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Full Length Research Paper

Growth and yield of sweet potato (*Ipomoea batatas* L.) as influenced by integrated application of chicken manure and inorganic fertilizer

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Field experiments were conducted at Wa (Guinea savanna agro-ecological zone) and Mampong-Ashanti (forest-savanna transition agro-ecological zone) in 2007 and 2008 to determine the growth and yield response of sweet potato (*Ipomoea batatas* L.) to chicken manure, inorganic fertilizer (NPK, 15-15-15) and combinations thereof. The experimental design used was a randomized complete block design (RCBD) with four replicates. The treatments were: (i) sole NPK (15-15-15) fertilizer (IF) (200 kg NPK ha^{-1}); (ii) sole chicken manure (CM) (6 t CM ha^{-1}); (iii) 150 kg NPK ha^{-1} + 1.5 t CM ha^{-1}; (iv) 100 kg NPK ha^{-1} + 3.0 t CM ha^{-1} (v) 50 kg NPK ha^{-1} + 4.5t CM ha^{-1}); and (vi) no fertilizer (control). The sweet potato variety "Okumkom" was used in both years. On the average, all the amended treatments accumulated higher plant dry matter over the growing period than the unamended or control treatment at both locations. Plant dry matter accumulation produced at Mampong-Ashanti was higher than at Wa. The highest marketable root yields of 21.4 and 23.0 t ha^{-1} were obtained from combinations of 150 kg NPK ha^{-1} + 1.5 t CM ha^{-1} and 100 kg NPK ha^{-1} + 3.0 t CM ha^{-1} at Wa and Mampong-Ashanti, respectively. Integrated combinations of 150 kg NPK ha^{-1} + 1.5 t CM/ha and 100 kg NPK ha^{-1} + 3.0 t CM/ha are recommended for the Guinea savanna and forest-savanna transition zones, respectively, and similar representative environments to maximize yields and reduce cost on applied soil nutrient inputs.

Key words: Integrated application, sweet potato, chicken manure, inorganic fertilizer, growth.

INTRODUCTION

Sweet potato is one of the most important root and tuber crops in sub-Saharan Africa with both domestic and industrial uses, and its nutritional value far exceeds yam, cassava and cocoyam (Onwueme, 1978). Root yields as low as 7 t ha^{-1} compared with yield potentials of 18 to 24 t ha^{-1} of improved varieties have been recorded in Ghana, due to low soil fertility, planting low yielding varieties and outdated agronomic practices (CRI, 2002). Sweet potato may be adapted to grow on poor soils; as such most farmers do not apply fertilizer to their crops, resulting in poor yield. Small-holder farmers apply little or no fertilizer, often citing high cost or non-availability of inorganic fertilizers as reasons for not applying recommended dosage. Though inorganic fertilizers have been the conventional method of soil mineral input in sweet potato production, these fertilizers may pose danger to the environment especially if inappropriately applied. According to Buresh et al. (1997) and Palm et al. (1997), it has generally been accepted that both inorganic and organic inputs are needed to increase crop production in West Africa. The concept of 'integrated nutrient management' utilizing all available organic and inorganic resources has become a dominant paradigm for improved

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or increased yields in smallholder agriculture system of sub-Saharan Africa (SSA) to ensure both efficient and economic use of scarce nutrient resources (Smailing et al., 1997; Vanluawe et al., 2001). Therefore, the use of organic manure to supplement inorganic fertilizer use, as an integrated management strategy, is of paramount importance to reducing the cost of soil mineral input, maximizing yields and sustaining sweet potato as well as other food crops production in Ghana. In the rural communities, cheaper sources of organic inputs especially poultry manure is in abundance. A number of studies carried out on organic and inorganic fertilizer combination in sweet potato production, have attested to a positive interaction between them when simultaneously applied. However, the use of poultry manure as a supplement has added positive benefits on the physical properties of the soil (Palm et al., 1997). .

In Ghana, very little information exists on the appropriate combination rates of organic and inorganic fertilizers for sweet potato production. However, it has been reported that the response of the crop to varying regimes of nitrogen, phosphorus and potassium fertilizers has been positive (Dapaah et al., 2004). The crop equally responds visibly to the application of organic fertilizers. Several hypothesis have been formulated concerning possible positive interaction between inorganic and organic inputs when applied simultaneously (Giller et al., 1998) resulting in added benefits in terms of improved crop yields, soil fertility or both, and lower cost of production (Palm et al., 1997). There is a need to explore the huge and rich potential of sweet potato for commercial and industrial utilization. The identification and selection of an appropriate combination rate of inorganic and organic fertilizers will increase the production levels of sweet potato in the country to improve food security, reduce poverty, improve nutrition as well as contribute significantly to reduce the importation of wheat flour and other products meant for the food industry. Additionally, the crop has a significant role to play in the national crusade against Vitamin A deficiency because some varieties (that is, the orange-fleshed sweet potato varieties) have high levels of beta-carotene content, one of the major sources of vitamin A.

The objective of this study was to determine the growth and yield response of sweet potato to an integrated scheme of supplementing inorganic fertilizer with chicken manure for sustainable production.

MATERIALS AND METHODS

Field experiments were conducted at Wa located in the Guinea savanna agro-ecological zone and Mampong-Ashanti in the transitional agro-ecological zone of Ghana during the 2007 and 2008 growing seasons, respectively. Details of the agro-ecological characteristics of the locations are given in Table 1. The experimental design used was a randomized complete block with four replications. The treatments were: (i) recommended NPK (15-15-15) fertilizer (IF) (200 kg NPK ha^{-1}); (ii) recommended chicken manure (CM) (6 t CM ha^{-1}); (iii) 150 kg NPK ha^{-1} + 1.5 t CM ha^{-1} (that is, ¾ IF + ¼ CM); (iv) 100 kg NPK ha^{-1} + 3.0 t CM ha^{-1} (that is, ½ IF + ½ CM); (v) 50 kg NPK ha^{-1} + 4.5 t CM ha^{-1} (that is, ¼ IF + ¾ CM); and (vi) no fertilizer (control). The chicken manure used at both locations was four (4) months old (11.0% moisture content). Vines of the sweet potato variety, "Okumkom" (a 120-day maturing improved variety released by the CSIR-Crops Research Institute, Kumasi, Ghana) were planted on ridges at a spacing of 1 m between ridges and 0.3 m within rows. Each plot size consisted of six ridges with each ridge being 2.4 m long. The chicken manure was applied and worked into the ridges two weeks (to allow further decomposition) before planting of vines. Vine cuttings of 0.3 m length from apical sections and other actively growing sections were used for planting. Two-thirds of each vine (with 4 to 6 nodes) was buried into the soil (about 15 to 20 cm deep) leaving one-third above the soil. The NPK (15-15-15) rates were applied two weeks after planting (WAP). One hoe weeding was done at both locations at 3 to 4 WAP to control weeds.

Growth and yield parameters measured were: Dry matter accumulation, fresh vine yield at harvest, marketable, unmarketable and total root yields, storage root dry matter content, weight per root and harvest and commercial harvest indexes. The marketable and unmarketable roots were determined by measuring root diameter from the middle portion of the root using vernier calipers. Roots with root diameter less than 3 cm were considered unmarketable, while those with root diameter of 3 cm or more were considered as marketable roots. Harvest index was estimated as the ratio of the total storage root yield to total biomass at harvest (that is, sum of the storage root yield and vegetative biomass). Commercial harvest index was also estimated as the ratio of the weight of the marketable storage roots to the total root yield (CRI, 2003). Agronomic data was collected from the two central rows. The analysis of variance (ANOVA) procedure was carried out to determine the differences in parameters using the SAS statistical package (SAS, 1999). The significantly different means were separated using the Least Significant Difference (LSD) at 5% significant level ($p < 0.05$).

RESULTS AND DISCUSSION

Soil and chicken manure characteristics

The chemical properties of the top 30 cm soils at the experimental sites and the characteristics of chicken manure used in the experiments are shown in Table 2. The soil pH across both locations ranged from 5.7 to 5.8, indicating that the soils were slightly acidic. Total N was low across locations in the rating of SRI (2007). The levels of available P were moderate at both locations. However, Bray extractable K was moderate at Wa, but very high at Mampong-Ashanti. Exchangeable Ca and Mg were low, while exchangeable Na levels were moderate at Wa. The Mampong-Ashanti soil had higher exchangeable Ca, but moderate levels of Mg and Na (SRI, 2007). The chicken manure used at both locations had N, P and K ranges of 1.9 to 13.8, 0.48 to 2.27 and 1.0 to 1.5%, respectively and a pH of 7.9 to 8.4 (that is, slightly alkaline). The exchangeable cations were of moderate levels. The nutrient contents of the manures were moderate to high; therefore, the quantities applied must have supplied the important nutrients such as N, and especially P and K, which are critical for sweet potato

Table 1. Agro-ecological characteristics of the experimental locations.

Characteristics	Locations	
	Wa	Mampong-Ashanti
Coordinates	2° 45′ N, 10° 20′ W	7° 8′ N, 1° 24′ W
Elevation	300 masl	458 masl
Agro-ecological zone	Guinea savanna	Forest-savanna transition
Soil type	Lateritic savanna Orchrosol ‡ (with deep grayish brown alluvial clay in wide bottomland, soil is deep well drained, light to moderate textured and loamy in nature)	Chronic Luvisol ‡ (with deep, friable, brown-sandy loam and well-drained with a high water-holding capacity)
Slope gradient	2 - 6%	2 - 6%
Planting period (growth season)	August-November (18 August 2007)†	July-October (2 July 2008)
Total rainfall during growth season (mm)	429.6	569.5

Weather conditions

Month	Wa: Total monthly rainfall (mm)	Wa: Mean monthly relative humidity (%)		Wa: Mean monthly temperature(°C)		Mampong-Ashanti: Total monthly rainfall (mm)	Mampong-Ashanti: Mean monthly relative humidity (%)		Mampong-Ashanti: Mean monthly temperature (°C)	
		6 h	15 h	Min	Max		6 h	15 h	Min	Max
January	0.0	38	24	18	35	0.0	59	29	19	33
February	0.0	34	19	26	38	53.7	87	38	22	35
March	17.4	45	23	26	39	97.4	91	52	23	34
April	136.9	78	48	26	38	132.0	84	59	23	33
May	198.0	88	57	25	34	239.6	96	62	23	32
June	72.4	87	58	24	31	286.7	95	67	23	31
July	116.8	89	58	23	32	131.1	95	71	22	23
August	186.7	93	71	22	30	192.6	95	69	22	29
September	103.3	93	62	22	31	170.7	95	76	22	30
October	113.3	89	53	23	33	75.1	95	63	24	32
November	26.3	83	38	22	35	18.3	94	55	23	33
December	0.0	51	21	19	35	54.8	93	53	23	33
Total	971.1					1452.0				

‡, FAO/UNESCO classes; FAO/UNESCO (1988), †, Planting dates in parenthesis.

Table 2. Soil chemical properties (0 to 30 cm depth) of the experimental locations and characteristics of chicken manure used.

Soil chemical properties	Locations	
	Wa	Mampong-Ashanti
pH (1:2.5 H_2O)	5.7	5.8
Organic matter (%)	2.55	2.17
Total nitrogen (%)	0.15	0.15
Available P (mg/kg)	16.5	11.3
Available K (mg/kg)	55.5	180.8
Exchangeable cations:		
Ca (Cmol(+)/kg)	4.2	6.4
Mg (Cmol(+)/kg)	2.4	2.1
Na (Cmol(+)/kg)	0.1	0.2
ECEC (Cmol(+)/kg)	6.7	9.4
Chicken manure characteristics		
pH (1:2.5 H_2O)	7.9	8.4
Total nitrogen (%)	1.9	13.8
Organic C (%)	14.7	13.8
Organic matter (%)	25.4	26.3
Available P (%)	0.48	2.27
Exchangeable cations:		
Ca (Cmol/kg)	5.2	2.4
Mg (Cmol/kg)	0.7	3.4
K (Cmol/kg)	1.5	1.0
Na (Cmol/kg)	0.8	0.8

growth and yield.

Percentage crop establishment and dry matter accumulation

Crop establishment ranged from 97 to 100% at both locations and there were no significant differences among the various treatments (data not presented). The high percentage crop establishment (97 to 100%) indicated achievement of optimum plant population density. The fresh actively growing portions of vines used as planting materials contributed significantly to the high percentage crop establishment. Onwueme and Sinha (1991) and Dapaah et al. (2004) have emphasized the need to use the most appropriate planting materials (active vine growing portions), optimum planting depth and spacing and good land preparation to enhance good sprouting and crop establishment as well as reduction in weed competition for growth resources later during the season. High mean monthly rainfall values recorded in the months of August and September 2007 at Wa and July and August 2008 at Mampong-Ashanti (Table 1) might have also contributed to the high percentage crop establishment.

The effect of chicken manure and inorganic fertilizer on dry matter (DM) accumulation in sweet potato production is presented in Figure 1. At Wa, DM accumulation for all amended treatments (200 kg IF; 6 t CM/ha; 150 kg IF + 1.5 t CM/ha; 100 kg IF + 3 t CM/ha and 50 kg IF + 4.5 t CM/ha) was significantly higher ($p \leq 0.05$) than the unamended or control treatment (Figure 1a). Among the amended treatments, the 6 t CM/ha with relatively the highest mean DM differed significantly from 200 kg IF/ha in DM accumulation after 4 WAP. Similarly, 150 kg IF + 1.5 t CM/ha had significantly higher gains over 200 kg IF/ha after 4 WAP. The control treatment recorded the lowest mean DM weight over the sampling period. The DM accumulated at 12 WAP ranged from 200 to 270 g m^{-2} at Wa.

At Mampong-Ashanti, there was no significant differrence in DM accumulation among the treatments at 4 WAP. However, generally the 50 kg IF + 4.5 t CM/ha treatment had relatively higher DM accumulation from 4 to 10 WAP (Figure 1b). The DM accumulation peaked at 10 WAP at Mampong-Ashanti with the integrated treatments generally having higher DM accumulation than the sole CM or IF and the control (Figure 1b). On the average, DM ranged from 250 to 430 g m^{-2}. Averaged across both locations, all amended treatments recorded higher mean DM gains than the unamended (control) treatments over the periods, an indication of the need for

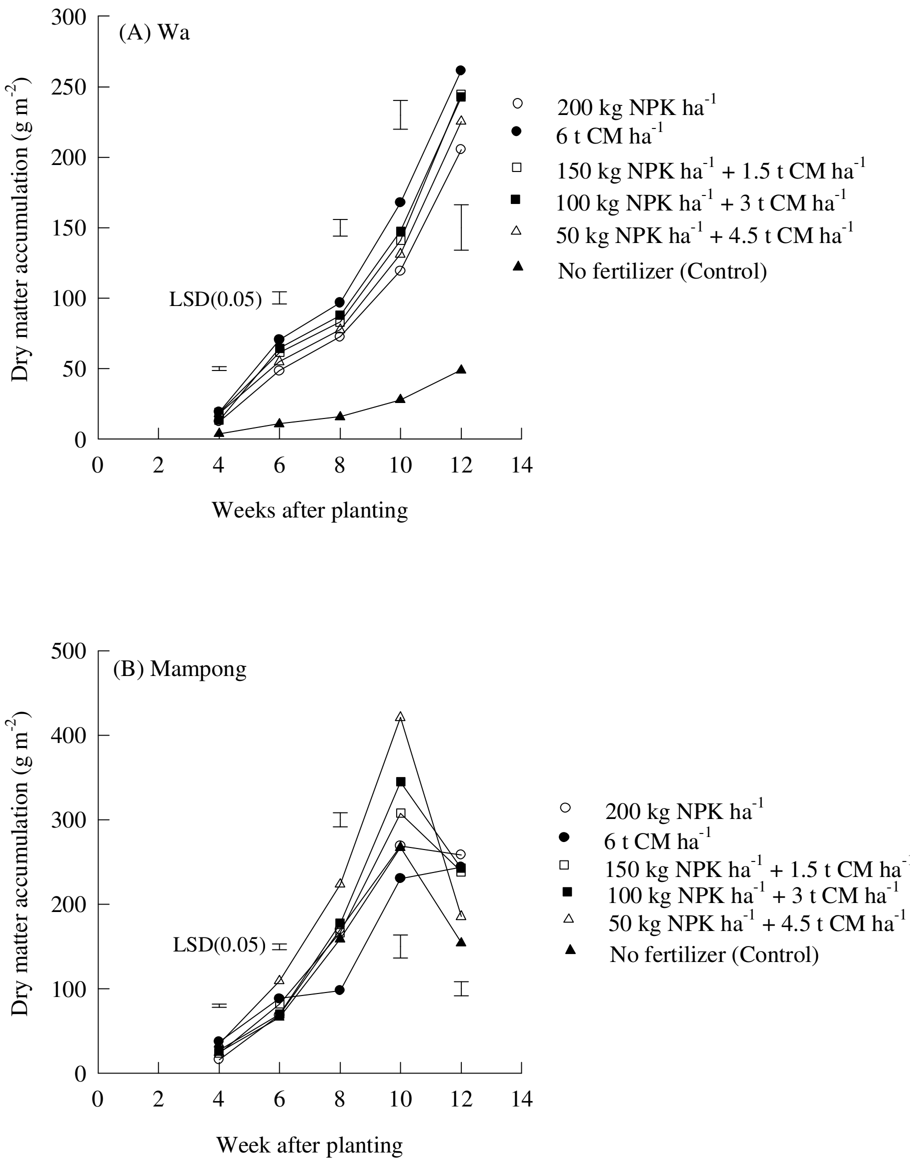

Figure 1. Dry matter accumulation of sweet potato as influenced by chicken manure and NPK fertilizer at Wa and Mampong-Ashanti.

fertilization (Myers et al., 1994; Palm et al., 1997; Smailing et al., 1997). Dry matter accumulation at Mampong-Ashanti was generally higher than at Wa. Although total monthly rainfall values were high during the cropping period (August to October) at Wa, intermittent long periods of drought might have resulted in the lower DM accumulation. These results indicate positive influence of chicken manure on vegetative biomass gain either as sole CM or in combination with other inorganic inputs over sole inorganic amended or unamended soils. The combinations of 50 kg IF ha^{-1} + 4.5 t CM ha^{-1}, 100 kg IF ha^{-1} + 3.0 t CM ha^{-1} and 150 kg IF ha^{-1} + 4.5 t CM ha^{-1} and generally accumulated higher or intermediate DM at both locations (Figure 1).

The slow and effective release of N and other nutrients from CM combined with the fast available N from the IF, might have accounted for the responses of the integrated treatments. Ayoola and Makinde (2008) also observed that maize growth was more favoured by enriched cow dung (with urea N) than sole inorganic fertilizer application. Murwira and Kirchman (1993) and Chung et al. (2000) have observed that the nutrient use efficiency of a crop increased through a combined application of organic manure and inorganic fertilizer. This shows that organic manures can be enriched or combined with inorganic nutrients to have an initial, fast release of nutrients to plants, prior to the release of nutrients from the organic sources, thereby, solving the characteristic shortcoming of slow initial release of nutrients from sole organic manure application (Ayoola and Makinde, 2008;

Table 3. Fresh vine, marketable, unmarketable and total root yields as influenced by chicken manure and inorganic fertilizer at Wa and Mampong-Ashanti.

Treatment	Wa				Mampong-Ashanti			
	Fresh vine yield	Marketable root yield	Unmarketable root yield	Total root yield	Fresh vine yield	Marketable root yield	Unmarketable root yield	Total root yield
	$t\ ha^{-1}$				$t\ ha^{-1}$			
200 kg IF† ha^{-1}	13.5	11.8	0.7	12.5	29.5	19.6	1.1	20.7
6 t CM ha^{-1}	19.1	18.6	0.6	19.2	27.0	18.7	1.3	20.0
150 kg IF ha^{-1} + 1.5 t CM ha^{-1}	14.0	21.4	0.6	22.0	20.3	19.3	1.2	20.6
100 kg IF ha^{-1}+ 3.0 t CM ha^{-1}	14.0	13.4	0.8	14.2	26.7	23.0	0.9	23.8
50 kg IF ha^{-1}+ 4.5 t CM ha^{-1}	19.7	19.8	1.4	21.0	26.6	18.0	1.0	19.1
No amendment (Control)	8.0	6.7	0.3	7.0	22.2	16.6	1.4	17.9
Mean	14.7	15.3	0.7	16.0	25.5	19.2	1.2	20.4
LSD (0.05)	4.77	5.14	0.59	5.17	10.20	4.31	0.55	4.23
CV (%)	21.5	22.4	15.3	12.4	25.2	14.9	18.6	13.8

† IF = Inorganic fertilizer (NPK 15-15-15); CM = chicken manure.

Dapaah et al., 2008). Several authors have indicated that for improved crop yield and good soil status, a combination of organic manure and inorganic fertilizer was the best for savannah soils, and that the combined effects were better than either inorganic fertilizer or poultry manure alone at different rates as well as equivalent amounts applied separately (Miller and Covington, 1982; Kingery et al., 1993; Dennis et al., 1994). The high percentage crop establishment coupled with early canopy closure and subsequent high leaf numbers increased the photosynthetic area and ability of particularly the integrated treatments and this might have contributed to the high DM accumulation through increased intercepted solar radiation.

Fresh vine and storage root yields at harvest

The results of fresh vine yield at harvest, which shows the potential of the vegetatively propagated crop for planting material production as well as usage as livestock feed are presented in Table 3. At Wa, all the amended treatments had significantly higher fresh vine yield at harvest (about 69 to 146% more) than the unamended treatment. Among the amended treatments, 50 kg IF + 4.5 t CM ha^{-1} and 6 t CM ha^{-1} produced significantly higher fresh vine yield at harvest (19.7 and 19.1 t ha^{-1}, respectively), about 36 to 46% more than 150 kg IF + 1.5 t CM ha^{-1}; 100 kg IF + 3 t CM ha^{-1} and 200 kg IF ha^{-1}. The lowest fresh vine yield of 8.0 t ha^{-1} was produced by the no fertilizer control treatment (Table 3). All amended treatments had significantly higher fresh vine yield at harvest than the control, similar to the findings of Onwueme and Sinha (1991) and CRI (2003). The trend in fresh vine yield followed the trends of leaf number and dry matter accumulation. The organic and inorganic fertilizer inputs might have augmented the otherwise lower levels of some exchangeable cations of the amended plots at Wa. There was no significant effect ($p \leq 0.05$) of the applied treatments on fresh vine yield at harvest at Mampong-Ashanti. Total exchangeable Ca, K and Na and ECEC in the Mampong-Ashanti soils (Table 2) were generally moderate to high and might have augmented the soil nutrient levels in the control treatment. Although no significant differences were observed at Mampong-Ashanti, the sole inorganic fertilizer, sole CM and the integrated combinations of 50 kg IF + 4.5 t CM ha^{-1} and 100 kg IF + 3 t CM ha^{-1} produced 31 to 45% fresh vine yield more than the control treatment, an indication of the need for fertilization (Myers et al., 1994; Palm et al., 1997; Smailing et al., 1997). Fresh vine yield produced at Mampong-Ashanti was about 50 to 64% more than that produced at Wa, perhaps the intermittent long periods of drought experienced during the cropping period at Wa might have contributed to the lower fresh vine yield at harvest.

All amended treatments, except the sole inorganic fertilizer significantly out-yielded the control treatment by two to three times more in terms of

Table 4. Storage root dry matter, weight per root, harvest index and commercial harvest index as influenced by chicken manure and inorganic fertilization at Wa and Mampong-Ashanti.

Treatment	Wa				Mampong-Ashanti			
	Storage root dry matter content (%)	Weight per root (kg)	Harvest index	CHI ‡	Storage root dry matter content (%)	Weight per root (kg)	Harvest index	CHI
200 kg IF ha^{-1}†	16.5	0.28	0.48	0.95	26.3	0.25	0.41	0.95
6 t CM ha^{-1}	25.8	0.29	0.50	0.97	29.5	0.23	0.43	0.93
150 kg IF ha^{-1} + 1.5 t CM ha^{-1}	33.3	0.34	0.61	0.97	30.5	0.28	0.51	0.94
100 kg IF ha^{-1}+ 3.0 t CM ha^{-1}	16.5	0.25	0.50	0.94	25.5	0.29	0.48	0.97
50 kg IF ha^{-1}+ 4.5 t CM ha^{-1}	34.3	0.28	0.52	0.94	29.8	0.24	0.42	0.94
No amendment (Control)	11.5	0.23	0.49	0.95	29.0	0.21	0.45	0.92
Mean	23.0	0.3	0.5	1.1	28.4	0.2	0.4	1.1
LSD (0.05)	11.65	0.08	0.13	0.05	4.39	0.08	0.12	0.05
CV (%)	12.7	20.7	16.8	2.3	10.9	22.4	17.3	2.4

‡ CHI = Commercial harvest index; † IF = Inorganic fertilizer (NPK 15-15-15); CM = chicken manure.

marketable and total root yields at Wa (Table 3). Although, the sole inorganic fertilizer produced similar marketable and total root yield with the control, it still yielded 76 to 79% more than the control, which can be very significant for a smallholder farmer. The 150 kg IF + 1.5 t CM ha^{-1} and 50 kg IF + 4.5 t CM ha^{-1} treatments produced the highest marketable storage root yields of 21.4 and 19.8 t ha^{-1} at Wa, while 150 kg IF + 1.5 t CM ha^{-1} and 100 kg IF + 3.0 t CM ha^{-1} gave the highest marketable storage root yields of 19.3 and 23.0 t ha^{-1}, respectively. The unmarketable root yield did not vary significantly among all treatments. Poultry manure in combination with inorganic N was equally reported to give significant marketable root yield of sweet potato (Hartemink, 2003). Giller et al. (1998) observed a positive interaction between organic and inorganic inputs when applied simultaneously. Fertilizer inputs, according to Palm et al. (1997), have added benefits in terms of improved crop yield, soil fertility status or both and lower cost of production. Similar responses have also been reported on maize (Adeniyan and Ojeniyi, 2005; Ayoola and Agboola, 2002; Dapaah et al., 2008, Chung et al., 2000), on rice (Satyanarayana et al., 2002) and on sorghum (Bayu et al., 2006).

At Mampong-Ashanti, only the 100 kg IF + 3.0 t CM ha^{-1} produced significantly higher marketable and total root yield (32 to 39% more) than the control. The other treatments had similar yields with the control. The unmarketable root yields were also similar for all treatments. Generally, the Mampong-Ashanti experiment did not elicit additive response in marketable and total root yields probably because of the high extractable K and equally high exchangeable cations and effective cation exchange capacity as indicated in the initial soil nutrient analysis (Table 2). Bourke (1985) indicated the importance of potassium in root development as elicited across all the treatments.

Marketable storage root yields at Mampong-Ashanti (ranging from 16.6 to 23 t ha^{-1}) were generally higher than the yields at Wa (6.7 to 21.4 t ha^{-1}) (Table 3). The high rainfall devoid of intermittent long drought periods and high initial K levels at the Mampong-Ashanti might have contributed to these results, similar to the findings of Hammett et al. (1984), Zhi (1991) and Villareal (1982) who emphasized the significant role of K on the yield of sweet potato.

Storage root DM content and mean tuber weight

Storage root dry matter content, which ranged from 11.5 to 34.3%, varied significantly among treatments at Wa (Table 4). The 150 kg IF + 1.5 t CM ha^{-1} and 50 kg IF + 4.5 t CM ha-1 treatments had the highest root DM content, about three times that obtained in the control treatment. The sole inorganic fertilizer and 150 kg IF + 1.5 t CM ha^{-1} had similar root DM with the control. At Mampong-Ashanti, root DM content, which ranged from 25.5 to 30.5% was similar for all treatments (Table 4). High root DM content (25.5% and above) is preferred in sub- Saharan Africa, especially in West Africa because of the various food preparations that sweet potato is generally used. On the average, root DM content was slightly higher at Mampong-Ashanti (28%) than at Wa (23%). Higher initial soil nutrients and better climatic conditions might have contributed to this outcome (Hahn and Hozyo, 1984). Mean weight per root did not differ among the treatments or between the locations. Mean weight per root ranged from 0.23 to 0.34 and 0.21 to 0.29 kg at Wa and Mampong-Ashanti, respectively.

Harvest and commercial harvest indexes

Harvest and commercial harvest indexes (HI and CHI) across locations did not show significant differences among the treatments as well as between locations. The harvest and commercial harvest indexes across locations ranged from 0.48 to 0.61 and 0.94 to 0.97, respectively for Wa and 0.41 to 0.51 and 0.92 to 0.97, respectively for Mampong-Ashanti. The CHI was quite high for both locations, indicating a very small percentage of unmarketable root yield production. Results across both experimental locations did not elicit significant effect of the fertilizer combinations on either harvest index or commercial harvest index. Higher fresh vine weight at harvest tends to lower root yield and subsequently lower harvest index and this could be attributed to high partitioning of assimilates to vegetative biomass at the expense of roots (sinks). Hartemink et al. (2000) and Zhi (1991) have observed that high vegetative growth results in low root yield and subsequently lower harvest index.

Conclusion

The results of the study indicate that organic and inorganic input combinations for soil mineral supplementation in sweet potato production is a better option than either of organic or inorganic input applied singly. A combination of 150 kg IF + 1.5 t CM/ha is preferred for higher sweet potato growth and marketable and total fresh root yield in the Guinea Savanna zone, while 100 kg IF + 3.0 t CM/ha may be preferred for forest-transition zone or similar representative environments.

These combinations produced sweet potato growth and yields either higher or comparable to inorganic fertilizer only as well as increased the soil nutrients and physical properties, thus may limit total dependence on inorganic fertilizers for sustainable sweet potato production.

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