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Genetic Variability, Correlation and Path Analysis of Yield Contributing Characters in Sweet Potato (*Ipomoea batatas* Lam.)

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Evaluation of 30 sweet potato (*Ipomoea batatas* Lam.) genotypes for yield contributing characters and tuber yield per plant revealed high phenotypic and genotypic coefficient of variation (PCV and GCV, respectively) for number of tubers per plant, average tuber weight and tuber yield per plant. The heritability and genetic advance were higher for tuber yield per plant, average tuber weight and number of tubers per plant. These three characters also reflected high heritability as well as high genetic advance. As high positive significant correlation, as well as positive direct effect of average tuber weight and number of tubers per plant on tuber yield per plant were found, these characters should be given prime importance for selecting high yielding sweet potato genotypes.

Key words: Path analysis, Sweet potato, Variability, Yield.

Introduction

Sweet potato, commonly known as Misti Alu, is one of the most important root crops in Bangladesh. It is a drought tolerant, high calorie producing crop with high yield per unit area. Rashid (1990) stated that it may be possible to increase yield of tuber crops like sweet potato through the use of its large genetic base. Many sweet potato genotypes are grown in different parts of Bangladesh. Little attention has been given to a systemic evaluation and characterization of these indigenous genotypes.

Like any other crop, tuber yield in sweet potato is a complex component character. The prerequisite in a breeding programme for increasing yield, quality, resistance to diseases and pests is the exploration of the genetic variability present in the available germplasms. Therefore, evaluation of genetic stock acclimatized to local conditions is very important. Improvement in tuber yield depends on the nature and extent of genetic variability, heritability and genetic advance in the base population from which selection is made. Besides, a clear understanding and knowledge of association and contribution of various yield components is essential for any selection programme aimed at yield improvement. Path coefficient analysis is useful for evaluating the relative contribution of each component trait, both direct and indirect, to the yield.

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The present paper reports results on variability, correlation and path analysis studies utilizing 30 germplasms collected from different parts of Bangladesh with a view to selecting sweet potato genotypes with high yield potential.

Materials and Methods

The experiment was conducted at the Horticulture Farm of the Agricultural University, during the period from Dec 1994 to May 1995. The treatment consisted of 30 sweet potato genotypes. The experiment was laid out in randomised complete block design (RCBD) with three replications. Due to shortage of land and large number of germplasms, planting system in the line was followed. The entire experimental area was divided into three blocks. Each contained 30 lines with 15 plants of each genotype in a line. The soil was a silty loam in texture with pH 6.4. The tip cuttings were planted at a spacing of 60 cm x 30 cm on 7th Dec 1994. The crop was fertilized with cowdung, urea, triple super phosphate (TSP) and muriate of potash (MP) at the rate of 10,000, 140, 100 and 150 kg^{-1} heçtare, respectively. Intercultural operations were done as and when needed and included weeding, mulching and irrigation. Weeding and mulching were performed twice, at 30 and 60 days after planting. A total of three irrigations were provided during the growing season; two, just after weeding and mulching and the last one at 90 days after planting. Data were recorded for the length of vine (cm), number of vines per plant, weight of vines per plant (kg), tuber length (cm), tuber diameter (cm), dry matter (%), average tuber weight (kg), number of tubers per plant and tuber yield per plant (kg) from ten randomly selected plants per germplasm from each replication.

Genotypic and phenotypic coefficients of variation were estimated using the formula suggested by Burton (1952). Broad sense heritability and genetic advance in percentage of mean were calculated according to Johson *et al* (1955) and Comstock and Robinson (1952), respectively. Correlation coefficient and path analysis were worked out as suggested by Dewey and Lu (1959).

Results and Discussion

Mean square values obtained from analysis of variance for yield contributing characters and tuber yield per plant are presented in Table 1. It is apparent from mean square values that there were significant differences among the genotypes for all the characters except average tuber weight.

The estimates of range, mean, phenotypic and genotypic coefficients of variation (PCV and GCV, respectively), heritability in broad sense (h^2_b), genetic advance in percentage of mean (GA%) are presented in Table 2. In general, the PCV estimates were higher than the GCV estimates for all the traits. Tuber yield per plant exhibited the highest PCV (65.06) followed by number of tubers per plant and average tuber weight while the lowest PCV (18.42) was found for tuber length. However, the magnitude of difference between PCV and GCV was less for all the characters except number of vines per plant which indicates that number of vines per plant was more influenced by environmental factors and the existing variation for the remaining characters were mainly due to the genetic factors. There is enough scope for selection base on these characters. The genetic variation ranged from 20.03 to 37.65% in sweet potato as reported by Chen *et al* (1995).

As regards to heritability, the values ranged between 35% for number of vines per plant to 99% for average tuber weight. Except for number of vines per plant, the present findings agree with the findings of Lin (1983) and Collins *et al* (1987) who reported more than 65% and 75 to 92% heritabilities, respectively for yield and yield factors. Estimates of heritability and genetic advance in combination are more important for selection than heritability alone (Johnson *et al* 1955).

Table 1

Mean square values of yield contributing characters and tuber yield per plant from anova

Sources of variation	df	Length of vine	No.of vines plant^{-1}	Wt.of vines plant^{-1}	Tuber length	Tuber diameter	Dry matter (%)	Average tuber wt.	No.of tubers plant^{-1}	Tuber yield plant^{-1}
Replication	2	1720.03	1.97	0.022	0.97	1.29	3.81	0.00001	0.096	0.006
Genotype	29	3102.22**	6.72**	0.230**	13.77**	39.17**	84.31**	0.003^{NS}	6.841**	0.118**
Error	58	501.57	2.60	0.013	0.96	1.71	2.39	0.00001	0.545	0.004

**indicates significant at 1% level of probability and NS indicates non-significant

Table 2

Range, mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense (h^2_b) and genetic advance in percentage of mean (GA%) of tuber yield per plant and yield contributing characters of sweet potato

Characters	Range	Mean ± SE	PCV	GCV	h^2_b	GA%
Length of vine (cm)	157.23-280.10	187.90 ± 18.29	19.69	15.67	63	26
Number of vines plant^{-1}	8.13-14.00	10.82 ± 1.32	18.42	10.83	35	13
Weight of vines plant^{-1} (kg)	0.63-1.700	1.07 ± 0.09	27.30	25.14	85	48
Tuber length (cm)	10.80-19.57	15.02 ± 0.80	15.22	13.76	82	26
Tuber diameter (cm)	8.97-21.63	14.81 ± 1.07	25.44	23.86	88	46
Dry matter (%)	16.47-35.87	28.18 ± 1.26	19.34	18.54	92	36
Average tuber weight (kg)	0.03-0.14	0.08 ± 0.0026	39.17	38.98	99	80
Number of tubers plant^{-1}	1.30-6.40	3.91 ± 0.60	41.58	37.05	79	68
Tuber yield plant^{-1} (kg)	0.09-0.87	0.32 ± 0.052	65.06	61.88	90	121

Panse (1957) also pointed out that high heritability coupled with high genetic advance help more reliable conclusions to be made in a selection programme. The high values of heritability are also reflected in higher genetic advance for tuber yield per plant, average tuber weight, number of tubers per plant, weight of vines per plant and tuber diameter suggesting the role of additive gene action in these characters.

To ascertain the interrelationship among yield and yield contributing characters, correlation coefficients were worked out and are presented in Table 3. Tuber yield per plant showed significant, positive association with tuber diameter, average tuber weight and number of tubers per plant. Positive correlation between tuber yield and number of tubers was reported by Zhang and Xu (1994), Perdomo (1985), Brouke (1984) and Kamalam *et al* (1977) while Bacusmo and Carpena (1982) and Janssens (1982) observed positive association of tuber yield with average tuber weight and number of tubers per plant. Mohan and Gowda (1992) mentioned that high yield was related to a large number of tubers per plant and high tuber weight.

Tuber yield per plant also had positive but non-significant correlation between number of vines per plant, weight of vines per plant and tuber length. Similar observations were also reported by Pushkaran *et al* (1976) where yield was influenced by girth of tuber, number of tubers and length of tuber. Average tuber weight also had positive, significant associa-

Table 3

Correlation coefficients between tuber yield per plant and yield contributing characters of sweet potato

Characters	No.of vines plant^{-1}	Wt.of vines plant^{-1}	Tuber length	Tuber diameter	Dry matter (%)	Average tuber wt.	No.of tubers plant^{-1}	Tuber yield plant^{-1}
Length of vine	0.144	0.075	0.307	0.002	-0.050	0.142	-0.056	0.064
No.of vines plant^{-1}	-	0.146	0.279	0.061	-0.182	0.184	0.097	0.234
Wt.of vines plant^{-1}	-	-	0.280	0.222	-0.615**	0.107	0.301	0.350
Tuber length	-	-	-	0.073	-0.115	0.274	0.331	0.309
Tuber diameter	-	-	-	-	-0.595**	0.712**	0.332	0.756**
Dry matter (%)	-	-	-	-	-	-0.455*	-0.444*	-0.694**
Average tuber wt.	-	-	-	-	-	-	0.002	0.729**
No.of tubers plant^{-1}	-	-	-	-	-	-	-	0.635**

*and** indicate significant at 5% and 1% level of probability, respectively

Table 4

Direct and indirect effects of various characters of tuber yield per plant of sweet potato

Characters	Indirect effects through							Correlation with tuber yield plant^{-1}
	No.of vines plant^{-1}	Wt.of vines plant^{-1}	Tuber length	Tuber diameter	Dry matter (%)	Average tuber wt.	No.of tubers plant^{-1}	
No.of vines plant^{-1}	**0.0622**	0.0151	-0.0483	-0.0017	0.0035	0.1401	0.0631	0.234
Wt.of vines plant^{-1}	0.0091	**0.1036**	-0.0456	-0.0064	0.0118	0.0815	0.1960	0.350
Tuber length	0.0185	0.0290	**-0.1627**	-0.0021	0.0022	0.2086	0.2155	0.309
Tuber diameter	0.0038	0.0230	-0.0119	**-0.0286**	0.0114	0.5421	0.2162	0.756**
Dry matter (%)	-0.0113	-0.06370	0.0187	0.0170	**-0.0192**	-0.3464	-0.2891	-0.694**
Average tuber wt	0.0114	0.0111	-0.0446	-0.0203	0.0087	**0.7614**	0.0013	0.729**
No.of tubers plant^{-1}	0.0060	0.0312	-0.0538	-0.0095	0.0085	0.0015	**0.6511**	0.635**

Residual effect (R) = 0.1982. **indicates significant at 1% level of probability; direct effects are indicated in bold and underlined diagonal figures.

tion with tuber diameter which indicated that with the increase of tuber diameter, average tuber weight increased. On the contrary, per cent dry matter exhibited negative, significant correlations with weight of vines per plant, tuber diameters, average tuber weight, number of tubers per plant and tuber yield per plant. Tsuno and Fujise (1963) reported unfavourable effect of excess leaf area index on dry matter production of sweet potato due to mutual shading. Enyi (1977) also observed negative correlation between vine weight and tuber yield. All other associations were very low.

Partitioning of the correlation coefficients through path analysis into direct and indirect effects (Table 4) revealed that average tuber weight and number of tubers per plant exhibited maximum direct effect on tuber yield per hill. These findings are in partial agreement with Pushkaran *et al* (176) who reporeted that the direct effect of number of tubers and length of tubers was more pronounced. Kamalam *et al* (1977) also found maximum direct effect of number of tubers per plant on yield. This means that average tuber weight and number of tubers per plant are the major component traits for tuber yield per plant. Maximum indirect effects were observed in the case of tuber diameter through average tuber weight, followed by tuber diameter and tuber length through number of tubers per plant. Maximum negative, indirect effects were calculated for per cent dry mater through average tuber weight and number of tubers per plant. All other positive or negative and direct or indirect effects were negligible. However, a residual effect of 0.1982 indicates that the characters studied account for 80% of the variability and there might be some other characters not included in the present study, which contribute towards tuber yield.

The present study indicates that since tuber yield per plant, average tuber weight and number of tubers per plant had high heritability coupled with high genetic advance; average tuber weight and number of tubers per plant had positive, significant correlation with as well as positive direct effects on tuber yield per plant. These characters should be given prime importance when selecting high yielding sweet potato genotypes. As tuber diameter had high heritability and higher genetic advance and significant positive correlation as well as high indirect effect through average tuber weight on tuber yield per plant, it may also be deemed as good selection criteria for improvement of sweet potato.

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