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Effect of cocoa pod husk, urea fortified cocoa pod husk and NPK fertilizers on the growth and yield of *Solanum macrocarpon* cultivation.

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ABSTRACT

Field trial was conducted on the effects of cocoa husk, urea fortified cocoa pod husk and NPK fertilizers on the growth and marketable yield of *Solanum macrocarpon* at Cocoa Research Institute of Nigeria (CRIN), Ibadan during the dry season of 2009/2010. There were four treatments (Cocoa Pod Husk (CPH), urea fortified CPH at ratio 4:1, NPK 20:10:10 and control), laid out in a randomized complete block design (RCBD). *S. macrocarpon* seedlings raised in seed trays in the nursery were transplanted to manually prepared beds in the field. (Cocoa Pod Husk (CPH), CPH + Urea at a ratio 4:1, NPK 20:10:10 and control were laid out in a randomized complete block design (RCBD). *S. macrocarpon* seedlings raised in seed trays in the nursery were transplanted to manually prepared beds in the field. Watering was done thrice per week and weeds controlled manually. Fertilizers were applied at the rate of 80KgN/ha. Data were collected on, plant height; numbers of leaves per plant and marketable yield (the vegetative part of the plant).
The results indicated that there was no significant difference in plant height between the fertilizer-based treatments and control. All the fertilizer-based treatments significantly enhanced number of leaves and total marketable yield of *S. macrocarpon* than control. The highest cumulative marketable yield (39.8ton/ha) from CPH + Urea was not significantly different from 39.7 and 37.2 ton/ha obtained from NPK and CPH fertilizer- based treatments respectively.
The use of CPH as organic fertilizer in the cultivation of *S. macrocapon* in cocoa growing areas could be seen as a way of converting waste to wealth in crop production.
Key words: Cocoa pod husk, urea, NPK, *Solanum macrocarpon*

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INTRODUCTION

Vegetable production in Africa is as old as peasant farming though its cultivation is still at the household level with very few farmers producing on a commercial level. This could be due to the fact that energy-given crops such as cereals, roots and tubers and body-building crops like legumes are given much attention. Cereals and tubers form the bulk of food consumed in the tropics but they are deficient in minerals and vitamins compared to the body requirement to guarantee good health living. Vegetables supply an important amount of vitamins and minerals required by the body. In Nigeria, vegetables are usually cultivated in the rainy season when they grow luxuriantly given high yields with a resultant cheap market price.

The commonly grown and consumed vegetables in Nigeria include: *Amaranthus* spp., *Solanum* spp., *Hibiscus* spp. and *Curcubita* spp. *Solanum macrocarpon* is a non-tuberous leafy specy possibly indigenous to Nigeria and known as a good source of vitamins and minerals (Oyenuga and Fetuga, 1998).This vegetable has been given different local names by various authors. It is called "Osun' or "Igbagba" (Denton and Olufolaji, 2000; Kogbe, 1983).

S. macrocarpon is an important member of the family Solanaceae alongside with other cultivated specie like potato, tomato and pepper. It is grown commonly for its leaves. It could be cultivated sole or intercropped in patches with staple food crops such as cassava and yam. It has biennial tendency and sprouts at the onset of rains the following year after withering of the top growth in the dry season. All this being equal, this vegetable exhibits its full potential luxuriant growth when grown in a soil that supplies all required nutrients in adequate quantity. Most soils used for its cultivation do not supply the crops nutrients requirements. This necessitates the need for fertilizer application. The use of inorganic fertilizer has not been sustainable in Nigerian agriculture because it is not readily available and not affordable by most peasant farmers who grow the crop couple with the negative effect of it on the environment (such as loss of soil organic matter, increased soil acidity, nutrient imbalance and low residual effect) and the health of the consumer of the vegetable. Soil amendments through organic-based fertilizer could be a better option (Sobulo and Aduayi, 1990; Agboola and Fagbenro, 1985). Cocoa farmers generate a lot of cocoa pod husk as waste on their farms. These wastes could be turned to wealth by using it to organic fertilizer for vegetable production for healthy living as well as additional income generation to farmers.

The objective of this study is to determine the response of *S. macrocarpon* in terms of growth and yield to different soil amendments using cocoa pod husk, urea fortified cocoa pod husk organic and NPK.

METHODOLOGY

Field trial was carried out at Cocoa Research Institute of Nigeria (CRIN), Ibadan, Nigeria during the dry season of 2009/2010 (November 2009 to March 2010).

The treatments consisted of three fertilizers types (Cocoa pod husk (CPH), CPH + Urea (4:1), NPK 20:10:10) and control (no fertilizer application). The fertilizers were applied at the rate of 80KgN/ha based on the result of soil analysis of the site and the N requirement of *S. macrocarpon* as reported by Ojo and Olufolaji (1997). Dried cocoa pod husks were grinded and sieved through 2mm diameter for chemical analysis. Seeds of *S. macrocarpon* obtained from National Institute of Horticultural Research (NIHORT) Ibadan, Nigeria were raised in seed trays in the nursery for five weeks prior to transplanting to the field. The land was cleared and vegetable beds of 2 m x 1.5 m with 1m alley between plots and blocks. Seedlings were transplanted on beds at spacing of 50 cm x 20 cm while the application of fertilizer was done two weeks after using ring method at 10 cm away from the crop.

Each vegetable bed contained thirty plants out of which five were randomly tagged for data collection. Data were collected on plant height and number of leaves per plant at 2, 4, 6 and 8 weeks after transplanting (WAT) and also on marketable yield at 3, 6, 9 and 12 WAT by cutting the plant at a height of 5 - 8 cm above ground level, leaving 2 - 5 buds to aid re-growth.

RESULTS AND DISCUSSION

Results of physical and chemical analysis of the soil used (Table 1) indicate that the soil was loamy and slightly acidic. Nitrogen, phosphorus, potassium and organic carbon contents of the soil were low. The low soil contents for the major nutrients and soil organic carbon signify the need for improvement for optimal *S. macrocarpon* performance. Soil amendments through the application of CPH fertilizer was observed to increase the total nitrogen, organic carbon and improved the pH and available phosphorus (Ibiremo *et al.,* 2006; Adeoye, *et. al.*, 2001). Agboola and Omueti (1982) reported improvement of soil CEC for better nutrient retention following the addition of organic fertilizers.

Chemical analysis of the CPH used as shown in Table 2 revealed that it contained appreciable amount of both macro and micro nutrients that could supply the nutrient requirements of *S. macrocarpon* if applied appropriately.

The effect of CPH, Urea fortified CPH and NPK fertilizers on plant height of *S. macrocarpon* was significantly different only at 6WAT when plants treated with NPK had mean height of 20.7 cm which was significantly higher than the control treatment but not significantly different from values obtained in other treatments (Table 3). The highest plant height was obtained from NPK treatment probably due to faster release of nutrient contents of NPK than those of CPH- based fertilizers. Similar reports have been made on faster nutrient release from inorganic fertilizers compared to organic nutrient sources when used for the production of vegetables, cereal and tree crops (Ipinmoroti, *et al*., 2006; 2007 Adeoye, *et al*., 2001).

Table 4 shows that NPK and Urea fortified CPH significantly enhanced the production of leaves than CPH and the control at 2WAT and maintained the trend on the control throughout the period of investigation. The reduced leaf production of CPH treated solanum compared to that of NPK and urea fortified CPH might be due to immobilization of nitrogen released from soil organic matter. Previous investigators have reported that the burying in soil of low nitrogen crop residues immobilizes nitrogen (Smith and Sharply, 1990). The Urea fortified CPH compared favourably with the NPK treated *Solanum*. Number of leaves from CPH treated Solanum was increasingly comparable with that from NPK and NPK + Urea at 4, 6, and 8WAT. This could be due to increasing rate of mineralization and consequent release of nutrients in CPH. Number of leaves produced under the various treatments at 8WAT were in the order CPH + Urea > NPK > CPH > Control. Ogunlade (2008) also reported higher cocoa seedling growth from urea fortified CPH compared to inorganic fertilizer or CPH alone. The higher number of leaves from the CPH + Urea over the NPK at this stage could be due to the sustaining release of nutrients from the former over the latter.

The economic marketable yield (t/ha) of *Solanum macrocarpon* obtained at each periodic harvest as shown in Table 5 followed similar trend as observed for the number of leaves. CPH + Urea treatment had the highest cumulative yield (39.82t/ha) which was significantly higher than the yield under control but comparable to that obtained from other fertilizer treatments. This was similar to the work of Makinde *et al* (2001) who reported higher maize yield from a mixture of organic and inorganic fertilizer application.

The higher marketable yield of *S. macrocarpon* treated with fertilizers over the control indicated that the soil of the site used was low in fertility thus the

observed response of the vegetable to the added fertilizers.

Future study may focus on the residual effect of cocoa pod husk-based fertilizer and organo-mineral fertilizer on the growth and yield of *S. macrocarpon*. Conclusively, the use of CPH as organic fertilizer in the cultivation of *S. macrocapon* in cocoa growing areas is hereby recommended. This practice could be a way of converting waste to wealth.

Table 1: Physical and chemical properties of the soil experimental site

Parameters	Values
pH	6.36
N (g/kg)	0.3
O.C. (G/kg)	0.32
P (g/kg)	5.21
K (cmol/kg)	0.25
Na (cmol/kg)	2.1
Mg(cmol/kg)	0.66
Ca (cmol/kg)	2.26
Sand	74.6
Silt	20.2
Clay	5.20

Table 2: Result of chemical analysis of Cocoa pod husk

Parameters	Values
PH	6.41
O.C (%)	13
N (%)	1.15
P (%)	0.77
K (%)	15.6
Ca (%)	2.42
Mg (mg/kg)	1.17
Fe (mg/kg)	2.11
Zn (mg/kg)	1.25
Mn (mg/kg)	0.15
Cu (mg/kg)	1.29

Table 3: Effects of CPH based fertilizers and NPK on the heights of S. Macrocarpon

Treatment	Height (cm)			
	2 WAT	4 WAT	6 WATS	8 WAT
Control	7.0 a	8.3a	12.3b	12.7a
CPH	8.0a	10.3a	15.0ab	19.0a
	7.3a	9.0a		20.0a
CPH + Urea	9.3a	12.3a	16.7ab	22.7a
NPK	n.s	n.s	20.7a	n.s

Means in the same column followed by the same letters are not significantly different by Duncan Multimedia Range Test (DMRT) at P<0.05 n.s = not significant at P<0.05

Table 4: Effect of CPH based fertilizers and NPK on number of leaves of S. Macrocarpon

Treatment	Number of Leaves			
	2 WAT	4 WAT	6 WATS	8 WAT
Control	6 b	12b	17b	23b
CPH	7 b	14ab	24ab	36a
CPH + Urea	9 a	17a	29a	43a
NPK	9 a	18a	30a	39a

Means in the same column followed by the same letters are not significantly different by Duncan Multiple Range T6est (DMRT) at P<0.05 n.s = not significant at P<0.05

Table 5: Effect of Cocoa pod husk based organic, Urea fortified CPH and NPK fertilizers on the yield of S. Macrocarpon

Treatment	Yield (t/ha)				
	1st	2nd	3rd	4th	Cumulative
Contro	l4.64b	2.35ab	3.98c	14.11c	24.08b
CPH	5.10b	2.45ab	4.68ab	21.14ab	37.24a
CPH + Urea	8.50a	2.51a	5.55a	23.33a	39.82a
NPK	8.70a	3.03a	5.93a	23.63a	39.73a

Means in the same column followed by the same letters are not significantly different by Duncan Multiple Range Test (DMRT) at P<0.05
n.s = not significant at P<0.05

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