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RESEARCH ARTICLE

CORRELATION AND PATH COEFFICIENT STUDIES FOR SELECTING TRAITS CONTRIBUTION TO ROOT YIELD IN SWEETPOTATO GENOTYPES (*IPOMOEA BATATAS* (L.) LAM)

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ABSTRACT

This study was undertaken to determine associations among yield and yield related traits in sweetpotato crop so as to identify the major traits of importance that could be used as a basis for soil nutrients formulation. The experiment was conducted at Umudike in rain forest region during 2013 and 2014 cropping season. The experiments were laid out in split randomized complete block designs with three replications. The plot size used was 3m x 2m with 1m inter and intra- row spacing. The treatments included eight sweetpotato genotypes and combination of Fertilizer treatment NPK 15:15:15 and Poultry manure. Observations were made on the following characters: number of Salable root, Length of salable root, width of salable root, fresh salable root, Dry matter content, vine length at 4 week after planting, number of Leaves at 4 week after planting, vine length at 4week after planting, and Vine diameter at 4 weeks after planting. Data collected were analyzed using analysis of variance and means were separated using Standard Error of difference. Correlation and path analysis were used to select and determine characters that contributed significantly to root yield of sweetpoitato. The result of correlation and Path analysis revealed that number of salable roots, width of salable roots, number of lateral branches at 4 weeks after planting (WAP), vine length at 4WAP, number of leaves at 4WAP and dry matter content were characters that exhibited high direct effects on root yield per plant. Improving these characters through soil amendment at the recommended levels of nutrients would give better response of these characters to root yield improvement in sweetpotato.

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INTRODUCTION

Sweetpotato (*Ipomoea batatas* L.), is one of the most important and popular root crop in the world. It belongs to the family *Convolvulaceae* (Degrass, 2000), with chromosome number (2n = 6n =90) and is normally propagated asexually through vine cutting and sexually through seeds. Many developing countries like Nigeria benefited from food security in sweetpotato now and can substantially reduce malnutrition through orange fleshed sweetpotato with high vitamin A content. Sweetpotato can help famers generate income which eventually alleviate poverty. Sweetpotato is one of the most important roots in terms of acreage, production, yield, commercial use and consumption. At present 204.7 million hectares of land area is under sweetpotato cultivation (Agbo *et al*., 2013). It is cultivated all over the country due its adaptability to wide range of marginal soil (Afuape, 2014). It is the most cultivated root and tuber crop after cassava and yam. Sweetpotato are use directly as raw fresh vegetable in salads (Ekeledo *et al.,* 2010). The Orange fleshed sweetpotato drinks contain vitamin A to fight its deficiency (Omodamiro *et al.,* 2010). Seventy processed items like cake, doughnuts, and vegetable dishes etc are prepared on a large scale and enjoy high acceptance as food ingredients (Amajor *et al.,* 2010). High yield with good quality is the most important objective in sweetpotato breeding. Root yield is a complex character associated with many interrelated components. The degree of association between characters as indicated by the correlation coefficients has always been a helpful instrument for the selection of desirable characters under a breeding program. Likes other crops, yield of sweetpotato is the final product attributed by a complex chain of interrelating effects of different characters (Singh *et al*., 1989; Islam and Kham, 1991). Generally a path coefficient analysis is needed to

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clarify relationships between characteristics, because correlation coefficients describe relationships in a simple manner. Path coefficient analysis shows the extent of direct and indirect effects of the causal components on the response component. In most studies involving path analysis, researchers considered the predicator characters as first-order variables to analyze their effects over a dependent or response variable such as yield (Gopal, *et al*., 1994, Bhagowati, *et al*., 2003, Tuncturk *et al*., 2005). This approach might result in multi callinearity for variables, particularly when correlations among some of the characters are high (Samonte, *et al.,* 1998). Selection for storage root yield, which is a polygenic trait, often leads to changes in other characters. Therefore, knowledge of the relationships that exist between storage root yield among and other characters is necessary to be able to design appropriate selection criteria in sweetpotato breeding program. According to Grafuis (1959), increasing total yield would be made easier by selecting for components because the components are more simply inherited than to total yield itself. Thus, studies on correlation enable the breeder to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic environment. In study by Hossain *et al.* (2000), average root weight and number of root per plant had maximum positive direct effect on sweetpotato root yield. The aim of this study is to evaluate the interrelationship of tuber yield components by path analysis and soil nutrient formulation to enhance their performance.

MATERIALS AND METHODS

The experiment was conducted at the experimental field of sweetpotato programme of National Root Crops Research Institute (NRCRI), Umudike during 2013 and 2014 growing season under rainfed condition. According to meteorological statistics NRCRI station (2013 -2014) annual rainfall of about 2177 mm and annual average temperature of about 26^0C. The relative humidity varies from 51% to 87%. The sunshine hours vary from 2.69 to 7.86 hours per day. The dominant soil is acid sandy loam in the ultisol group (EDALR, 1985). To determine the physical and chemical characteristics of the soil, it was sample from the depths of 0-30 and 30-60cm before land preparation for planting (Table 1). The experiment consisted of 8 sweetpotato genotypes. These materials were collected from the Sweetpotato breeding programme of NRCRI Umudike. The 8 genotypes were sown in a randomized complete block design with 3 replications. The plot size was 3m × 2m with the spacing of 1.0m between the rows and 0.3m between plants in the same row. The treatments included eight sweetpotato genotypes and ten levels of single and combination of Fertilizer and Poultry manure. single application of 100kg, 200kg, 300kg fertilizer and 5t/ha, 10t/ha,15t/ha while combination application of 2.5t/ha PM and 50kgNPK, 5t/ha PM and 1000kgNPK and 7.5t/ha PM and 150kgNPK fertilizer 15:15:15 plus poultry manure. Observation was made from ten randomly selected plants and data were taken on number of Salable root, Length of salable root, width of salable root, fresh salable root, Dry matter content, vine length at 4 week after planting, number of Leaves at 4 week after planting, vine length at 4week after planting, and Vine diameter at 4 weeks after planting. Data collected were analyzed using analysis of variance to determine the significant differences and means were separated using Standard Error of difference. Correlation and path analysis were used to select and determine characters that contributed significantly to root yield of sweetpotato (Dewey and Lu, 1959).

RESULT AND DISCUSSION

Different levels of Fertilizer, Poultry manure and a combination of poultry manure and fertilizer was applied to the sweetpotato genotypes to provide conducive environments to express themselves in terms of root yield and yield components. The result of the Mean performance of the plant characters at different levels of Poultry manure and inorganic fertilizer in the two years combined are presented in Table 1. The result on Table 1 shows that the mean performance of the root yield and yield component traits for the two years combined indicated that 10t/ha of poultry manure gave the highest mean performance of 28.5 across all the traits performances. This was followed by the application of 30t/ha of poultry manure which gave 27.1 mean performance while application of 0t/ha of poultry manure gave mean performance of 21.71 across the traits. The result indicated that as the levels of both poultry manure and inorganic fertilizer NPK 15:15:15 increases, the performances of the traits declined showing that sweetpotato genotypes do not require heavy application of both poultry manure and inorganic fertilizer. The application of these nutrients enhance the general performance of the traits to a level, however, as the levels of poultry manure and inorganic fertilizer increased, this increased the above ground luxurious performance of the sweetpotato genotypes, this affected the fresh root performance of the sweetpotato crop. This confirmed the findings of Agbo, *et al*. (2013) that sweetpotato grows luxuriantly in soils with very high fertility to the expense of root yield.

Character association: Correlation coefficients among the various root yield component characters are presented in Table 2. Significant ($P<0.01$) positive correlation existed between root yield and length of saleable roots (r=0.275**), width of saleable roots (r=0.289**), dry matter (r=0.123**), vine length (r=0.111), number of leaves (r=0.249**), number of lateral branches at 4WAP (r=0.407**) and yield of salable roots. Also, there was significant positive correlation between number of leaves at 4 WAP with number of salable roots (r=0.249**), length of salable roots (r=0.150**), width of salable roots (r=0.232**), dry matter content (r=0.351**), and vine length at 4WAP. The significant positive correlation between these characters is an indication that the applied levels of poultry manure and inorganic fertilizer enhanced the performance of the sweetpotato roots and root related component so that the crop expressed themselves through its yield component traits.

However, the negative significant ($P< 0.001$) correlation between number of saleable roots and root weight (r= -0.137**) and between number of leaves and root weight (r= -0.321**) indicated that small number of unsalable roots increases as a result of increased addition of various levels of fertilizer and poultry manure which make the crops much vegetative.

Table 1. Mean performance of the plant characters at different levels of Poultry manure and inorganic fertilizer in the two years combined

Genotypes	Vine Length 4WAP		Leaves Number 4WAP		Branch Number 4WAP		Vine Diameter 4WAP		Length Salable Root		Width salable Root		Dry Matter		Number of salable root		Root yield Kg/Ha		MMEAN	MEAN
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
3D	60.27	64.29	44.03	51.61	6.73	6.53	2.47	0.49	25.36	20.09	21.60	15.86	40.40	40.10	12.27	11.17	2.74	1.68	25.1	24.1
Centinnal	36.12	42.02	25.96	43.72	2.43	5.93	2.42	0.68	23.09	20.71	14.78	13.74	41.78	41.55	21.33	34.17	2.23	3.16	18.9	22.9
Ex-Igbariam	64.18	59.39	46.37	50.47	5.46	5.63	2.25	0.58	23.25	21.53	20.47	20.66	43.45	43.54	17.03	17.77	3.24	2.60	25.8	25.8
Ex-0nyunga	32.22	76.94	29.93	36.66	4.5	3.67	0.83	0.32	16.85	13.34	11.69	10.81	36.23	35.13	10.93	7.23	0.55	0.31	16.0	20.5
TIS8164	44.36	53.84	37.89	41.11	5.20	5.53	2.72	0.72	26.13	23.06	29.39	23.13	43.89	43.85	21.20	27.40	6.42	5.82	24.1	25.0
TIS870087	71.82	97.89	42.10	65.70	5.90	6.73	2.25	0.49	26.51	24.75	29.25	24.53	44.92	43.33	20.60	24.63	7.67	5.97	27.9	32.9
UMUSPO/3	28.22	64.48	23.93	35.47	3.17	7.33	0.70	0.34	18.37	21.26	17.73	20.84	24.25	24.57	12.77	26.93	1.21	3.87	14.5	22.8
UMUSPO/1	36.01	47.29	31.58	57.91	7.17	10.70	2.48	0.71	24.86	23.71	22.28	24.90	39.87	39.12	25.93	43.03	7.10	10.86	21.98	28.7
MEAN	46.65	63.64	35.22	47.83	5.1	6.51	2.01	0.5	23.1	18.8	21.2	19.3	39.7	39.8	18.0	28.47	4.0	4.4		
Significance	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**		
LSD	14.12	28.53	9.62	6.64	2.59	2.83	0.723	.163	3.97	7.09	3.71	5.40	0.53	1.67	6.88	8.38	2.20	1.93		

Table 2. Correlation matrix between yield t/ha and other yield components characters of the sweetpotao genotypes in two seasons combined

	NoSal	LenSal	WidSal	Mois con	Drymat	Vinlt4wk	Leavs 4wk	Dimet 4wk	Bran4wk	YldSal
NoSal	1	0.275**	0.289**	-0.137**	0.123**	0.111*	0.249**	-0.05	0.407**	0.733**
LenSal	1	0.530**	-0.222**	0.224**	0.268**	0.150**	0.265**	0.279**	0.394**	
WidSal	1	-0.199**	0.242	0.363**	0.232**	0.277**	0.285**	0.571**		
Mois con	1	-0.837**	-0.221**	-0.321**	-0.279**	-0.105*	-0.241**			
Drymat	1	0.294**	0.351**	0.296**	0.090**	0.264**				
Vinlt4wk	1	0.667**	-0.06	0.234**	0.228**					
Leavs4wk	1	-0.162**	0.369**	0.311**						
Dimet r4wk	1	-0.072	0.0174**							
Bran4wk	1	0.475**								
YldSal	1									

NoSal= Number Salable root, LenSal= Length salable root, widsal=width salable root, Moisal = Moisture salable root, Drymat= Dry matter content, VinLt4wk= vine length at 4 week after planting, Leavs4wk= Leaves vine number at 4week after planting, VinCir4wk=Vine circumference at 4 weeks after planting, YldSalplt= Yield Salable per hector

Table 3. Path analysis of direct (bold) and indirect effects of characters on yield per plant in 8sweetpotato genotypes

	NoSal	LenSal	WidSal	MoisSal	Drymat	VinLt4wk	Leavs4wk	VinCir4wk	Bran4wk	YldSalplt
NoSal	0.574	-0.00556	0.094352	-0.00366	0.009891	-0.00429	0.017041	-0.006	0.058106	0.734**
LenSal	0.157806	-0.020	0.172895	-0.00591	0.017933	-0.0104	0.010277	0.031934	0.039832	0.442**
WidSal	0.165838	-0.01071	0.339	-0.00531	0.01936	-0.01408	0.015903	0.033454	0.040689	0.610**
Mois con	-0.07858	0.004479	-0.06497	0.039	-0.06702	0.08583	-0.02197	-0.03365	-0.01499	-0.241
Drymat	0.070746	-0.00452	0.078785	0.02231	0.080	-0.0114	0.024066	0.035704	0.012849	0.340
VinLt4wk	0.06336	-0.00542	0.118355	-0.0059	0.023546	-0.057	0.045678	-0.01957	0.034692	0.233
Leavs4wk	0.142518	-0.00303	0.075669	-0.00855	0.028138	-0.02585	0.0759	-0.01957	0.052681	0.310*
VinCir4wk	-0.02847	-0.00134	0.090383	-0.00744	0.023703	0.002327	-0.01111	0.121	-0.01028	0.244
Bran4wk	0.23298	-0.00563	0.092972	-0.0028	0.007216	-0.00942	0.025242	-0.00872	0.145	0.546**
Residual										0.414

NoSal= Number Salable root, LenSal= Length salable root, widsal=width salable root, Moisal = Moisture salable root, Drymat= Dry matter content, VinLt4wk= vine length at 4 week after planting, Leavs4wk= Leaves vine number at 4week after planting, VinCir4wk=Vine circumference at 4 weeks after planting, Bran4wk= Branched at 4 week after planting, YldSalplt= Yield Salable plo

This led to weight reduction of the roots. Also, the negative significant (P< 0.001) correlation between number of roots at 4WAP and root weight indicated that large foliage as a result of poultry manure application and increases in fertilizer levels, increased the luxurious performance of the sweetpotato genotypes and this affected the fresh root weight of the sweetpotato crop. This suggested that root yield per plant would increase with improving these characters at the suggested level of soil nutrient amendment. Apart from information on the association between storage root yield and other agronomic characters, an understanding of the interrelationships among various characters is necessary for the intelligent choice of breeding procedures which would make possible selection for traits that could yield highly in low nutrients/marginal soil and simultaneous improvement of such desirable traits will improve the performance of the sweetpotato crop.

Path coefficient Analysis: The estimates of direct and indirect effects of yield contributing characters on root yield per plant using path coefficient analysis are presented in Table 3.

The result indicated that significant highest positive direct effect of root yield was exhibited by number of saleable roots, followed by width of salable root, lateral branches at 4WAP, vine length at 4WAP, number of leaves at 4WAP, dry matter content and tuber weight. The direct effects of these characters on root yield were as a result of the causes of strong correlation. In any improved environment such as application of the right quantity of soil nutrients, the characters will significantly improve the root yield of sweetpotato. The characters: length of salable root and vine length at 4WAP had negative direct effect on root yield which suggests that these characters cannot be improved more than their genetic potential in any improved soil conditions.

High negative indirect effect of fresh root weight per plant through number of salable roots, width of salable roots, dry matter content, number of leaves at 4WAP, vine circumference at 4WAP and lateral branches at 4WAP reduced the corerlation of the characters with fresh root weight to be negative, resulting to a very poor correlation of the characters to total yield. However, the high positive and negative indirect effect of width of salable roots and lateral branches at 4WAP with other plant characters caused high correlation of the characters with root yield. Negative correlation between yield components in crop plants create obstacles to yield improvement through soil amendment. The study of the relationship between root yield and yield contributing characters in sweetpotato through path analysis suggested that number of salable roots, width of salable roots, number of lateral branches at 4WAP, vine length at 4WAP, number of leaves at 4WAP and dry matter content were characters that exhibited high direct effects on root yield per plant. Improving these characters through soil amendment with the selected levels of nutrients would give better response of these characters to root yield improvement in sweetpotato.

Conclusion

The result of this work indicated that 10t/ha of poultry manure gave the highest mean performance of 28.5 across all the traits performances and the relationship between root yield and yield contributing characters in sweetpotato through path analysis suggested that number of salable roots, width of salable roots, number of lateral branches at 8WAP, vine length at 8WAP, number of leaves at 8WAP and dry matter content were characters that exhibited high direct effects on root yield per plant. However, these characters could be improved to contribute to root yield by the application of 10t/ha of Poultry manure.

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