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Character Association Studies in Sweet Potato [*Ipomea batatas* (L.)]

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ABSTRACT

An experiment was conducted at SG college of agriculture and research station, IGKV, Jagdalpur to estimate correlation and path analysis among different characters of twenty eight sweet potato genotypes in randomized block design in 3 replication during *Kharif* 2020-21. Observed thirteen quantitative characters *viz.,* vine internode length, length of tubers per plant, diameter of tubers, starch, dry matter of tubers, no. of tubers per plant, tubers weight per plant, harvest index and tubers yield (t/ha). Analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all the characters. Correlation revealed that tubers yield (t/ha) showed high significant positive correlation with tubers weight per plant at both phenotypic and genotypic level (0.807 and 0.963) followed by number of tubers per plant, starch (%), diameter of tubers (cm), length of tubers (cm), harvest index (%), dry matter of tubers (%). Path co-efficient analysis revealed maximum direct contribution towards tubers weight per plant showed maximum positive direct effect on tubers yield (1.125t/ha) followed by diameter of tubers, vine length, number of tubers per plant, TSS of tubers percent and length of tubers per plant.

Key Words: Correlation, Path co-efficient, Character association, Tuber weight, Tuber yield.

INTRODUCTION

Sweet potato (*Ipomea batatas* (L.) is one of the most popular and extensively consumed tubers vegetable crops grown worldwide due to its acclimatization to a wide variety of environments, as well as its high nutritive value. In Chhattisgarh it is locally known as "Kalmal Kanda", 'Maati Kanda' and 'Kevat Kanda' is one of the most popular and important tubers crops in India and abroad because of its yield potential and high calorific value. Sweet potato ranks fifth after rice, wheat, maize and cassava, sweet potato (CIP, 2018). In India sweet potato occupied 1.16 lakh thousand ha area with 12.07 lakh thousand Mt production and having productivity of 10.2 thousand Mt/ha whereas in Chhattisgarh it covers 4.47 thousand ha area with 48.15 thousand Mt production and having productivity of 10.75 thousand Mt/ha (Anonymous, 2020). In breeding programme information about extends of genetic variability, correlation is basic requirement. Genotypes exhibiting high variability for desirable characters that contribute to the yield are to be selected in such a programme of evaluation in the breeding programme, selection of parents for hybridization is largely based on high yield potentials, wide adoption and genetic diversity.

The efficiency of selection can be improved by using correlation between different characters. The phenotypic correlation indicates the extent of observed relationship between two characters and this includes both hereditary and environmental influences, while genotypic correlation coefficient provides a real association between two characters and is most useful in selection (Johnson *et al,* 1955). Genetic correlation can result either from pleiotropy or from linkages. While phenotypic value is a non-additive combination of both genetic and environmental correlation. This study merely

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Table 1. Analysis of variance for fruit yield and its component characters in sweet potato.

Sr. No.	Character (df)	Mean sums of square		
		Replication	Treatment	Error
		(2)	(27)	(54)
01	Vine length (cm)	186.46	8591.04**	157.61
02	Vine internode length (cm)	1.04	6.94**	0.19
03	Vine weight per plant (fw) g	9920.39	18282.32**	1143.10
04	Length of tubers (cm)	13.96	46.88**	3.23
05	Diameter of tubers (cm)	0.17	3.01**	0.20
06	TSS of tubers (%)	0.29	5.67**	0.25
07	Starch (%)	0.04	61.55**	2.33
08	Dry matter of tubers (%)	0.42	133.89**	1.16
09	Dry matter of foliage (%)	760.96	542.73**	37.04
10	No. of tubers per plant	0.37	3.48**	0.19
11	Tubers weight per plant (g)	1189.97	15366.18**	768.04
12	Marketable tubers yield per plant (g)	1211.63	12769.83**	774.42
13	Marketable tubers yield (t/ha)	5.43	56.01**	3.49
14	Weevil infested tubers yield per plant (g)	0.23	732.62**	1.12
15	Weevil infested tubers yield (t/ha)	0.00	3.25**	0.00
16	Biological yield (g/plant)	17540.10	40323.76**	1454.59
17	Harvest Index (%)	25.42	257.67**	19.28
18	Tubers yield (t/ha)	67.36	67.58**	8.29

*: Significant at 5%, **: significant at 1%

indicates the nature of association and this alone does not provide the exact insight of the relative effect of each component character. A component character may have no direct effect on considerable economic trait but it may influence it via related characters. Hence, knowledge of direct and indirect effects of different characters on desired traits is essential for selection to improve the population. The path coefficient divides the correlation into direct and indirect effects and thus determines the nature of association (Falconer, 1960).

MATERIALS AND METHODS

The experiment was carried out during the year 2020-2021 at Instructional cum Research Farm of S.G. Collage of Agriculture and Research Station, Jagdalpur, Bastar. The experimental material comprised of twenty-eight genotypes along with two checks Indira Nandini as local check and Sree Bhadhara as national check. The experiment was laid out in a randomized block design with three replications at the spacing of 60 cm between rows and 20 cm between plants to plant. A net plot size of 2 x 1.8 m was kept for each genotype. All the recommended cultural practices were taken to grow a healthy crop. Data were recorded on five randomly selected plants for thirteen characters *viz.,* vine length (cm), vine internode length (cm), vine weight per plant (fw) g., length of tubers (cm), diameter of tubers (cm), TSS of tubers (%), starch (%), dry matter of tubers (%), dry matter of foliage (%), no. of tubers per plant, tubers weight per

Table 2. Genotypic and phenotypic correlation coefficient between tubers yield and its component characters in sweet potato

Characters		1. Vine internode length (cm)	2. Vine weight per plant (fw) g	3. Length of tubers per plant (cm)	4. Diameter of tubers (cm)	5. TSS of tubers (%)	6. Starch (%)	7. Dry matter of tubers (%)	8. Dry matter of foliage (%)	9. No. of tubers per plant	10. Tubers weight per plant (g)	11. Harvest Index (%)	12. Tubers yield (t/ ha)
Vine length (cm)	P	0.395*	0.214	-0.043	0.016	-0.120	0.302	-0.050	0.029	0.233	0.195	-0.066	0.172
	G	0.415 *	0.255	-0.043	0.188	-0.131	0.325	-0.055	0.333	0.258	0.230	-0.077	0.243
Vine internode length (cm)	P	1.000	-0.092	-0.039	0.044	0.010	0.038	-0.354	-0.031	-0.170	-0.059	0.003	-0.059
	G	1.000	-0.103	-0.034	0.076	0.014	0.041	-0.377 *	0.045	-0.207	-0.047	0.015	-0.052
Vine weight per plant (fw) g	P		1.000	0.307	0.371	-0.202	0.059	0.046	0.068	0.188	0.155	-0.713	0.165
	G		1.000	0.335	0.430 *	-0.267	0.060	0.065	0.754**	0.208	0.225	-0.701	0.225
Length of tubers per plant (cm)	P			1.000	0.483**	-0.154	0.487 **	0.350	0.208	0.408*	0.540**	0.118	0.509**
	G			1.000	0.585 **	-0.198	0.549 **	0.410 *	0.287	0.508 **	0.647**	0.171	0.676**
Diameter of tubers (cm)	P				1.000	-0.397*	0.472 *	0.160	0.452*	0.543 **	0.664 **	0.141	0.622**
	G				1.000	-0.431*	0.628 **	0.181	0.518**	0.679 **	0.786**	0.149	0.850**
TSS of tubers (%)	P					1.000	-0.322	-0.074	-0.348	-0.378*	-0.380 *	-0.038	0.354
	G					1.000	-0.377*	-0.066	-0.405*	-0.422 *	-0.417 *	0.171	-0.446*
Starch (%)	P						1.000	0.477*	0.205	0.683 **	0.707 **	0.428*	0.664**
	G						1.000	0.524**	0.207	0.764 **	0.825 **	-0.007	0.856**
Dry matter of tubers (%)	P							1.000	0.051	0.569 **	0.418*	0.252	0.394*
	G							1.000	0.072	0.624 **	0.460 *	0.277	0.469*
Dry matter of foliage (%)	P								1.000	0.312	0.257	-0.391*	0.244
	G								1.000	0.344	0.333	-0.498 **	0.364
No. of tubers per plant	P									1.000	0.723**	0.329	0.655**
	G									1.000	0.842**	0.407 *	0.895**
Tubers weight per plant (g)	P										1.000	0.564 **	0.807**
	G										1.000	0.522**	0.963**
Harvest index (%)	P											1.000	0.493*
	G											1.000	0.563**

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

Table 3. Direct and indirect effect of component character on tubers yield and its components in sweet potato

Characters	1. Vine length (cm)	2. Vine inter-node length (cm)	3. Vine weight per plant (fw) g	4. Length of tubers per plant (cm)	5. Diameter of tubers (cm)	6. TSS of tubers (%)	7. Starch (%)	8. Dry matter of tubers (%)	9. Dry matter of foliage (%)	10. No. of tubers per plant	11. Tubers weight per plant (g)	12. Harvest Index (%)	13. Tubers yield (t/ ha)
Vine length (cm)	0.028	-0.011	-0.048	0.000	0.007	0.000	-0.027	0.001	-0.001	0.002	0.280	0.013	0.244
Vine internode length (cm)	0.012	-0.026	0.019	0.000	0.003	0.000	-0.003	0.005	0.000	-0.001	-0.057	-0.003	-0.052
Vine weight per plant (fw) g	0.007	0.003	-0.188	0.001	0.016	-0.001	-0.005	-0.001	-0.001	0.001	0.275	0.118	0.226
Length of tubers per plant (cm)	-0.001	0.001	-0.063	0.003	0.022	-0.001	-0.045	-0.005	-0.001	0.003	0.791	-0.029	0.676**
Diameter of tubers (cm)	0.005	-0.002	-0.081	0.002	0.038	-0.002	-0.050	-0.002	-0.001	0.004	0.942	-0.025	0.828**
TSS of tubers (%)	-0.004	0.000	0.050	-0.001	-0.016	0.004	0.031	0.001	0.001	-0.003	-0.510	0.001	-0.446
Starch (%)	0.009	-0.001	-0.011	0.001	0.023	-0.001	-0.082	-0.006	0.000	0.005	1.008	-0.088	0.856**
Dry matter of tubers (%)	-0.002	0.010	-0.012	0.001	0.007	0.000	-0.043	-0.012	0.000	0.004	0.563	-0.046	0.469*
Dry matter of foliage (%)	0.009	0.001	-0.142	0.001	0.020	-0.001	-0.017	-0.001	-0.002	0.002	0.392	0.080	0.342
No. of tubers per plant	0.007	0.005	-0.039	0.001	0.025	-0.002	-0.063	-0.008	-0.001	0.006	1.029	-0.068	0.895**
Tubers weight per plant (g)	0.006	0.001	-0.042	0.002	0.029	-0.001	-0.067	-0.006	-0.001	0.005	1.125	-0.088	0.963**
Harvest index (%)	-0.002	0.000	0.132	0.000	0.006	0.000	-0.043	-0.003	0.001	0.003	0.638	-0.168	0.563**

Residual value: 0.128

Diagonal and bold underlined figures show direct effect on tubers yield

plant (g), harvest index (%), were recorded on five competitive random plants from each replication. Three important characters *viz*., tubers yield (t/ha), marketable tubers yield (t/ha) and weevil infested tubers yield (t/ha) were calculated on the basis of observed data.

RESULT AND DISCUSSION

The analysis of variance for tubers yield and its component characters indicated that mean sum of squares due to genotypes were highly significant for all the characters under study. Significant mean sum of squares due to tubers yield and attributing characters revealed existence of considerable variability in material studied for improvement of various traits. These findings were closely associated with the reports of Anshebo *et al* (2004), Teshome *et al* (2004), Chaurasiya (2012), Mohanty (2013), Dash *et al* (2014), Bhadauriya *et al* (2018). 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 2). Nedunzhiyan and Reddy (2000), Choudhary *et al* (2000) also found similar results in their studies on sweet potato.

Tuber yield

Tuber yield (t/ha) showed high significant positive correlation with tubers weight per plant at both phenotypic and genotypic level (0.807 and 0.963) followed by number of tubers per plant (0.655 and 0.895), starch (%) (0.664 and 856), diameter of tubers (cm) (0.622 and 0.850), length of tubers (cm) (0.509 and 0.676), harvest index (%) (0.493 and 0.563), dry matter of tubers (%) (0.394 and 0.469) and significant negative correlation observed with TSS of tubers (-0.446) at genotypic level only. Similar result had been also reported by Choudhary (2000) for tubers yield, Hussain (2000) for tubers weight, number of tubers per plant, Nedunzhiyan and Reddy (2000) for growth parameters, Sahu (2005) for Diameter of tubers, harvest index and length of tubers, Engida *et al* (2006) for storage root weight and harvest index, Jha (2012) for harvest index, Mohanty (2013) for number of root per plant and root girth, Dash *et al* (2015) for diameter of tubers and harvest index. Correlation coefficient analysis revealed that tubers yield (t/ha) showed high significant positive correlation with tubers weight per plant at both phenotypic and genotypic level followed by number of tubers per plant, starch, diameter of tubers, length of tubers, harvest index, dry matter of tubers and significant negative correlation observed with TSS of tubers at genotypic level only.

Path coefficient analysis

The path coefficient analysis which splits total correlation coefficient of different characters into direct and indirect effect of yield attributing characters on tubers yield (t/ha) was presented (Table 3). The data revealed that genotypic path, tubers weight per plant showed maximum positive direct effect on tubers yield tone per hectare (1.125) followed by diameter of tubers (0.038), vine length (0.028), number of tubers per plant (0.006), TSS of tubers percent (0.004) and length of tubers per plant (0.003) which indicated that these were the main contributors to the tubers yield which was in consonance with the findings of Hossain *et al* (2000), Shasikant *et al* (2008), Tirkey *et al* (2011), Bhadauriya *et al* (2018). Whereas, vine weight per plant showed maximum negative direct effect (-0.188) followed by harvest index (-0.168), starch percent (-0.082), vine internode length (-0.026), dry matter of tubers percent (-0.012) and dry matter of foliage percent (-0.002).

The effect of residual factor (0.128) on tuber yield was low, thereby, suggested that no other major yield component is left over. Overall, the path analysis confined that direct effect of tubers yield, diameter of tubers, length of tubers, starch, dry matter of tubers, no. of tubers, tubers weight per plant should be considered simultaneously for amenability in tubers yield of sweet potato.

CONCLUSION

In this present study the correlation between tuber yield and a character is due to direct effect of tubers weight per plant, vine length, diameter of tubers, number of tubers per plant, length of tubers revealed true relationship between them and direct selection for this trait would be rewarding for yield improvement. Overall, in this study selection of genotypes having higher tubers weight or selection of tubers weight characters for further breeding programme will improve the tubers yield per hectare. In genotypic path, tubers weight per plant showed maximum positive direct effect on tubers yield tone per hectare followed by diameter of tubers, vine length, number of tubers per plant, TSS of tubers percent and length of tubers per plant which indicated that these are the main contributor to the tuber yield.

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