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Estimation of Correlation and Path coefficient analysis for yield and yield associated traits in Potato (*Solanum tuberosum* L.) under normal conditions

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ABSTRACT

The present investigation was carried out at the Potato research farm Tirhut, College of Agriculture, Dholi, Bihar, during Rabi crop season of 2021-22 in Augumented Block Design with forty five potato genotypes/ varieties and 3 checks *viz*., Kufri khyati, Kufri chipsona and kufri shailja each replicated in 3 blocks to determine the association of yield and its components. The association was analyzed by correlation coefficient, and further subjected by path coefficient analysis to estimate direct and indirect effects of each character on tuber yield. Correlation coefficient for most of the traits revealed that plant height, number of shoot per plant, number of compound leaves per plant, number of tubers per plant, harvest index, dry matter and starch content were significantly and positively correlated with tuber yield. Path coefficient analysis indicated that the total sugar content of tubers had the most positive direct effect on tuber yield, followed by the starch content, harvest index, dry matter, plant height, number of tubers per plant, number of compound leaves per plant, and specific gravity of tubers. Non-reducing sugar, reducing sugar, and number of shoots per plant all had negative direct effects on tuber yield.

Key words: *Potato (Solanum tuberosum L.), Correlation coefficients, Path analysis, Yield components*

Introduction

Potato scientifically known as "*Solanum tuberosum* L." is a significant member of the nightshade family, or Solanaceae. Among the tuber crop potato holds the top spot followed by yams, cassava, and sweet potato. The domesticated potato was first grown close to the current border between Bolivia and Peru, near Lake Titicaca. It undoubtedly travelled to India in the early 17th century by Portuguese traders or British missionaries. In addition to being important for human food security, potatoes have unique genetic characteristics and a rich cultural past (Swaminathan, 19 99). Potato is a tuber-bearing herbaceous plant that is traditionally propagated by tubers. At present, cultivated potatoes (tetraploid;

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2n=4x=48) represent *Solanum tuberosumsubsp. tuberosum* and *S. tuberosum subsp. andigena,* while their countless diploid (2 =2x=24) relatives are being grown in and around their major and secondary centres of origin in South America. The genetic variability is crucial to plant breeding programmes. It is a crucial measure for parent selection in hybridization to create cultivars with high production potential and to satisfy the varied objectives of plant breeding (Hayder *et al.,* 2009). A good understanding of genetic variability will assist in differentiating, identifying, and classifying genotypes (Hornokova *et al.,* 2003). Any successful hybridization curriculum for varietal improvement is primarily determined by the level of variability in clones available with the breeder. Amount of diversity in a population split into heritable and non-heritable components, aided by phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), genetic advance and heritability, which may lay the framework for selecting of superior clones from the already accessible genotypes. The degree of association between total tuber yield and its components, as well as among the components is recognized by correlation. There are multiple factors which influence yield and they can be positively or negatively correlated with other variables. The correlation coefficient defines the type of interaction that exists between the features and informs about the existence of a link between different characters. The correlation coefficient analysis, on the other hand, is insufficient to explain the interaction between features. As a result, path analysis is employed to break it down into indirect and direct components. So that we may understand how various features interact and their indirect and direct influence on yield. The present investigation was carried out in order to study these genetic parameters which would be utilized for further improvement of potato through appropriate breeding programs.

Materials and Methods

The experiment of present investigation was conducted to evaluate the 45 potato germplasm lines along with 3 checks viz., Kufri khyati, Kufri chipsona and kufri shailja in Augumented Block Design at Tirhut farm, Dholi, Bihar. Dr. Rajendra prasad Central Agriculture university, Bihar, India. The experimental field was divided into 3 blocks and 18 plots (15 genotypes along with 3 checks) will be accommodated in each Block. The data were recorded from the randomly selected plants from the field for Plant height (cm), Number of shoots per plant, Number of compound leaves, Number of tubers per plant, Drymatter of tuber in percent, specific gravity of tuber (g/cm^3), starch content in percent, reducing sugar (mg/100g), total sugar (mg/100gm), non-reducing sugar (mg/100gm), Harvest index inpercent and Total Tuber yield (q/ha).

Correlation Analysis

The estimate of correlation coefficient among different character has been given in Table 1. An essential strategy in a breeding programme is association analysis. It provides insight into the relationships between the numerous traits and identifies the component characters that selection for genetic improvement in tuber yield might be based on. The strength of the selecting process is also impacted by the degree of association. An analysis of correlation coefficients is a method of determining if two variables are associated with each other. It is important to keep in mind that tuber yield is influenced by a variety of independent traits. Selection for tuber yield on the basis of per se performance may not be much effective unless the yield components directly or indirectly affecting the tuber yield are taken into account. As a result, it is essential to have an understanding of the degree and direction of association between the character under study and the yield improvement prospect to reach a rational genetic improvement.

From the result it was found that tuber yield manifest significant and positive association with plant height, number of shoot per plant, number of compound leaves per plant, number of tubers per plant, dry matter, starch content and harvest index suggests that these component trait can be used as in indirect selection for tuber yield. Exercising selection for higher values for these traits can lead to increment in yield. The similar findings was reported by Kumar and Kang's (1998), Mishra (2017), Roy and Singh (2006), Sattar *et al.* (2007), Tuncturk and Cftc (2005).

Path coefficient

The direct and indirect effects of 12 characters on tuber yield is estimated by path coefficient analysis using simple correlations are given in Table 2.

Path coefficients divide correlation coefficients into assessments of direct and indirect effects of in-

Table 1. Correlation coefficients among different traits

Characters	PH	NSP	NCL	NTP	DM	SG	SC	RS	TS	NRS	HI	TTY
PH		0.266	0.140	0.251	0.145	-0.021	0.004	-0.343*	-0.304*	-0.079	0.178	0.321*
NSP			0.520**	0.394**	0.203	-0.054	0.153	-0.084	0.088	0.142	0.290*	0.335*
NCL				0.438**	0.305*	0.084	0.260	-0.200	-0.019	0.111	0.590**	0.470**
NTP					0.141	0.014	0.159	-0.260	-0.309*	-0.138	0.439**	0.458**
DM						0.163	0.473**	-0.165	-0.021	0.087	0.360*	0.553**
SG							0.061	-0.104	-0.040	0.028	0.292*	0.105
SC								-0.155	-0.080	0.021	0.307*	0.521**
RS									0.311*	-0.340*	-0.157	-0.066
TS										0.788**	-0.090	-0.153
NRS											0.013	-0.108
HI												0.610**

PH= Plant height, NSP= Number of shoots per plant, NCL= Number of compound leaves per plant, NTP= Number of tuber per plant
DM= dry matter, SG= Specific Gravity, SC= Starch content, RS= Reducing sugar, TS= Total sugar, NRS= Non-reducing sugar,
HI= Harvest index.

dependent factors on a dependent variable using the standardised partial regression coefficient. The correlation between yield and trait, if it is due to the trait's direct effects on yield, then this indicates that there is a true relationship between the two, and selection may be used to improve the yield. If, on the other hand, the link is due to the trait's indirect effects through another component trait, the breeder must choose the latter trait. This knowledge gives a better insight into the nature of relationship between traits and thus helps to make selection more effective.

Path coefficient analysis revealed that following traits *viz*. plant height, number of compound leaves, number of tubers per plant, dry matter, specific gravity, starch content, total sugar and harvest index were all observed to exert positive direct effects on the dependent variable *i.e.* tuber yield indicating a strong association between these traits, priority must be given to these traits for increasing production. Direct selection based on these features may be profitable to increase total tuber yield. This shows that there is a true link among independent and dependent variable. Negative direct effect was exerted by number of shoots per plant, reducing sugar and non-reducing sugar.

Number of shoot per plant exerted negative direct effect on tuber yield and a positive indirect effect *via* plant height, number of compound leaves, number of tuber per plant, dry matter, starch content, reducing sugar, total sugar and harvest index on tuber yield. This trait showed negative indirect effect *via* specific gravity and non-reducing sugar. This was the case in the results obtained by Patel *et al.,* (2018) and Tuncturk and Cftc (2005).

Reducing sugar exerted negative direct effect on tuber yield and a positive indirect effect *via* number of shoots per plant and non-reducing sugar. This trait showed negative indirect effect *via* plant height, number of compound leaves, number of tubers per plant, dry matter, specific gravity, starch content and harvest index. Similar results were found by Lamboro *et al.* (2014), and Shubha *et al.* (2018).

Non-reducing sugar exerted negative direct effect on tuber yield and positive indirect effect *via* number of compound leaves, dry matter, specific gravity, starch content, reducing sugar, total sugar and harvest index. This trait showed negative indirect effect *via* plant height, number of shoots per plant and number of tubers per plant. Similar results were also found by Verma and Jha (1990) and Nakitandwe *et al.* (2003).

Conclusion

Correlation coefficient for traits revealed that plant height, number of shoot per plant, number of compound leaves per plant, number of tubers per plant, harvest index, dry matter were significantly and positively correlated with tuber yield. Based on path coefficient analysis, it was determined that total sugar was the factor which exerted the greatest direct influence on tuber yield, followed by starch content, harvest index, dry matter, plant height, number of tubers per plant, number of compound leaves per

Table 2. Path coefficientanalysis for 12 characters in potato

Characters	PH(cm)	NSP	NCL	NTP	DM(%)	SG (g/cm^3)	SC (%)	RS (mg/100g)	TS (mg/100g)	NRS (mg/100g)	HI (%)	TTY (q/ha)
PH (cm)	0.2409	-0.0015	0.0095	0.0540	0.0384	-0.0004	0.0012	0.2881	-0.4885	0.1303	0.0495	0.321*
NSP	0.0640	-0.0058	0.0354	0.0848	0.0537	-0.0009	0.0449	0.0709	0.1410	-0.2336	0.0805	0.335*
NCL	0.0337	-0.0030	0.0680	0.0944	0.0805	0.0015	0.0762	0.1677	-0.0301	-0.1828	0.1640	0.470**
NTP	0.0604	-0.0023	0.0298	0.2152	0.0372	0.0002	0.0464	0.2185	-0.4963	0.2268	0.1219	0.458**
DM (%)	0.0350	-0.0012	0.0207	0.0303	0.2642	0.0028	0.1385	0.1386	-0.0330	-0.1427	0.1001	0.553**
SG (g/cm^3)	-0.0051	0.0003	0.0057	0.0030	0.0432	0.0173	-0.0178	0.0873	-0.0644	-0.0457	0.0811	0.105
SC (%)	0.0010	-0.0009	0.0177	0.0341	0.1251	-0.0011	0.2926	0.1303	-0.1289	-0.0348	0.0853	0.521**
RS (mg/100 g)	-0.0826	0.0005	-0.0136	-0.0560	-0.0436	-0.0018	-0.0454	-0.8400	0.4992	0.5612	-0.0436	-0.066
TS (mg/100 g)	-0.0734	-0.0005	-0.0013	-0.0666	-0.0054	-0.0007	-0.0235	-0.2613	1.6045	-1.2995	-0.0250	-0.153
NRS (mg/100 g)	-0.0190	-0.0008	0.0075	-0.0296	0.0229	0.0005	0.0062	0.2858	1.2641	-1.6495	0.0036	-0.108
HI (%)	0.0429	-0.0017	0.0402	0.0944	0.0952	0.0051	0.0898	0.1318	-0.1441	-0.0211	0.2780	0.610**

Residual value = 0.213

PH= Plant height, NSP= Number of shoots per plant, NCL= Number of compound leaves per plant, NTP= Number of tuber per plant DM= dry matter, SG= Specific Gravity, SC= Starch content, RS= Reducing sugar, TS= Total sugar, NRS= Non-reducing sugar, HI= Harvest index

plant, and specific gravity. Conversely, non-reducing sugar exerted the most negative effect, followed by reducing sugar and the number of shoots.

Conflict of Interest - None

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