EFFECT OF FERTILIZER COMBINATIONS ON THE GROWTH OF TWO ORANGE-FLESHED SWEETPOTATO (*IPOMOEA BATATAS* (L) LAM) VARIETIES IN A HUMID ENVIRONMENT OF SOUTHEASTERN NIGERIA

***Akpaninyang, F.E[1], Okpara, D.A[1], Njoku, J.C[2], and Ogbologwung, L.P[1].**
[1] College of Crop and Soil Sciences
Michael Okpara University of Agriculture, Umudike
Umudike, Abia State, Nigeria
[2] National Root Crops Research Institute
Umudike, Abia State, Nigeria
*Contact E-mail: fidelekan@gmail.com

Abstract
Field experiment was carried out in the 2013 cropping season in the rainforest of southeastern Nigeria to determine the effect of fertilizer combinations on the growth of two orange-fleshed sweetpotato varieties. Treatments consisted of nine fertilizer combinations (0-control, 5.3kg/ha of Agrolyser, 400kg/ha of NPK, 5t/ha of poultry manure, 10t/ha of poultry manure, 200kg/ha NPK + 2.7kg/ha Agrolyser, 2.5t/ha poultry manure + 200kg/ha NPK, 5t/ha poultry manure + 200kg/ha NPK, and 2.5t/ha poultry manure + 200kg/ha NPK + 2.7kg/ha Agrolyser) and two orange-fleshed sweetpotato varieties (UmuSpo 1 and UmuSpo 3) laid out as split plot in randomized complete block design. The result showed that more branches were produced from 2.5t/ha poultry manure + 200kg NPK than from 5.4kg/ha Agrolyser or no fertilizer application at all sampling dates. Similarly, application of 2.5t/ha poultry manure + 200kg NPK produced significantly higher fresh shoot weight than 400kg/ha NPK or 5.4kg/ha Agrolyser or no fertilizer application. At 8WAP, application of 2.5t/ha poultry manure + 200kg NPK gave higher fresh storage root weight than application of Agrolyser at 5.4kg/ha. However, at 12WAP, application of 10t/ha poultry manure gave higher root weight than other treatments except 5t/ha poultry manure. UmuSpo 1 variety gave higher number of branches, leaf area index, fresh shoot weight, and fresh root weight than UmuSpo 3.

Introduction

Sweetpotato (*Ipomoea batatas* (L) Lam) is a crop that had suffered neglect in the past, but is now assuming increasing importance as a source of food in Nigeria. It is a starchy root crop containing vitamins particularly vitamin A (Anderson *et al.,* 2007) and minerals comparable to those of various fruits (Truong, 1987) while its edible leaves contain about 34.5% crude protein (Nwinyi, 1988) and could be fed to animal as forage.

Generally, nutrient deficiency has been shown to account for low yields in the production of sweetpotato (Njoku *et al.,* 2001; Okpara *et al.,* 2011). Although yields are still low, it has been shown that there is tremendous potential for increasing yield by the introduction of new and improved varieties, as well as adequate nutrition (Nedunchezhiyan *et al.,* 2003). For farmers to benefit and realize higher yields from the newly released orange-fleshed sweetpotato varieties by the National Root Crops Research Institute in Nigeria, there is need to explore the effect of fertilizer combinations involving organic and inorganic sources on the crop.

This paper evaluated the effect of nutrient management strategies involving the use of various combinations of poultry manure, NPK, and Agrolyser on the growth of two orange fleshed sweetpotato varieties.

Materials and Methods

The experiment was conducted at the National Root Crops Research Institute, Umudike, in South-Eastern Nigeria in the early planting season of 2013. The location is situated at latitude $05^0 29^{'}$N and longitude $07^0 33^{'}$E and at an elevation of 122m above sea level. The soil is sandy loam classified as an ultisol (Eke-Okoro, 2001). The soil had the following properties: sand 78.8%, silt 6.8%, clay 14.4%, pH 4.7, organic matter 1.59%, N 0.08%, P 32.1mg/kg and K 0.35 Cmol/kg. Poultry manure analyses showed the following: pH 7.06, N 2.17%, P 1.06% and K 0.62%. The poultry manure rates were applied into appropriate plots after ridging while the NPK (15:15:15) compound fertilizer and Agrolyser rates were applied at 4WAP. The Agrolyser contained the following secondary and micronutrients: Ca 20.14%, Na 1.04%, Zn 0.11%, Mg 0.19%, Cu 0.19%, and S 2.12%. Each sub-plot measured 3m x 2m ($6m^2$).

Two orange-fleshed sweetpotato varieties (UmuSpo 1 and UmuSpo 3) and nine fertilizer combinations (0-control, 5.3kg/ha of Agrolyser, 400kg/ha of NPK, 5t/ha of poultry manure, 10t/ha of poultry manure, 200kg/ha NPK + 2.7kg/ha Agrolyser, 2.5t/ha poultry manure + 200kg/ha NPK, 5t/ha poultry manure + 200kg/ha NPK, and 2.5t/ha poultry manure + 200kg/ha NPK + 2.7kg/ha Agrolyser) were arranged as split plot in a randomized complete block design (RCBD) with three

replications. The main plot treatments were the two orange fleshed sweetpotato varieties and the sub plot treatments were the nine fertilizer combinations.

Sweetpotato vine cuttings of 20cm length were planted 30cm apart along the crest of ridges on 23rd June, 2013. The plants were spaced at 1m x 0.3m to maintain a plant population of 33,333 plants/ha. Supply of vacant stand was done at 4WAP. Agronomic data on number of branches/plant, leaf area index, fresh shoot weight(g/plant), and fresh root weight(g/plant) were collected at 8, 10, and 12 WAP and subjected to analysis of variance using GenStat (2007) statistical package.

Results

The number of branches of the orange-fleshed sweetpotato was significantly influenced by fertilizer combination and variety at all sampling dates (Table 1). Application of poultry manure, NPK or a combination of both gave significantly higher number of branches than application of Agrolyser or zero application at all sampling dates. UmuSpo 1 gave more branches than UmuSpo 3. In general, number of branches increased with plant age up to 10 WAP, and tended to stabilize at 12 WAP.

Leaf area index (LAI) at 8WAP was higher with the application of 2.5t/ha poultry manure + 200kg NPK than with application of 5.4kg/ha Agrolyser or no fertilizer application (Table 2). At 10 WAP, however, application of 5t/ha poultry manure + 200kg NPK produced higher leaf area index than no fertilizer application or application of 400kg/ha NPK or 5.4 kg/ha Agrolyser or combining Agrolyser with manure and NPK. Irrespective of rate, application of poultry manure alone or in combination with NPK gave statistically similar LAI values. The variety UmuSpo 1 gave significantly higher LAI than UmuSpo 3 at 8 and 10 WAP.

Application of 2.5t/ha poultry manure + 200kg/ha NPK produced significantly higher fresh shoot weight than application of 400kg/ha NPK or 5.4kg/ha Agrolyser or no application (Table 3). Irrespective of rate, application of poultry manure alone or in combination of NPK fertilizer gave statistically similar rate of above ground biomass accumulation, especially at 10 and 12 WAP. UmuSpo 1 gave significantly higher fresh shoot weight than UmuSpo 3 at the various growth stages (Table 4). Shoot fresh weight increased with plant age up to 12 WAP.

At 8WAP, fresh root weight of the orange-fleshed sweetpotato was significantly higher with application of 2.5t/ha poultry manure + 200kg NPK than with application of Agrolyser alone or Agrolyser in combination with poultry manure and NPK (Table 4). However, later in crop growth at 12WAP, application of 10t/ha poultry manure gave significantly higher fresh storage root weight than other treatments except application of 5t/ha poultry manure. UmuSpo 1 consistently and significantly gave higher weight of storage roots than UmuSpo 3. Fresh storage root weight increased with crop age

Discussion

In general, plant size attributes of leaf area index and shoot fresh weight of the orange-fleshed sweetpotato were higher with combined application of 2.5t/ha poultry manure + 200kg NPK or 5t/ha poultry manure + 200kg NPK than with application of 400kg/ha NPK or 5.4kg/ha Agrolyser or no application at most sampling dates. Ndukwe *et al*. (2009) and Page (1966) reported that plants grown in plots receiving organic manure were always larger than those receiving inorganic fertilizer while Costa *et al* (1991) observed that manure increased the soil water holding capacity thereby enhancing sustained release of nutrients. In the present study, combined application of the lower rate of 2.5t/ha poultry manure + 200kg NPK had no disadvantage in improving top growth compared to the application of poultry manure at 5 or 10t/ha. However, at 12WAP, poultry manure application at 10t/ha gave higher fresh storage root weight than other treatments, except 5t/ha poultry manure. This finding agrees with the observation of Atayese *et al.* (2013) for white-fleshed sweetpotato cultivars in south-western Nigeria. The relatively poor performance of NPK fertilizer corroborates the findings of Obi and Ebo (1995), and Ojenniyi (2000) that the use of inorganic fertilizer alone has adverse effects under intensive agriculture as it is associated with reduced crop yield, soil acidity and nutrient imbalance.

The orange-fleshed sweetpotato variety UmuSpo 1 was consistently superior to UmuSpo 3 in crop growth. At final harvest taken at 12WAP, UmuSpo 1 produced more branches, fresh shoot (top) and storage root weights than UmuSpo 3 by 56%, 345% and 240%, respectively, indicating that the former may be more suitable for food and feed (pasture) cultivation in southern Nigeria.

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Table 1: Effect of fertilizer combinations and variety on number of branches/plant at different sampling periods.

	Weeks After Planting		
Fertilizer combinations	**8**	**10**	**12**
0	5.3	6.3	6.3
5.4kg Ag	4.3	5.3	5.3
400kg NPK	7.6	9.5	9.7
200kg NPK + 2.7kg Ag	7.3	10.1	8.9
5t PM	8.2	8.8	8.4
10t PM	8.8	10.3	10.4
5t PM + 200kg NPK	7.5	10.4	10.6
2.5t PM + 200kg NPK	9.2	10.7	9.7
2.5t PM + 200kg NPK + 2.7kg Ag	8.7	9.3	8.3
Mean	7.4	9.0	8.6
$LSD_{(0.05)}$	2.1	2.2	2.2
Variety			
UmuSpo 1	9.6	11.2	10.5
UmuSpo 3	5.3	6.7	6.7
Mean	7.5	9.0	8.6
$LSD_{(0.05)}$	2.8	1.7	1.6

Table 2. Effect of fertilizer combination and variety on Leaf Area Index at different sampling periods in 2013.

	Weeks After Planting		
Fertilizer combinations	**8**	**10**	**12**
0	7.6	10.7	12.0
Ag	7.3	6.4	7.2
400kg NPK	15.1	18.3	19.6
200kg NPK + Ag	17.9	19.0	20.0
5t PM	16.9	21.3	22.0
10t PM	19.0	20.0	22.0
5t PM + 200kg NPK	15.6	28.1	29.0
2.5t PM + 200kg NPK	24.6	24.9	25.0
2.5t PM + 200kg NPK + Ag	15.8	18.2	19.0
Mean	15.5	18.5	19.5
$LSD_{(0.05)}$	9.6	9.17	NS
Variety			
UmuSpo 1	25.9	30.4	32.1
UmuSpo 3	5.2	6.7	7.2
Mean	15.6	18.6	19.7
$LSD_{(0.05)}$	15.0	11.0	NS

NS=Not significant

Table 3: Effect of fertilizer combinations and variety on fresh shoot weight (g)/plant at different sampling periods.

	Weeks After Planting		
Fertilizer combinations	**8**	**10**	**12**
0	80.0	107.2	129.1
5.4kg Ag	58.0	93.3	98.0
400kg NPK	163.0	209.4	219.0
200kg NPK + 2.7kg Ag	204.2	335.4	347.1
5t PM	234.3	360.3	368.0
10t PM	200.0	334.0	358.3
5t PM + 200kg NPK	206.1	385.2	418.2
2.5t PM + 200kg NPK	323.3	429.1	444.4
2.5t PM + 200kg NPK + 2.7kg Ag	175.0	342.0	363.0
Mean	182.6	288.2	304.9
$LSD_{(0.05)}$	110.9	145.5	140.0
Variety			
UmuSpo 1	306.0	482.3	498.2
UmuSpo 3	59.0	95.1	112.3
Mean	185.5	288.55	305.0
$LSD_{(0.05)}$	163.5	377.5	398.8

Table 4: Effect of fertilizer combinations and variety on fresh root weight (g)/plant at different sampling periods.

	Weeks After Planting		
Fertilizer combination	**8**	**10**	**12**
0	3.7	5.0	75.0
5.4kg Ag	3.4	3.4	48.0
400kg NPK	6.3	12.7	89.0
200kg NPK + 2.7kg Ag	4.5	8.0	105.3
5t PM	4.5	12.9	165.4
10t PM	4.1	10.6	269.1
5t PM + 200kg NPK	5.8	17.0	143.2
2.5t PM + 200kg NPK	8.9	9.9	148.0
2.5t PM + 200kg NPK + 2.7kg Ag	3.1	11.2	147.1
Mean	4.9	10.1	132.0
$LSD_{(0.05)}$	5.2	NS	105.3
Variety			
UmuSpo 1	8.3	13.0	204.4
UmuSpo 3	1.5	7.2	60.0
Mean	4.9	10.1	132.0
$LSD_{(0.05)}$	3.5	3.0	14.6

NS=Not significant