CORRELATION AND PATH COEFFICIENT ANALYSIS OF YIELD CHARACTERS OF SWEET POTATO (*Ipomoea batatas* L.) VARIETIES AS INFLUENCED BY MINERO-ORGANIC FERTILIZER

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ABSTRACT
A field experiment was conducted during the wet seasons of 2019 and 2020 at the Research farm of the Faculty of Agriculture, Kaduna State University (09°34'N and 08° 18' E, 740 m above sea level) in the southern Guinea savannah Nigeria, to determine the contributions of some crop characters to tuber yield of two sweet potato varieties as influenced by minero-organic fertilizer (MOF). The treatments consisted of three levels of minero-organic fertilizer (0, 500 and 1000 kg ha^{-1}), and two sweet potato varieties. The treatments were laid out in a randomized complete block design and replicated three times. The correlations between number of tubers per plot (0.7740**) and tuber weight per plot (0.7804**) with total tuber yield were positive and highly significant. The direct effect on tuber yield based on the combined data was by number of tubers per plot (0.8023), which also made the highest direct percent contribution to tuber yield (18.79%). Shoot dry weight made the least indirect effect to tuber yield (-0.0507). The greatest positive combined contribution of 17.29% was made by number of tubers per plant via number of tubers per plot. The study revealed that number of tubers per plot should be explored by researchers during improvement programme of sweet potato.

Keywords: Correlation, Minero-organic fertilizer, crop characters and yield.

INTRODUCTION

Sweet potato (*Ipomoea batatas*) L. Lam) is a widely grown and an important staple food crop in most parts of tropical and subtropical regions of the world (Laban *et al.*, 2015) and ranked 7th among the world's major food crops (Anonymous, 2018). Of the approximately 50 genera and more than 1,000 species in the family *Convolvoluceae*, only *Ipomoea batatas* is of economic importance as food (Edmond and Ammerman, 1971). World production figures stood at 91.9 million tonnes in 2018, with China and Nigeria supplying about 94.5 and 3 % respectively (Anonymous, 2019).

In Nigeria, sweet potato is the third most important root and tuber crops, after cassava and yam (FAOSTAT, 2018). The Federal Government of Nigeria released a plan in 2015 to improve the productivity of sweet potato in the country from 6 tonnes per hectare to 25 tonnes per hectare, and national production from two to six million tonnes per annum by 2016. There's great opportunity for sweet potato export in Nigeria (Ajetomobi, 2015).

Yield characters of crops have been found to be associated with the final yield of the crops. For instance, in tuber crops such as potato, Babaji, (2004) found that tuber yield per hill, tuber fresh weight and number of tubers per plant had great influence on the final yield of the crop. Similarly, in legumes such as Soybean, the main contributing components to yield were 100-seed weight and number of pods per plant (James *et al.*, 1999; Amodu, 2004). Also, Emmanuel *et al.*, (2013) reported that capsules per plant, seeds per capsule and 100 – seed weight contributed more to seed yield in Sesame. In view of the above therefore, the objective of the study was to assess the magnitude and nature of relationship between some crop quantitative character and tuber yield for sweet potato improvement.

MATERIALS AND METHODS

A field experiment was conducted during the wet seasons of 2019 and 2020 at the Research farm of the Faculty of Agriculture, Kaduna State University, Kafanchan Campus (09°34'N and 08° 18' E, 740 m above sea level) in the southern Guinea savannah Nigeria, to determine the inter-relationship between tuber yield in sweet potato and its various yield parameters. The treatments consisted of three neem based minero-organic compound fertilizer (7:7:7) (0, 500 and 1000 kg ha^{-1}), and two orange flesh sweet potato varieties (UMUSPO 1 and UMUSPO 11). The gross plot size was 16.0 m^2. Each plot was separated by a border of 1 m across and 1 ridge along the ridges. The varieties used were UMUSPO 1 and UMUSPO 11, developed by the National Root Crops Research Institute (NRCRI) Umudike. Fertilizer application was as per treatments. Crop maturity was decided by yellowing of leaves, die back of vines and cracking of soil. The net plots of each plot were harvested by lifting root tubers with the aid of a hand hoe at the base of the plant. All yield characters like number of tubers per plant, tuber weight per plant, number of tubers per plot and tuber weight per plot were determined from samples obtained from net plot yields. Simple Correlation coefficients involving some growth and yield parameters was analysed to determine the relationship between them and the final tuber yield as described by Little and Hills (1978).

RESULTS

Correlation Analysis
Correlation coefficients among some crop growth and yield parameters of sweet potato are presented in Table 1. The correlations between number of tubers per plot (0.7804**) and tuber weight per plot (0.7740**) with total tuber yield were strong and positive, while correlations between LAI (0.0969), shoot dry weight (0.0869), number of tubers per plant (0.2911 *) and tuber weight per plant (0.0884) with total tuber yield, were positive but weak. However, there were positive but moderate correlations between LAI and shoot dry weight (0.3569*), number of tubers per plant (0.4118**) and tuber weight per plot (0.3141*). while with

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tuber weight per plant (0.1830*), and number of tubers per plot (0.1666*) were weak The relationships between shoot dry weight and number of tubers per plant was moderate (0.3644*) and per plot (0.0483) and tuber weight per plot (0.0730) were positive but weak. However, shoot dry weight correlated negatively and significantly with tuber weight per plant (-0.0265**). The relationships between number of tubers per plant and tuber weight per plant (0.0376), number of tubers per plot (0.0228) and tuber weight per plot (0.0667) were positive but weak. Tuber weight per plant correlated positively with number of tubers per plot (0.1336*) and tuber weight per plot (0.2452*). There was positive but weak relationship between number of tubers per plot with tuber weight per plot (0.0457). The strongest correlation was between number of tubers per plot with total tuber yield (0.7804**)

Path Analysis, Direct and Indirect Effects on Yield
Result of direct and indirect effects of some growth and yield characters to tuber yield is presented in Table 2, while Table 3 gives per cent contributions of these characters to tuber yield of sweet potato in 2019, 2020 and the combined. In 2019, the direct and indirect contributions from all the growth and yield components was positive except shoot dry weight,

Table 1: Correlation between some crop growth and yield characters against total tuber yield (kg ha^{-1}) of sweet potato at Kafanchan in 2019 and 2020 combined

	V1	V2	V3	V4	V5	V6	V7
V1	1						
V2	0.0969	1					
V3	0.0869	0.3569*	1				
V4	0.2911 *	0.4118**	0.3644*	1			
V5	0.0884	0.1830*	-0.0265**	0.0376	1		
V6	0.7804**	0.1666*	0.0483	0.0228	0.1336*	1	
V7	0.7740**	0.3141*	0.0730	0.0667	0.2452*	0.0457	1

Key:
V1----yield t/ha
V2---LAI
V3---Shoot dry weight
V4---Number of tubers/plant
V5---Tuber weight/plant
V6---Number of tubers/plot
V7---Tuber weight/plot
*---Significant at 5% level of probability (r =) ** Significant at 1% level of probability (r =)

Table 2: Direct and indirect effects of growth and yield components to tuber yield (kg ha^{-1}) of sweet potato in 2019 and 2020 at Kafanchan

	LAI	Shoot dry weight	No of tubers/plant	Tuber weight/plant	No of tubers/plot	Tuber weight /plot	Total
			2019				
LAI	**1.1358**	-0.0497	0.5788	0.176	0.6386	0.1538	2.6333
Shoot dry weight	1.1033	**-0.0749**	0.6271	0.1854	0.6622	0.1653	2.6684
No tubers /plant	1.038	-0.0239	**0.7268**	0.2139	0.6978	0.1969	2.8495
Tuber weight/plant	1.0674	-0.0296	0.6835	**0.2411**	0.7385	0.2195	2.9204
No of tubers/plot	1.0725	-0.0329	0.6654	0.2173	**0.8036**	0.2345	2.9604
Tuber weight/plot	1.0397	-0.0081	0.6363	0.2023	0.7303	**0.2679**	2.8684
			2020				
LAI	**1.1375**	-0.0517	0.5778	0.18	0.6375	0.1533	2.6344
Shoot dry weight	1.1048	**-0.0771**	0.6257	0.1898	0.6605	0.1647	2.6684
No tubers /plant	1.0387	-0.0254	**0.7241**	0.2197	0.6963	0.196	2.8494
Tuber weight/plant	1.0684	-0.0311	0.6816	**0.248**	0.7364	0.2182	2.9215
No of tubers/plot	1.0737	-0.0345	0.6636	0.2231	**0.8011**	0.2333	2.9603
Tuber weight/plot	1.0405	-0.0079	0.6348	0.2075	0.7287	**0.2662**	2.8698
			COMBINED				
LAI	**1.1366**	-0.0507	0.5783	0.178	0.63805	0.1535	2.63385
Shoot dry weight	1.1041	**-0.0761**	0.6264	0.1876	0.66135	0.1651	2.6684
No tubers /plant	1.0384	-0.0246	**0.7254**	0.2168	0.69705	0.1964	2.84945
Tuber weight/plant	1.0705	-0.0303	0.6826	**0.2445**	0.73745	0.2188	2.9236
No of tubers/plot	1.0731	-0.0337	0.6641	0.2202	**0.8023**	0.2339	2.96035
Tuber weight/plot	1.0565	-0.008	0.6355	0.2049	0.7295	**0.2670**	2.8855

Bold figures = Direct effect

the direct and indirect contributions from it and through it was negative and thereby made the least contribution to final tuber yield (Table 2). Number of tubers per plot made the greatest direct effect on the tuber yield of sweet potato (0.8036). The weakest indirect effect was via tuber weight per plot (-0.0081). All the growth characters had their greatest effect on tuber yield through number of tubers per plot in the combined which invariably gave the greatest per cent contribution to tuber yield (17.06%) (Table3). This was followed by number of tubers per plant (10.64%) and the least was tuber weight per plot (2.45%). The greatest positive combined contribution of 17.29% was made by number of tubers per plant via number of tubers per plot, followed by LAI via tuber weight per plot (13.44%). In 2020, a similar trend was observed, for instance, direct and indirect contributions from all the growth and yield components were positive even with the combined, except shoot dry weight. The combined result in Table 2 also indicated that number of tubers per plot made the greatest direct effect on the tuber yield of sweet potato (0.8023). The weakest indirect effect was via tuber weight per plot (-0.008). The greatest per cent contribution to tuber yield based on the combined data as presented in Table 3 is from number of tubers per plot (17.29%), while the least is by tuber weight per plot (2.37%).

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Table 3: Percent contributions of some growth and yield characters of sweet potato to tuber yield (kg ha-1) in the combined (2019 – 2020) rainy seasons at Kafanchan.

Direct contribution	2019	2020	% Contribution
Individual			
LAI	4.36	3.72	4.04
Shoot dry weight	3.71	4.8	4.25
No tubers /plant	4.87	4.61	4.74
Tuber weight/plant	10.64	4.22	7.43
No of tubers/plot	17.06	20.52	18.79
Tuber weight/plot	2.45	2.29	2.37
Combined			
LAI+dry wt	-4.7	-4.88	-4.79
LAI+t/plant	2.96	3.1	3.03
LAI+t/wt/plant	1.65	1.72	1.68
LAI+t/plot	7.31	5.27	6.29
LAI+t/wt/plot	12.52	14.36	13.44
dry wt+t/plant	-5.13	-5.25	-5.19
dry wt +t/wt/plant	-3.91	-4.15	-4.03
dry wt + t/plot	-8.64	-8.81	-8.73
dry wt+ t/wt/plot	-3.7	-3.81	-3.75
t/plant + t/wt/plat	5.08	8.13	6.60
t/plant + t/plot	16.14	18.44	17.29
t/plant + t/wt/plot	4.24	3.07	3.65
t/wt/plant + t/plot	10.02	13.61	11.81
t/wt/plant + t/wt/plot	3.25	4.8	4.01
t/plot + t/wt/plot	12.5	9.13	10.79
Residual	7.36	8.21	7.78
Total	100.0	100.1	100.02

DISCUSSION

The positive association between tuber yield in tones ha⁻¹ with some growth and yield characters such like shoot dry weight, LAI, number of tubers per plant, number of tubers per plot and tuber weight per plant implies that, increase in these characters led to more dry matter production and yield of sweet potato. The strong and positive correlation between, number of tubers per plot (r = 0.7740**) and tuber weight per plot (r = 0.7804**) with tuber yield per hectare is an indication that these yield parameters are important and have great influence on the final tuber yield of sweet potato. The negative correlation between shoot dry weight and tuber weight per plant implies inverse relationship. The strongest correlation was between tuber weight per plot and total yield. The non-significant relationships between LAI (0.0969), shoot dry weight (0.0869) and tuber weight per plant (0.0884) with total tuber yield ha⁻¹ could have been as a result of unfavourable influence through tuber weight per plot. This assertion can only be established through the path coefficient analysis. The strong relationship between number of tubers per plot and tuber weight per plot with total tuber yield ha⁻¹ of sweet potato and some of these yield characters is expected because these parameters directly determine the extent of photosynthates partitioned for tuber yield. This finding conforms to that of Babaji, (2004) who reported positive and significant correlations between yield characters and total marketable tuber yield.

Path Coefficient

This study revealed through the combined data in Table 2 that all yield characters had direct and positive contributions to total marketable yield of sweet potato except shoot dry weight which was negative. Number of tubers per plot made the highest individual, direct percent contribution to tuber yield (18.79%) while the least contribution was from tuber weight per plot (2.37). For this yield characters to have contributed to tuber yield in this manner would have meant that they might have acted as sink regions where most of the assimilates produced translocate to. In this case, sweet potato yield depended mostly on the yield characters. This finding support earlier reports by some researchers like Ibrahim and Khidir (2012), Azeez and Morakinyo, 2011) and Aliyu *et al.*, (1994) who observed that yield characters among other variables had the highest direct influence on yield.

Acknowledgements

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