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CORRELATION AND PATH ANALYSIS IN SWEET POTATO [*IPOMOEA BATATAS* (L.) LAM]

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Abstract

Understanding interrelationships among various agronomic traits is vital to plan an effective breeding program in sweet potato [*Ipomoea batatas* (L.) Lam]. This study was undertaken to determine associations among yield and yield related traits. A replicated field experiment was carried out using twelve sweet potato genotypes. Observations were recorded on fourteen characters. Correlation coefficient analysis of tuber yield per hectare expressed a positive significant correlation with biological yield per plant at both genotypic and phenotypic levels whereas, tuber diameter and harvest index showed positive significant correlation at only genotypic level. In path coefficient analysis, biological yield per plant showed maximum positive direct effect on tuber yield (t/ha) followed by vine length, harvest index, neck length of tuber, dry matter per cent of both vine and tuber. Whereas, the characters namely vine weight, vine length, tuber length, inter node length, neck length, tuber diameter and TSS had the highest indirect effect on tuber yield, which ultimately lead to development of high yielding varieties. It could be conclude that due to high estimated positive correlation and positive direct effect of biological yield and harvest index on tuber yield (t/ha), these traits would be most suitable for indirect selection in sweet potato improvement programs that aims to increasing tuber yield.

Key words : Agronomic traits, correlation, path co-efficient, tuber yield, sweet potato.

Introduction

Sweet potato [*Ipomoea batatas* (L.) Lam.] locally known as *Shakarkand* is one of the most popular tuber crops in India and abroad because of its yield potential and high calorific value. It is mainly cultivated almost in all the tropical and subtropical countries as well as in the warmer region of temperate countries. Sweet potato is the world's seventh most important food crop other than wheat, rice, maize, barley, potato and cassava.

Sweet potato is a highly heterozygous and cross-pollinated crop in which many of the traits show continuous variation. Since it is highly heterozygous, there is extensive variability within the species, which is available for exploitation by plant breeders (Jones *et al*., 1986). Estimates of genetic parameters serve as a base for selection and hybridization as the degree of variability for a given character is a basic prerequisite for its improvement. Selection of storage root yield, which is a polygenic traits, often leads to changes in other characters. Therefore, knowledge of relationship exists between tuber yield and other characters also inter relationships among various characters is necessary to be able to design appropriate selection criteria in sweet potato breeding programs. Thus, studies on correlation enable the breeder to know the mutual relationships between various characters and determine the component characters on which selection can be used for genetic improvement.

Materials and Methods

The study was conducted at Research and Instructional Farm, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), India; during the *rabi* season of 2013-2014. Twelve genotypes of sweet potatoes (Indira Madhur, Indira Naveen, Indira Nandini, Sree Rethna, Gauri, IGSP.C-15, IGSP-20, IGSP-21, IGSP-24, IGSP-25, IGSP-36 and IGSP-39) taken and the experiment was arranged in a Randomized Complete Block Design, with three replications. Each genotype was planted on 2 m long and 1.8 m wide plot consisting four rows which accommodated nine plants per row and twenty seven plants per plot. A distance of 60 cm maintained between the plots. Vine cutting of 20 cm upper portions from sweet potato nursery were taken and

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vertically planted on 1st November 2013 in the well-prepared field at 60 cm × 20 cm spacing on the ridges. Hoeing and earthing up operations were done twice at 30 and 60 days after planting. During the courses of this experiment, no serious disease or insect pest infestations were noticed and thus crop protection measures were not employed.

For each character under study, data were recorded on five randomly taken plants from each plot and expressed on plant basis. The mean of five plants used for statistical analyses. Observation on important characters *viz*., vine length (cm), inter node length (cm), vine diameter (cm), vine weight (g), number of tubers per plant, neck length (cm), tuber length (cm), tuber diameter (cm), tuber yield per plant (g), biological yield per plant (g), harvest index (%), dry matter percentage of vine (%), dry matter percentage of tuber (%) and total soluble solids (TSS) were recorded.

The mean values of each character under the study were computed and subjected to analysis of variance. The phenotypic and genotypic correlations between all possible characters were calculated according to Miller *et al*. (1958). The genotypic correlation coefficients were further partitioned into direct and indirect effects with the help of path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

Results and Discussion

The assessment of genetic potentiality of yield contributing traits and their association is important to carry out the effective selection for isolating productive genotypes. In general, the genotypic correlations were observed to be higher than the corresponding phenotypic correlations for all the character combinations in present investigation, thus indicating the suppression of phenotypic expression under the influence of environmental factors (table 1). Babu (1987), Nedunzhiyan and Reddy (2000), Choudhary *et al*. (2000) and Tirkey (2011) also found similar results in their studies on sweet potato.

Tuber yield per hectare expressed positive significant correlation with biological yield per plant (0.767 and 0.784 phenotypic and genotypic level, respectively). Similar results had been also reported by Choudhary *et al*. (2000), Hossain *et al*. (2000) and Sahu (2005). Similar results had been found by Babu (1987), but Tirkey (2011) observed significant phenotypic correlation with harvest index. Tuber diameter showed highly significant positive correlation (0.741) with the tuber yield at genotypic level only.

Biological yield per plant showed highly significant correlation with vine weight at genotypic level (0.931) and significantly correlation at phenotypic level (0.917) and vine length per plant at genotypic level (0.590). Tuber length showed highly significant correlation with vine weight (0.595) and neck length (0.668) at genotypic level. Inter node length showed highly significant correlation with vine length at phenotypic (0.850) and genotypic level (0.881). Gupta *et al*. (1969), Panse *et al*. (1972), Pushkaram *et al*. (1978), Bacusmo *et al*. (1982) and Nedunzhiyan and Reddy (2000) reported strong correlation between growth parameters.

TSS showed positive highly significant correlation with harvest index at genotypic (0.651) and significant correlation at phenotypic (0.595) level whereas, negatively significant correlation with number of tubers at both phenotypic (-633) and genotypic (-770) levels.

Dry matter % of tuber also showed positive highly significant correlation at both genotypic level (0.726) and significantly correlation at phenotypic level (0.622) with Dry matter % of vine. Dry matter % of vine showed negative significant correlation with vine diameter (-674) and tuber diameter (-680) at genotypic level. Harvest index showed negative and significant correlation with vine weight at both genotypic (-0.759) and phenotypic (-0.733) level.

Path coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation into direct and indirect effects. In other words, it measures the direct and indirect contribution of various independent characters on a dependent character. The concept of path analysis was developed by Wright (1921) and the technique was first used by Dewey and Lu (1959) that helps in determining yield contributing characters thus, useful in indirect selection. Correlation coefficients along with path coefficients together provide more reliable information, which can be effectively predicted in crop improvement program. If the correlation between yield and a character is due to direct effect of a character, it reveals true relationship between them and direct selection for the trait will be rewarding for yield improvement. However, if the correlation coefficient is mainly due to indirect effect of the character through another component trait, indirect selection through such trait will be effective in yield improvement. Direct and indirect effect of yield attributing characters on total tuber yield (t/ha) are presented in table 2.

In genotypic path, biological yield per plant showed maximum positive direct effect on tuber yield t/ha (2.302) followed by vine length (0.039), harvest index (0.034), neck length of tuber (0.017), dry matter per cent of foliage (0.013), dry matter per cent of tuber (0.010) which

Table 1: Correlation coefficient between tuber yield and its component characters in sweet potato

Characers		Inter node length (cm)	Vine diameter (cm)	Vine weight (g)	No. of tubers	Neck length (cm)	Tuber length (cm)	Tuber diameter (cm)	Biological yield (g)	Harvest index (%)	index index % of vine	Dry matter % of tuber	TSS (%)	Tuber yield (t/ha)
Vine length (cm)	**P**	0.850**	0.146	0.560	0.360	0.028	-0.052	0.275	0.529	-0.379	0.093	0.169	-0.417	0.312
	G	0.881**	0.294	0.594*	0.429	0.044	-0.135	0.451	0.590*	-0.374	0.129	0.192	-0.422	0.404
Inter node length (cm)	**P**		0.142	0.527	0.440	0.068	0.049	0.126	0.516	-0.332	0.015	0.125	-0.500	0.332
	G		0.448	0.549	0.496	0.124	-0.012	0.287	0.567	-0.334	0.066	0.178	-0.531	0.420
Vine diameter (cm)	**P**			0.101	-0.100	0.257	0.178	0.062	0.081	-0.106	-0.134	0.022	0.019	0.030
	G			0.398	-0.415	0.546	0.428	0.530	0.422	-0.204	-0.674*	0.011	0.131	0.319
Vine weight (g)	**P**				0.321	0.346	0.499	0.161	0.917**	-0.733*	0.149	0.119	-0.403	0.448
	G				0.332	0.401	0.595*	0.235	0.931**	-0.759*	0.161	0.111	-0.437	0.503
No. of tubers	**P**					-0.144	0.168	-0.178	0.200	-0.404	0.244	0.201	-0.633*	-0.074
	G					-0.153	0.267	-0.126	0.156	-0.547	0.434	0.277	-0.770*	-0.197
Neck length (cm)	**P**						0.476	0.041	0.440	-0.075	0.276	0.262	0.214	0.430
	G						0.668*	0.001	0.490	-0.104	0.309	0.294	0.255	0.473
Tuber length (cm)	**P**							-0.082	0.400	-0.500	0.044	-0.106	-0.221	0.091
	G							-0.020	0.568	-0.462	-0.039	-0.182	-0.257	0.308
	P								0.362	0.186	-0.350	0.028	-0.057	0.563
	G								0.482	0.207	-0.680*	-0.047	-0.081	0.741**
Biological yield (g)	**P**									-0.421	0.073	0.135	-0.234	0.767**
	G									-0.484	0.072	0.132	-0.257	0.784**
Harvest index (%)	**P**										-0.151	0.052	0.595*	0.235
	G										-0.145	0.079	0.651*	0.147
Dry matter % of vine	**P**											0.622*	0.205	-0.077
	G											0.726**	0.250	-0.104
Dry matter % of tuber	**P**												0.207	0.113
	G												0.213	0.128
TSS (%)	**P**													0.118
	G													0.131

*5% level of significance, ** 1% level of significance

Table 2 : Direct and indirect effect of component character on tuber yield in sweet potato.

Characters	Vine length (cm)	Inter node length (cm)	Vine diameter (cm)	Vine weight	No. of tubers	Neck length (cm)	Tuber length (cm)	Tuber diameter (cm)	Biological yield (g/plant)	Harvest index (%)	Dry matter % of foliage	Dry matter % of tuber	TSS (%)	Tuber yield (t/ha)
Vine length (cm)	**0.039**	-0.012	-0.003	-0.971	-0.025	0.001	0.001	-0.001	1.359	-0.013	0.002	0.002	0.026	0.404
Inter node length	0.034	**-0.041**	-0.005	-0.897	-0.029	0.002	0.000	-0.001	1.305	-0.011	0.001	0.002	0.033	0.420
Vine diameter (cm)	0.011	-0.006	**-0.010**	-0.651	0.024	0.009	-0.005	-0.002	0.971	-0.007	-0.009	0.000	-0.008	0.319
Vine weight	0.023	-0.00	-0.004	**-1.635**	-0.019	0.007	-0.007	-0.001	2.142	-0.026	0.002	0.001	0.027	0.503
No. of tubers	0.017	-0.007	0.004	-0.543	**-0.058**	-0.003	-0.003	0.000	0.358	-0.019	0.006	0.003	0.047	-0.197
Neck length (cm)	0.002	-0.002	-0.006	-0.655	0.009	**0.017**	-0.008	0.000	1.128	-0.004	0.04	0.003	-0.016	0.473
Tuber length (cm)	-0.005	0.000	-0.004	-0.972	-0.016	0.012	**-0.011**	0.000	1.307	-0.016	0.000	-0.002	0.016	0.308
Tuber diameter (cm)	0.017	-0.004	-0.006	-0.384	0.007	0.000	0.000	**-0.003**	1.109	0.007	-0.009	0.000	0.005	0.741
Biological yield (g/plant)	0.023	-0.008	-0.004	-1.521	-0.009	0.008	-0.006	-0.001	**2.302**	-0.017	0.001	0.001	0.016	0.784
Harvest index (%)	-0.014	0.005	0.002	1.241	0.032	-0.002	0.005	-0.001	-1.114	**0.034**	-0.002	0.001	-0.040	0.147
Dry matter % of foliage	0.005	-0.001	0.007	-0.263	-0.025	0.005	0.000	0.002	0.166	-0.005	**0.013**	0.007	-0.015	-0.104
Dry matter % of tuber	0.007	-0.002	0.000	-0.181	-0.016	0.005	0.002	0.000	0.304	0.003	0.009	**0.010**	-0.013	0.128
TSS (%)	-0.016	0.007	-0.001	0.714	0.045	0.004	0.003	0.000	-0.591	0.022	0.003	0.002	**-0.061**	0.131

Residual value : 0.0014, Diagonal and bold underlined figures shows direct effect on tuber yield

indicated that these are the main contributors to the tuber yield, which is in consonance with the findings of Engida *et al*. (2006) and Tirkey (2011). Whereas, vine weight showed maximum negative direct effect on tuber yield (t/ha) (-1.635) followed by TSS (-0.061), numbers of tubers (-0.058), inter node length (-0.041), tuber length (-0.011), vine diameter (-0.010) and tuber diameter (-0.003). Alam *et al.* (1998) showed similar result but Sahu (2005) observed that vine weight plant^{-1}, number of marketable tuber plant^{-1} had positive direct effect and were important traits influencing tuber yield.

Only tuber diameter and biological yield showed highly significant positive correlation with tuber yield. High positive direct effect (2.302) of biological yield plant^{-1} is main contributor to its highly significant correlation to tuber yield whereas, the direct of tuber diameter is negative (-0.003) but it has highly significant correlation with tuber yield via indirect effect of biological yield (1.109).

The effect of residual factor (0.0014) on tuber yield per plant was negligible thereby, suggested that no other major yield contributing component is left over.

Conclusion

In this present study, the correlation between yield and a character due to direct effect of biological yield per plant, TSS, vine length, harvest index, neck length, dry matter per cent of vine and tuber revealed true relationship between them and direct selection for this trait would be rewarding for yield improvement. The correlation mainly due to indirect effects of the character through another component trait, indirect selection through such trait would be live in yield improvement. So, the selection of the above mentioned traits having direct and indirect effect on yield may lead to improvement in total tuber yield in sweet potato for Chhattisgarh plains. Overall in the study, selection of high biological yield will improve the tuber yield per hectare.

It could be conclude that due to high estimated positive correlation and positive direct effect of biological yield and harvest index on tuber yield (t/ha), these traits would be most suitable for indirect selection in sweet potato improvement programs that aims to increasing tuber yield.

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