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Integrated nutrient management for orange-fleshed sweet potato in south eastern Nigeria

F. Akpaninyang[1], D.A. Okpara[1] and J.C.[2]

[1]College of Crop and Soil Sciences, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
[2]National Root Crops Research Institute, Umudike, Abia State, Nigeria
Author for correspondence: daokpara@yahoo.com

Abstract

In the rainforest of south eastern Nigeria, new varieties of orange-fleshed sweet potatoes (*Ipomea batatas* Lam) have been introduced but appropriate soil nutrient management for these cultivars is lacking. The present study evaluated the response of two varieties of orange-fleshed sweet potatoes (Umuspo 1 and Umuspo 3) to different fertilizer combinations (Poultry manure, NPK and agrolyser). The experiment was a split plot laid out in a randomised complete block design with three replications. Results obtained showed that weed dry matter was lower with the control or with application of 2.5t/ha poultry manure + 200kg NPK than with application of poultry manure at 10t/ha. Storage root yields obtained from 400kg/ha NPK(the check) or 2.5t/ha poultry manure + 200kg NPK were comparable but significantly higher than the yields from the control or agrolyser or from 200kg/ha NPK + agrolyser. Umuspo 1 variety gave higher shoot biomass and lower weed density than Umuspo 3. There was no interaction between the fertilizer combinations and variety, suggesting that the orange-fleshed sweet potato varieties responded similarly to nutrient management strategies.

Key words: ***Ipomoea batatas*, nutrient management, storage root yield, south eastern Nigeria**

Introduction

Sweet potato (*Ipomoea batatas* Lam) is a starchy root crop which belongs to convolvulaceae family. A very large number of sweet potato cultivars exist; the number is larger than for yams, cassava or cocoyams (Onwueme and Charles, 1994). Sweet potato has many nutritive values and is particularly rich in Vitamin A (Woolfe, 1992).

Increasing the consumption of orange-fleshed sweet potato which contains more beta carotene than the white or yellow fleshed ones, can help alleviate vitamin A deficiency (Anderson *et al.*, 2007). Vitamin A is very vital to the diet of the rural poor and its deficiency causes night blindness, a serious public health problem in many developing countries (WHO, 1995).

Low soil fertility is a major constraint to sweet potato production in south eastern Nigeria (Njoku *et al.*, 2001; Okpara *et al.*, 2011). Research has shown that application of inorganic fertilizer increases root yield (Njoku *et al.*, 2001) but hampers sweet potato quality (Nedunchezhiyan *et al.*, 2003) and aggravates soil degradation (Adeniyi and Adejobi, 2002). Research reports on sweet potato response to fertilizer in Nigeria has been on the white-

fleshed type while little is known about nutrient management for orange-fleshed sweet potato (Njoku *et al.*, 2001; Okpara *et al.*, 2009; Olaoye *et al.*, 2013). The present paper examined the response of two orange-fleshed sweet potato varieties to nutrient management strategies involving various combinations of poultry manure, NPK and agrolyser.

Materials and methods

The study was conducted during 2013 planting season at the National Root Crops Research Institute research farm at Umudike, south eastern Nigeria. Umudike is situated at latitude 05° 29' N, longitude 07° 33'E and 122m altitude. The soil is a sandy loam ultisol. Soil properties of the site were: sand 78.8%, silt 6.8%, clay 14.4%, pH 4.7, organic matter 1.59%, N0.08%, P 32.1mg/kg and K 0.35 cmol/kg).

The treatments were arranged as split plot in randomised complete block design with three replications. The main plot treatments were two orange-fleshed sweet potato varieties (Umuspo 1 and Umuspo 3). Umuspo 1 is erect with thick vines, lobed leaf, pink root skin and light orange root flesh while Umuspo 3 is a creeper with purplish thin vines, triangular leaf without lobe, orange root skin and orange root flesh. The subplot treatments were nine fertilizer combinations 0 (control), 5.3kg/ha agrolyser (Ag), 400kg/ha NPK, 5t/ha poultry manure (pm), 10t/ha poultry manure, 200kg/ha NPK + 2.7kg agrolyser, 2.5t/ha poultry manure + 200kg NPK, 2.5t/ha poultry manure + 200kg NPK + 2.7kg agrolyser and 5t/ha poultry manure + 200kg NPK).

Chemical analyses showed that the poultry manure had 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 fertilizer (15:15:15) and agrolyser rates were applied 4 weeks after planting (WAP) by band placement.

Each plot (subplot) measured 3m x2m ($6m^2$). The agrolyser contained secondary and micronutrients (Ca 20.14%, Na 1.04%, Zn 0.11%, Mg 0.19%, Cu 0.19%, S 2.12%).

Sweet potato vine cuttings of 20 cm length with at least 4 nodes were planted along the crest of the ridges at a spacing of 1m x 0.3m on 23 June, 2013. This gave a plant population of 33333 plants/ha. Supply of vacant stands was done at 4WAP. Hoe weeding was done at 4WAP.

The weeds were sampled using 1m x1m quadrat and oven dried at 70°C for 72hrs. Crop measurements were on fresh shoot biomass, number of storage roots/plant and storage root yield (t/ha) at 16 WAP.

Data were subjected to analysis of variance using GenStat (2007) statistical package.

Results and discussion

The effect of fertilizer combination and variety on weed density and growth are presented in Table 1. Fertilizer combination had no effect on weed density but Umuspo 1 significantly reduced weed population by 38 percent compared to variety Umuspo 3. Crop canopy closure may have developed much earlier in Umuspo 1 which had higher leaf area index of 30.4 at 10 WAP, resulting in shading that reduced weed population. Ekeleme and Nwofia (2005) made similar observation in which high leaf area index in cowpea reduced weed density.

Weed dry matter was significantly lower with zero application (control) or

Table 1. Effect of fertilizer combination and variety on weed density and growth

Variety	Fertilizer combinations									
	0	5.4 kgAg	400 kg NPK	200 kg NPK 2.7 kg +Ag	5t PM	10t PM	5t PM+ 200 kg NPK	2.5t PM+ 200 kg NPK	2.5t PM+ 200 kgNPK 2.7 +Ag	Mean
	Weed density									
Umuspo 1	26.7	16.7	31.7	16.0	18.7	25.3	21.3	14.7	17.3	20.9
Umuspo 3	27.3	31.7	40.3	22.3	41.0	27.7	37.0	32.0	45.7	33.9
Mean	27.0	24.2	36.0	19.2	29.9	26.5	29.2	23.4	31.5	
	Weed dry matter (g/m^2)									
Umuspo 1	28.6	15.4	24.7	26.3	37.5	42.3	20.5	20.0	25.1	26.7
Umuspo 3	16.8	26.4	27.4	37.1	41.9	44.4	35.6	24.0	53.4	34.1
Mean	22.7	20.9	26.1	31.7	39.7	43.4	28.1	22.0	39.25	

		Weed density	Weed dry matter
LSD (0.05) for fertilizer (F) mean	=	NS	17.8
LSD (0.05) for variety (V) mean	=	14.8	NS
LSD (0.05) for F x V mean	=	NS	NS

with application of 2.5t/ha poultry manure + 200kg NPK than with application of poultry manure at the highest rate of 10t/ha. Okpara *et al.* (2011) reported a similar trend in sweet potato.

In this study, application of 10t/ha poultry manure encouraged greater weed growth due probably to more availability of water and nutrients as reported by Amanullah *et al.* (2010). Sweet potato variety and interactions had no effect on weed dry matter.

At 16 WAP, fresh shoot biomass was significantly influenced by fertilizer combination and variety (Table 2). Application of 10t/ha poultry manure gave higher shoot yield than the control or application of agrolyser or 200kg/ha NPK + agrolyser. Page (1966) had reported that plants grown in plots receiving organic manure were always large than those receiving inorganic fertilizer.

Between the varieties, Umuspo 1gave 316% higher shoot yield than Umuspo 3 although the interactions were not significant.

Data on number of storage roots and storage root yield are presented in Table 3. A combination of 2.5t/ha poultry manure + 200kg NPK + agrolyser had significantly higher number of storage roots than zero application or application of agrolyser or NPK + agrolyser. Variety and fertilizer combination X variety interactions were not significant on number of storage roots harvested per plant.

Average storage root yield obtained from 400kg/ha NPK or from combined application of 2.5t/ha poultry manure + 200kg NPK was 12t/ha and significantly higher than the yield from the control or of agrolyser or from application of 200kg/ha NPK + agrolyser. Olaoye *et al.* (2013) reported improvement in soil physical and

Table 2. Effect of fertilizer combination and variety on fresh shoot biomass (t/ha) of orange flesied sweet potato at 1 6WAP

Variety	Fertilizer combinations									
	0	5.4 kgAg	400 kg NPK	200 kg NPK 2.7 kg +Ag	5t PM	10t PM	5t PM+ 200 kg NPK	2.5t PM+ 200 kg NPK	2.5t PM+ 200 kgNPK 2.7 +Ag	Mean
	Fertilizer combination									
Umuspo 1	7.10	5.07	10.70	9.31	13.21	11.77	13.17	15.37	13.19	10.99
Umuspo 3	1.01	0.95	1.74	0.97	4.02	7.58	1.64	3.53	2.35	2.64
Mean	4.10	3.01	6.22	5.14	8.62	9.68	7.41	9.45	7.77	
LSD (0.05) for fertilizer (F) mean				=			4.2			
LSD (0.05) for variety (V) mean				=			3.4			
LSD (0.05) for F x V mean				=			NS			

Table 3. Effect of fertilizer combination and variety on number of storage roots/plant and storage root yields (t/ha) of orange fleshed sweet potato

Variety	Fertilizer combinations									
	0	5.4 kgAg	400 kg NPK	200 kg NPK 2.7 kg +Ag	5t PM	10t PM	5t PM+ 200 kg NPK	2.5t PM+ 200 kg NPK	2.5t PM+ 200 kgNPK 2.7 +Ag	Mean
	Number of storage roots/plant									
Umuspo 1	1.61	1.40	2.11	2.07	1.70	1.94	2.31	2.41	2.79	2.04
Umuspo 3	1.49	1.32	1.26	1.77	2.69	2.40	1.75	2.01	2.50	2.12
Mean	1.55	1.36	1.69	1.92	2.20	2.17	2.03	2.21	2.65	
Storage root yield (t/ha)										
Umuspo 1	7.68	7.61	12.49	9.12	10.31	8.56	14.01	16.70	14.18	11.24
Umuspo 3	2.18	1.93	12.01	3.42	8.35	8.50	5.64	7.99	7.31	6.37
Mean	4.93	4.77	12.25	6.27	9.33	8.53	9.83	12.35	10.75	

		Number of storage	Storage root yield
LSD (0.05) for fertilizer (F) mean	=	0.61	5.0
LSD (0.05) for variety (V) mean	=	NS	NS
LSD (0.05) for F x V mean	=	NS	NS

chemical properties following manure application and attributed the poor yields obtained from control plants or from application of 200kg NPK alone to inadequate nutrient supply. Storage root yield of Umuspo 1 was almost double that of Umuspo 3 but there was no significant difference in yield between the varieties.

However, taking into consideration that Umuspo 1 was more weed competitive (lower weed population) and had more top (shoot) yield than Umuspo 3, the former may be more suitable for cultivation in the humid forest zone of south eastern Nigeria.

Conclusion

Since application of 2.5t/ha poultry manure + 200kg NPK gave comparable yield as 400kg/ha NPK, combined application of the lower fertilizer doses of 2.5t/ha poultry manure + 200kg NPK may be recommended for orange-fleshed sweet potato based on economic considerations, given the high cost of inorganic fertilizers in Nigeria and the adverse effects of high application rates on the environment.

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