m long and 2 m wide plot consisting of five rows, which accommodated twelve plants per row and thus sixty plants per plot. A distance of 1 m was maintained between the plots. Nitrogenous fertilizer (urea 46% at 150 kg ha-1) was applied before sowing and all standard agronomic practices were applied. Agronomic characters were determined on five randomly selected plants in the mid-rows all of plots. seed weight t ha-1, plant emergence per cent, plant height (cm), Fresh weight of shoots plant-1, Dry weight of shoots plant-1, Tuber girth (cm), Tuber length (cm), Number of tubers plant-1, Fresh Weight of tubers plant-1, Process grade tuber yield t ha-1, Dry weight of tuber plant-1, harvest index per cent and Total tuber yield t ha-1 were determined. Significance of differences among genotypes was tested using the analysis of variance. To test the significance of treatment, the calculated value of ‘F’ was compared with tabular value of ‘F’ at 5 and 1 per cent level of probability against error degree of freedom. The data obtained from the individual plants were statistically analyzed as per the procedure given by Cocharan and Cox (1957) [6].

Results and Discussion

Mean performance for seed weight (t ha-1) ranged from 9.69 to 8.00. Plant emergence percentage ranged from 100.00 per cent to 83.00 per cent. Plant height ranged from 63.53 cm to 45.10 cm. The fresh weight of shoots plant-1 ranged from 225.43 gm to 160.73 gm, whereas, the dry weight of shoots plant-1 ranged from 38.43 gm to 25.23 gm, tuber girth ranged from 17.43 cm to 14.53 cm, tuber length ranged from 9.93 cm to 7.87 cm, number of tuber plant-1 ranged from 13.00 to 7.40, fresh weight of tubers plant-1 ranged from 902.93 gm to 481.00 gm, the processing grade tuber yield varied from 21.54 kg plot-1 or 29.92 t ha-**1**) to 11.65 kg plot-1 or 16.18 t ha-1, unmarketable tuber yield ranged from 1.97 kg plot-1 or

2.74 t ha-1 to 0.90 kg plot-1 or 1.36 t ha-1, dry weight of tubers per plant ranged from 20.38 gm to 18.80 gm, harvest index percentage varied from 68.04 per cent to 83.04 per cent and total tuber yield ranged from 26.40 kg plot-1 or 36.67 t ha-1 to 15.38 kg plot-1 or 21.37 t ha-1.

For all of the traits, the analysis of variance revealed that there was sufficient diversity among genotypes. The phenotypic variance was in general higher than genotypic variance for all the characters. It is due to presence of substantial influence of environmental factors besides the genetic variation for expression of these traits. Among different yield attributing characters studied, process grade tuber yield t ha-1, fresh weight of tubers plant-1, number of tubers plant-1, total tuber yield t ha-1 and dry weight of shoots plant-1 showed a moderate magnitude of GCV and PCV (10-20%). These findings are accordance with the findings by Shashikamal *et al*., (2006) [12] and Asefa *et al*., (2016) [2] for fresh weight of tubers plant-1, Chandrakar (2007) [4] for number of tubers plant-1.

The estimates of heritability revealed that characters, namely, plant emergence percentage followed by seed weight t ha-1 tuber girth, harvest index percentage and fresh weight of tubers plant-1 were recorded with high heritability (>70%). This finding on heritability is in accordance with findings reported by Barik (2007) [3] for plant emergence percentage and harvest index percentage.

Moderate genetic advance as a percentage of the mean was shown by the characters, namely, the fresh weight of tubers plant-1, process grade tuber yield t ha-1, and number of tubers plant-1. This indicates significance of non-additive gene effects.

In agreement to the above results, similar findings were also supported by Sharma (1999) [11] for fresh weight of tubers plant-1, Singh (2008) for process grade tuber yield t ha-1 and number of tubers plant-1.

High heritability coupled with high genetic advance was recorded for the traits *viz*., plant emergence percentage followed by seed weight t ha-1 tuber girth, harvest index percentage and fresh weight of tubers plant-1. Hence, these characters were governed by both additive and non-additive gene action and can be improved through selection.

Table 1: Estimates of genetic parameters of variation for tuber yield and its attributing traits in potato

S. No.	Parameters	Mean	Coefficient of Variation Heritability (%) (H2b) % Genetic			
			Genotypic	Phenotypic	% of me	an
1	Seed weight (t/ha)	8.79	8.18	8.98	82.9	15.34
2	Plant emergence %	94.15	6.52	6.99	87.0	12.52
3	Plant height (cm)	55.32	8.17	12.30	44.1	11.17
4	Fresh weight of shoots (gm/plant)	185.92	8.31	15.91	27.3	8.95
5	Dry weight of shoots (gm/plant)	30.20	12.61	15.51	66.1	21.11
6	Tuber girth (cm)	15.51	5.63	6.27	80.5	10.40
7	Tuber length (cm)	8.89	7.41	8.94	68.6	12.64
8	Number of tubers/plant	10.01	16.11	21.10	58.3	25.35
9	Fresh Weight of tubers(gm /plant)	731.14	16.59	19.77	70.4	28.69
10	Process grade tuber yield (ton/ha)	22.05	16.69	20.33	67.4	28.22
11	Dry weight of tuber (gm/plant)	19.54	0.94	4.10	5.3	0.45
12	Harvest index %	79.22	5.71	6.49	77.3	10.34
13	Total tuber yield (ton/ha)	26.96	15.25	19.83	59.1	24.15

In conclusion, the study found significant variability in tested genotypes for economically important traits, as well as a higher chance of selecting genotypes with high yield and processing quality, indicating that early generation evaluation of breeding materials can be used as a foundation for plant breeding to improve the crop through selection. It is vital to transfer potato genotypes from the source every time because there is no way to create variety in the country through crossing. The genotypes introduced must be examined for target areas or for broad adaptability across the country.

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