Original Research Article

Assessment of growth and yield of Sweet potato genotypes

Abstract

The experiment was taken up to elicit the information on magnitude of genetic variability, heritability and to predict the gains realized through selection, character association, cause and effect relationship and divergence for the quantitative characters in sweet potato (Ipomoea batatas (L.) Lam.) genotypes. Fifteen genotypes of sweet potato were evaluated in RBD with three replications during kharif season of 2019 &2020 at in the K.V.K Dhenkanal District .

The study revealed significant differences among genotypes for different characters studied. Among all the genotypes studied, genotype Accession-22 recorded the highest root yield per hectare and found suitable to the local agro-climatic conditions. The genotypes ST-14 were also found to be elite for different characters.

Among the characters studied, high PCV and GCV were observed for characters like vine length, vine internodal length, number of branches per plant, number of leaves per plant, total leaf area, number of roots per plant, root yield per plant, β-carotene content, starch content, total sugars, reducing sugars, non reducing sugars and total root yield per hectare content indicating high variability available in the germplasm for these characters for further improvement.

High heritability coupled with high genetic advance as per cent of mean was observed for characters vine length, vine internodal length, number of branches per plant, length of leaf lobe, number of leaves per plant, total leaf area, root girth, root yield per plant, β-carotene content, starch content, total sugars, reducing sugars, non reducing sugars and total root yield per hectare indicated that these characters were least influenced by the environmental effects, and these characters were governed by additive genes and selection will be rewarding for improvement of such traits.

The total root yield per hectare (t/ha) had significant positive correlation with traits like number of branches per plant, number of roots per plant, root girth, root yield per plant and β-carotene content suggesting the importance of these traits in selection for yield and can be identified as yield attributing characters for the genetic improvement of yield in sweet potato.

The total root yield per hectare (t/ha) was result of direct effect of number of branches per plant, number of roots per plant, root length, root yield per plant, starch content and reducing sugars. The high direct effect of these traits appeared to be the main factor for their strong association with total root yield per hectare.

Analysis for divergence using D2 statistic revealed highly significant differences for different traits, grouping the 15 genotypes into 6 clusters. Cluster II had the maximum number of genotypes (8) followed by cluster I (7). Maximum inter cluster distance was observed between clusters III and VI while the intra cluster distance was maximum in cluster II and VI. Highest percent contribution to divergence came from β-carotene content, starch content, total sugar, total leaf area, root dry matter content, number of leaves per plant, root yield per plant, petiole length, root girth, vine length and reducing sugar suggested that selection of one or two elite genotypes from divergent (II & VI) and (III & VI) clusters based on the above characters and crossing would result in more heterosis and novel hybrid.

Introduction

Sweet potato yields high amount of energy per unit area per unit time and is expected to bridge the food shortages and malnutrition. The comparative short duration coupled with its innate power for tremendous dry matter production has enabled sweet potato to rank as the foremost tuber crop in respect of calorie value. In India, Sweet potato is being cultivated in almost all the states with an area of 1, 12, 250 ha, and production of 11, 05, 550 MT and productivity of 9.84 MT/ha. (NHB Database,2013). In Andhra Pradesh, it is grown in an area of 280 ha with a production of 5, 530 MT and productivity of 19.75 MT/ha (NHB Database, 2013). Odisha is the largest producer of sweet potato in India. Sweet potato in Asia is mainly used for human consumption, animal feed and to a limited extent as raw material for industrial purposes as starch alcohol production

Materials & Method

The experiment was conducted in the instructional farm of KVK, Dhenkanal. Fifteen accessions of Sweet potato was taken in a Randomized Block Design (RBD) experiment with three replications in kharif season , 2019 and 2020. The vines were planted in a Spacing : 60 cm x 30 cm. The planting material were obtained from CTCRI Regional Centre, ICAR, Bhubaneswar and local collection. They were: T 1 :Pol-19-9-3 , T2 : Pol-19-8-2 , T 3: Gouri , T4: Kaling , T5: Kanchangad ,T 6 :Sourin ,T 7: Bhu Sona ,T8 : T 9 :Sankar ,T 10: Sree Vardhini ,T11 :Sree Nandini ,T 12 :Pusa Safed ,T 13 :Goutam ,T14 :Kamala ,T 15 :Kishan . Well matured healthy and disease free vine cuttings of previous season of each genotype were used as vineing material for the experiment. Cuttings were vineed in the plots obtained from the nursery at a spacing of 60×20cm and 5-7cm depth. Standard recommended cultural practices were followed during the entire crop period.

Table 1: Analysis of variance (mean squares) for various biometrical traits First year

Sl. No	Character	First Year			Second Year			Pooled		
		Mean squares			Mean squares			Mean squares		
		Replication	Genotypes	Error	Replication	Genotypes	Error	Replication	Genotypes	Error
	Df	2	14	28	2	14	28	2	14	28
1	Vine Length (cm)	415.784	200.321*	253.106	388.078	521.341**	223.875	36.623	237.046**	60.616
2	Number of branches per vine	0.874	1.768**	0.290	0.038	2.254**	0.503	0.159	1.864**	0.125
3	Number of	108.90	409.578*	40.990	204.	835.99	153.26	6.947	479.344*	44.916

	leaves per vine	6	*		831	0**	6		*	
4	Number of tubers per vine	0.051	0.632**	0.036	0.042	0.735**	0.045	0.001	0.531**	0.018
5	Tuber weight (g)	42.454	860.371**	68.604	271.977	721.423**	162.353	96.394	636.699**	36.683
6	Tuber length (cm)	13.446	8.603*	4.051	7.487	17.866**	2.537	10.192	11.988**	1.746
7	Tuber girth(cm)	3.038	5.511*	1.018	4.592	15.181**	2.293	0.601	7.602**	0.860
8	Tuber yield/ vine (g)	1237.250	11907.261*	773.399	318.567	20552.423**	576.204	685.739	14452.50**	442.733
9	Tuber yield/ plot (kg)	2.840	13.956*	0.872	1.481	18.067**	0.741	1.985	14.988**	0.358
10	Tuber yield/ hectare (t/ha)	2.671	26.987*	1.016	8.767	34.801**	3.267	4.285	28.926**	0.929

** Indicate significance at 5% level

Table 2 General mean, range, coefficient of variation and heritability for ten characters among varieties in sweet potato (first year)

		First year							Second Year						
Sl. No.	**Character**	**General mean**	**Range**	**PCV**	**GCV**	**Heritability**	**GA**	**GA as % mean**	**General mean**	**Range**	**PCV**	**GCV**	**Heritability**	**GA**	**GA as % mean**
1	Vine Length (cm)	126.43	96.40 – 155.20	14.5	6.2	32.3	0.8	6.0	121.24	92.3 – 158.5	14.8	8.2	30.69	11.3	9.3
2	Number of branches per vine	4.13	2.66 – 6.30	21.4	16.9	62.9	1.1	27.7	4.13	2.02-7.84	25.3	18.5	53.68	1.1	28.0
3	Number of leaves per vine	96.32	62.80- 113.80	13.2	11.5	74.9	19.7	20.5	96.55	51.8 – 125.0	20.2	15.6	59.75	24.0	24.8
4	Number of tubers per vine	3.01	2.06 – 3.85	16.0	14.7	84.5	0.8	28.0	3.27	2.18- 4.49	16.0	14.6	83.77	0.9	27.6
5	Tuber weight (g)	111.52	78.30 – 151.10	16.3	14.5	79.3	29.8	26.7	104.30	63.8- 159.6	17.9	13.0	53.44	20.5	19.7
6	Tuber length (cm)	13.50	8.60 – 18.40	17.4	9.1	27.2	1.3	9.8	14.5	10.66 – 21.2	19.1	15.6	66.81	3.8	26.3
7	Tuber girth(cm)	11.64	9.10 – 14.50	13.6	10.5	59.5	1.9	16.7	12.51	17.8- 19.6	20.5	16.5	65.20	3.4	27.5
8	Tuber yield/ vine (g)	329.29	179.36 – 464.16	20.5	18.6	82.7	114.1	34.9	325.19	134.9 – 4.16	26.1	25.0	92.03	161.2	49.5
9	Tuber yield/ plot (kg)	11.22	6.75 – 16.38	20.3	18.6	83.3	3.9	34.9	11.60	6.15- 15.82	22.0	20.7	88.64	4.6	40.1

10	Tuber yield/ hectare (t/ha)	15.59	10.36 – 21.85	19.9	18.8	39.4	5.7	36.7	16.10	8.04- 22.01	23.0	20.1	76.29	5.8	36.2

Table 3 **General mean, range, coefficient of variation and heritability for ten characters among varieties in sweet potato (pooled over two years 2019 and 2020)**

Sl. No.	Character	General mean	Range	PCV	GCV	Heritability	GA	GA as % mean
1	Vine Length (cm)	123.83	104.152 – 147.85	9.46	4.502	22.613	5.346	4.410
2	Number of branches per vine	4.12	2.8 – 6.1	20.37	18.487	82.365	1.424	34.562
3	Number of leaves per vine	96.43	69.6- 118.6	14.28	12.479	76.326	21.657	22.458
4	Number of tubers per vine	3.14	2.31 – 3.85	13.81	13.151	90.691	0.811	25.00
5	Tuber weight (g)	107.91	78.8 – 146.05	14.25	13.105	84.502	26.780	24.817
6	Tuber length (cm)	14.0	10.6 – 19.57	16.25	13.224	66.179	3.098	22.161
7	Tuber girth(cm)	12.07	8.92- 16.37	14.60	12.416	72.328	2.627	21.753
8	Tuber yield/ vine(g)	325.74	207.14 - 441.22	21.95	20.979	91.340	134.539	41.302
9	Tuber yield/ plot (kg)	11.41	6.88 – 15.53	20.043	19.344	93.146	4.390	38.459
10	Tuber yield/ hectare (t/ha)	15.85	10.39 -20.79	20.214	19.278	90.954	6.003	37.874

Result & Discussion

The estimates of genetic parameters such as phenotypic and genotypic variance computed along with the coefficients of variation permits a sound basis to determine the variability components as well as to know the relative amounts of heritable and non-heritable variation for each of these characters.From the present study, it is clearly observed that there exists a wide range of phenotypic as well as genotypic variation for majority of the 10quantitative characters in sweet potato. Minimum differences were evident between the values of PCV and GCV for most of the traits studied except vine length and tuber length in all the trials and analysis. The existence of minimum variation between these two parameters indicated that environment has a little effect in expression of these characters and phenotype truly represents the genotype. In comparing the phenotypic coefficient of variation and genotypic coefficientof variation values it is observed that in general the former values aregreater than the latter in respect of all the 10 quantitative characters under study. In the present study, presence of high to moderate coefficients of variation in case of number of branches per plant,number of tubers per vine,tuber weight, tuber length, tuber girth and tuber yield per vine indicated the presence of good amount of variability among the materials evaluated and therefore, selection for these characters may be quite hopefully used in sweet potato for crop improvement programme.Choudhary and Mishra, 2011; Badu *et al*, 2017 and Mekonnen *et al*, 2021observed similar trends which are in agreement with the present findings.

In the present experiment, heritability (bs) was morefor tubers per vine, yield per vine, tuber weight and number of branches per plant in first year and second year and yield per hectare, yield per plot, yield per vine and number of tubers per vine and tuber weight in pooled analysis..Majority of the traits showed high to moderate levels of heritability suggesting that these characters might be highly heritable and less influenced by environment and selecting genotypes on the basis of such characters would be worthwhile in sweet potato improvement. The results obtained are in agreement with the findings of Sharma,2004; Gin *et al*,2008 and Choudhury and Mishra,2011.

It was suggested that information concerningheritability of quantitative characters and their genetic and environmental variances when considered together might be useful for improving the efficiency of selection. Considering the heritability estimates with genotypic coefficient of variation values .it was concluded that selection may be quite effective based on these characters. On the other hand, deviations noticed in the present study from the findings of previous workers may be due to differences in genetic stock and environmental variations.

Though the studies of heritability estimates are important, their scope is limited,since they are estimated in broad sense and are prone to change with changes inenvironment and the testing material. Further, the heritability estimate by itself maynot be alone a useful index of genetic potentiality of a character. According to Eswro*et al*. (1963), genetic advance (GA) indicates the potentiality of selection at aparticular level of selection intensity. Thus, heritability estimates along with geneticadvance are more valuable than heritability alone in predicting the response ofselection High heritability does notnecessarily mean that the character will show high genetic advance, but when suchcompatible association exists (high heritability and high GA) additive genes come intoprominence because no genetic advance is due to non-additive genes. The selectionbased on a character showing high genetic gain (GA) may be desirable particularly incase of directional selection, when the main aim of the selection is to change the meanvalue of a character to have better standards. On the other hand, high heritabilityaccompanied with low genetic advance indicates the prominence of non-additive geneeffect, suggesting the adoption of heterosis breeding (hybridization) instead of direct selection.

In the present investigation, high estimates of heritability coupled with high genetic advance for characters such as number of leaves per plant, number of tuber per vine, tuber weight, and yield per plantmay be ascribed to effect of additive genes; Sankarri*et al* 2001, Teshome*et al*., 2004 and Sh Liang and Walter, 1968) and may be amenable for selection.

Considering the three genetic parameters together such as genotypic coefficient of variation, heritability and predicted genetic gain at a glance the characters showing more values are due to additive gene action which is responsible for expression of these characters. So, direct selection through these characters will be effective in improvement of sweet potato.

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