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**Shaunak Singh**  
Department of Vegetable  
Science, ANDUA & T  
Kumarganj, Ayodhya,  
Uttar Pradesh, India

**Devendra Pratap Mishra**  
Assistant professor, ANDUA & T  
Kumarganj, Ayodhya,  
Uttar Pradesh, India

**Navneet Singh**  
Research Scholar, ANDUA & T  
Kumarganj, Ayodhya,  
Uttar Pradesh, India

**Shashank Singh**  
Assistant Professor, KNIPSS,  
Sultanpur, Uttar Pradesh, India

**Shivendra Pratap Singh**  
Research Scholar, ANDUA & T  
Kumarganj, Ayodhya,  
Uttar Pradesh, India

## Genetic variability and associations studies for yield and its component traits in potato (*Solanum tuberosum* L.)

**Shaunak Singh, Devendra Pratap Mishra, Navneet Singh, Shashank Singh and Shivendra Pratap Singh**

### Abstract

The present investigation was conducted during growing season of 2017-18. Data collected on tuber yield and its components were subjected for analysis of variability parameters, correlation coefficient and genetic advance. The estimates of analysis of variance were significant for the all parameters. The analysis of genetic variance revealed that the sufficient variability was present in experimental material. The Phenotypic coefficient of variation (PCV) was slightly higher in magnitude than genotypic coefficient of variation (GCV) for all the parameters. The high heritability estimates in broad sense was recorded in weight of 'C' grade tubers per hill, number of stems per hill, yield of tubers per hill (kg plant<sup>-1</sup>), number of leaves per plant, weight of 'A' grade tubers per hill, weight of 'B' grade tubers per hill, number of 'C' grade tubers per hill, weight of 'D' grade tubers per hill. The high heritability estimates coupled with high genetic advance was recorded for the parameters number of 'D' grade tubers per hill, weight of 'D' grade tubers per hill, weight of 'C' grade tubers per hill, number of 'B' grade tubers per hill, weight of 'B' grade tubers per hill and yield of tubers per hill (kg plot<sup>-1</sup>).

**Keywords:** Correlation coefficient, Genetic variability, Genetic advance.

### Introduction

Potato has been disseminated throughout the world and is known as "White or Irish Potato". It is one of the most important crops, not only important to meet the requirement of the country in substantial manner, but can also generate more opportunities for employment, particularly, for rural landless labour through its very high industrial values. The history of potato is the testimony of the fact that whenever, there has been scarcity of food grains, potato has become the food scarcity of people. The potato tuber contains high quality protein and substantial amount of essential vitamins, minerals and trace elements. The total cultivated area of potato in India is 1.84 million hectares and produces 50.33 million tonnes with an average productivity of 27.31 tonnes per hectare. Potato is grown in India in almost all the states under very diverse conditions except Kerala. The states of U.P, West Bengal and Bihar account for 3/4<sup>th</sup> of the area of the total production under potato in India. In Uttar Pradesh, it is cultivated in an area of 0.614 million hectares area and produces 15.56 million tonnes with an average productivity of 22.71 tonnes per hectare (Anonymous, 2017-18) [2].

In potato, tuber yield is a complex polygenic traits determined by interactions among genetically as well as environmental factors. The genetic variability along with heritability gives reliable information of the genetic advance expected from population during selection for a character. Development of high yielding cultivar is a continuous process and there is an urgent need to select best hybrid or culture suitable for growing in Uttar Pradesh. Considering the past increase in potato area and lack of suitable variety for this State, generation of basic information about the extent of variability with the available materials, association of important yield and its attributes are pre-requisite to breed suitable cultivar for the State.

### Materials and Method

The present investigation entitled "Genetic variability and associations studies for yield and its component traits in potato (*Solanum tuberosum* L.)" was carried out at main experiment station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) India during *rabi* season of 2017-18. Geographically Narendra Nagar (Kumarganj) falls under humid, sub-tropical climate

**Corresponding Author:**  
**Shaunak Singh**  
Department of Vegetable  
Science, ANDUA & T  
Kumarganj, Ayodhya,  
Uttar Pradesh, India

and is located in between 26.47° N latitude and 82.12° E longitude at an altitude with 113 meters above the mean sea level. Narendra Nagar falls under semiarid region receiving an annual mean precipitation of about 1001.5 mm. The maximum precipitation is received from July to September. The mean squares for error was subtracted from the mean squares due to genotypes and the difference was divided by number of replications for obtaining the genotypic variance, which was calculated according to the method suggested by Burton (1952) [4]. Environmental variance is the mean squares due to error. Phenotypic variance was calculated by adding genotypic variance and environmental variance, which was suggested by Burton and de Vane (1953) [4].

Environmental variance ( $\sigma^2_e$ ) = M.S.E.

$$\text{Genotypic variance } (\sigma^2_g) = \frac{\text{M.S.T.} - \text{M.S.E.}}{r}$$

$$\text{Phenotypic variance } (\sigma^2_p) = \sigma^2_g + \sigma^2_e$$

Where,

M.S.T. is genotypes / varieties meansquare

M.S.E. is error mean square and

r is number of replications.

#### Estimation of coefficient of variation

The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed following Burton and de Vane (1953).

$$\text{GCV} = \frac{\text{Genotypic standard deviation}}{\text{Mean } (\bar{X})} \times 100$$

$$\text{GCV} = \frac{\sqrt{\sigma^2_g}}{\bar{x}} \times 100$$

$$\text{PCV} = \frac{\text{Phenotypic standard deviation}}{\text{Mean } (\bar{X})} \times 100$$

$$\text{PCV} = \frac{\sqrt{\sigma^2_p}}{\bar{x}} \times 100$$

#### Heritability and genetic advance

##### Heritability

Heritability in broad sense ( $h^2_{bs}$ ) was calculated using the formula suggested by Burton and deVane (1953) [4].

$$h^2_{bs} = \frac{\sigma^2_g}{\sigma^2_g + \sigma^2_e} \text{ or } \frac{\sigma^2_g}{\sigma^2_p}$$

$$h^2_{bs} (\%) = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

#### Genetic advance

Genetic advance ( $\bar{GA}$ ) was estimated by the method suggested by Johnson *et al.* (1955).

$$Ga. = K \cdot \sigma_p \cdot \frac{\sigma^2_g}{\sigma^2_p}$$

$$= K \cdot \sigma_p \cdot h^2$$

Where,

K= Selection differential at 5% selection intensity (2.06).

$h^2$ = Heritability

$\sigma_p$ = Phenotypic standard deviation

$$(\bar{Ga} \%) = \text{Genetic advance in per cent of mean}$$

$$\bar{GA} (\%) = \frac{\text{genetic advance}}{\bar{x}} \times 100$$

#### Result and Discussion:

The phenotypic and genotypic coefficient of variance, heritability, genetic advance and genetic advance percent of mean was calculated for all fifteen characters as given in Table 1.

#### Coefficient of variance

The analysis of variation for different characters is presented in table 4.1. The mean sum of squares due to replication was non- significant for all the characters. The variation due to genotypes was highly significant for all the characters. The analysis of genetic variance revealed that the sufficient variability was present in genotypes. Similar results have been reported by Rangare and Rangare (2017).

The significant differences were observed among genotypes for all the characters studied. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels were observed for number of 'B' grade tubers per hill, weight of 'B' grade tubers per hill, number of 'D' grade tubers per hill and weight of 'D' grade tubers per hill. Similar results have been reported by Ahmad *et al.* (2005) [1]. In general the phenotypic coefficient of variation were slightly higher than genotypic coefficient of variation for most of the quality attributing traits, which indicates the minor role of environment in the expression of these traits. Similar results have been also reported by Hazam *et al.* (2018) [3]. In broad sense heritability of a character is important for breeder since it indicates the possibility and extent to which improvement is possible through selection. It also indicates direction of selection pressure to be applied for the traits during selection because it measures relationship between parent and their progeny, widely used in determining to degree to which a character may be transmitted from parent to off springs. However, high heritability alone is not enough to make efficient selection in advanced generation unless accompanied by substantial amount of genetic advance (Burton and De-Vane, 1953) [4].

**Table 1:** Coefficient of variance (Phenotypic and genotypic), heritability (in broad sense), genetic advance and in per cent of mean for yield and quality traits potato (2017-18)

S. No.	Characters	PCV %	GCV %	Heritability ( $h^2$ ) in broad sense	Genetic advance (GA)	Genetic advance in per cent of mean
1.	Plant height (cm.)	22.47	22.06	96	20.55	44.62
2.	No. of stem per hill	31.57	31.29	98	3.57	63.91
3.	No. of leaves per plant	32.37	32.08	98	62.12	65.51
4.	No. of tubers per hill	35.34	34.94	97	3.02	71.16
5.	No. of eyes per tuber	20.18	19.78	96	2.82	39.93
6.	No. of A grade tuber	39.24	37.61	91	1.70	74.27
7.	Weight of A grade tuber (gm)	37.36	37.06	98	152.41	75.73
8.	No. of B grade tuber	43.39	42.47	95	2.74	85.63
9.	Weight of B grade tuber (gm)	42.16	41.93	98	176.5	85.91
10.	No. of C grade tuber	34.19	33.90	98	6.43	69.23
11.	Weight of C grade tuber (gm)	34.07	33.98	99	220.11	69.84
12.	No. of D grade tuber	45.74	44.66	95	2.22	89.81
13.	Weight of D grade tuber (gm)	42.36	42.09	98	29.27	86.17
14.	Dry matter content (%)	2.44	1.85	57	0.52	2.90
15.	Yield of tuber per hill (Kg.)	35.83	35.54	98	0.54	72.64

The genetic advance is commonly predicted as a product of heritability ratio and selection differentials. Panse (1967) mentioned that where high heritability value is accompanied by high genetic advance. The progress realized by selection would be most appropriate.

In the present investigation, the estimates of heritability in broad sense was high for most of the characters indicating a great scope in the improvement of these traits. Similar results have been also reported by Hazam *et al.* (2018) [3]. The highest heritability were observed in weight of 'C' grade tubers per hill, number of leaves per plant, yield of tubers per hill and plant height. Rangare and Rangare (2017) have also reported similar results in their studies. As these characters in general possessed high estimates of heritability coupled with high genetic advance except dry matter content indicating preponderance of additive gene action for control of these traits. On the other hand, the traits namely yield of tubers per hill (kg), number of tubers per hill, number of leaves per plant had high heritability coupled with high genetic advance also revealed the additive gene action for these characters. Similar results were reported by Nasiruddin *et al.* (2014) [5].

### Conclusion:

The estimation of phenotypic coefficient of variation (PCV) were higher than the genotypic coefficient of variation (GCV) for all the characters. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels were observed for number of 'B' grade tubers per hill, weight of 'B' grade tubers per hill, number of 'D' grade tubers per hill and weight of 'D' grade tubers per hill. The higher heritability coupled with high genetic advance in per cent of mean was recorded for all the characters.

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