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Effect of Animal Manure Amended Spent Grain and Cocoa Husk on Nutrient Status, Growth and Yied of Tomato

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Abstract: Combined use of crop and animal wastes is necessary in order to obtain adequate amount of organic manure for use in crop production. Hence field experiments were conducted at two sites in Akure, Southwest Nigeria to compare effect of NPK (15-5-15) fertilizer (200 kg ha $^{-1}$) and each of Spent Grain (SG) and ground Cocoa Husk (CH) amended with Cattle Dung (CD), Poultry Manure (PM) and Goat Manure (GM) at equal rates (12.5 t ha^{-1}:12.5 t ha $^{-1}$). The effects of treatments on leaf N, P and K concentrations, growth and fruit yield of tomato were studied. Compared with control, NPKF and animal manure amended SG and CH increased leaf N and K, plant height, number of branches, leaf area, number and weight of fruits significantly ($p>0.05$). Fruit yields given by CD, PM and GM amended CH and PM and GM amended SG were similar. Among eight treatments compared, CH and SG amended with PM gave highest fruit yields. Compared with control, NPKF, amended SG and CH increased fruit yield by 268,342 and 397%, respectively.

Key words: Animal manure · cocoa husk · nutrient · spent grain · tomato yield

INTRODUCTION

In Nigeria, tomato *(Lycopersicon esculentum)* production is about 600000 tonnes annually. The average yield of 10 t ha^{-1} is lower than the world average of 22 t ha^{-1}. Among the factors that contribute to its low yield is low soil fertility and inadequate use of chemical fertilizers. The cost of fertilizer is high for the farmers who are mainly small-scale producers and fertilizer is often scarce. Hence research attention shifted to the use of agricultural wastes for supplying nutrients to tomato and other crops. These wastes such as cocoa pod husk, wood ash, oil palm bunch refuse, brewery waste (spent grain), droppings of poultry, cattle and goat [1-4] pose disposal and environmental problem. However recent studies have shown that they are effective as manure for enhancing yield and nutrient status of vegetables and grain crops [2, 5-9]. Ikpe *et al*. [7] observed that about 75% of farmers in the forest zone of West Africa keep livestock predominantly goats and poultry. Egunjobi [10] noted that Nigeria produced about 8 million tones of cocoa pod husk annually which were wasted. With this, between 64000-94000 tonnes of nutrients such as K, Ca and P and between 6000-9000 tonnes of N are lost annually.

Because the quantities of the agricultural wastes available may not be sufficient for large-scale vegetable production [2], there is need to combine annual and plant wastes. Studies are rare on integrated application of plant and animal manures. MoyinJesu and Ojeniyi [11] study effect of animal manure amended crop wastes on yield of okra (*Abelmoschus esculentum)* and found that amendment of wood ash, ground cocoa husk, rice bran, spent grain and saw dust with goat, pig and poultry manures enhanced okra yield and N, P, K, Ca and Mg uptake. Similar observation was made by MoyinJesu [8] with respect to amaranthus. Ojeniyi and Adejobi [9] found that wood ash and goat manure complemented each other as to their effects on nutrient content, growth and yield of amaranthus. Addition of 2 t ha^{-1} ash to 8 t ha^{-1} goat manure increased leaf yield of amaranthus by 54%. Compared with control, combined application of these treatments increased leaf yield of amaranthus by 342%. This work investigates effects of animal manure amended

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spent grain (sorghum brewery waste) and ground cocoa husk on nutrient status, growth and yield of tomato in southwest Nigeria.

MATERIALS AND METHODS

Field experiments:

Statistical analysis: Plant data were subjected to analysis of variance and least significant difference at 95% level of probability was used to compare mean data on treatment basis. Data for the two site were pooled because of similarity.

RESULTS AND DISCUSSION

Chemical analysis data for the test soils are presented in Table 1. The soils were slightly acidic, low in organic matter, total N, exchangeable K, Ca and available P. The emulations is in respect to standards given for crop production in different ecological zones of Nigeria [14]. The soils and crops of tomato are expected to benefit from application of manners derived from agricultural wastes.

Table 2 shows data on response of leaf N, P and K concentrations of tomato to application of manure and fertilizer treatments. Compared with control, NPKF and animal manure amended SG and Ch increased leaf N and K significantly ($p>0.005$). Amended SG and CH also increased leaf P of early tomato (except SG+GM) but the increases were not significant. The overall mean leaf N for the control, NPKF, SG+manure and CH+manure were 2.9, 4.4, 5.0 and 4.2%, respectively; the values for leaf P were 0.2, 0.4, 0.3 and 0.4%, while values for leaf K were 1.2, 2.6, 2.1 and 3.8%.

The increases in plant nutrients content is attributable to release of nutrients from the plant and animal wastes. Analysis of SG gave values of 5.18% N, 1.78% P, 0.07% K, 1.44% Ca and 0.58% Mg: the C:N being 11.1. Analysis data for CH were 1.83%N, 2.38%P, 4.12%K, 1.19%Ca, 0.04%Mg and C: N of 12.5. The amendment of the residues with animal manures should have enhanced decomposition and release of nutrients from the plant residue due to lower C:N of the animal manures [8].

Application of animal manure amended SG and CH increased growth parameters (Table 3) and fruit yield (Table 4) significantly ($p>0.05$). However the increases in height of late tomato plant were not significant. The mean values of plant height for the control, NPKF, amended SG and amended Ch were 69.2, 74.1, 80.5 and 78.3 cm, respectively; the values for number of branches were 4.6, 8.9, 7.0 and 7.2 and values for leaf area per plant

Table 1: Precropping soil chemical property at Akure, Nigeria

Property	FUTA Site	FECA Site
Ph ($CaCl_2$)	6.00	6.10
Organic matter %	1.77	1.53
Total N%	0.11	0.10
Exch K C mol kg^{-1}	0.08	0.11
Exch Ca C mol kg^{-1}	0.16	0.11
Exch Mg C mol kg^{-1}	1.14	1.12
Available P mg kg^{-1}	4.70	4.20

Table 2: Effect of animal manure amended spent grain and cocoa husk on leaf nutrient content of early and late tomato plant

	N%		P%		K%	
Treatment	Early	Late	Early	Late	Early	Late
Control	2.9	2.8	0.2	0.2	1.0	1.3
NPKF	4.9	3.9	0.4	0.3	3.1	2.2
SG+CD	4.9	4.9	0.3	0.1	2.1	2.1
SG+PM	5.0	5.1	0.9	0.1	2.1	2.1
SG+GM	5.1	5.2	0.9	0.1	2.3	2.0
CH+CD	4.1	4.3	0.8	0.2	3.9	4.1
CH+PM	4.8	3.9	0.5	0.3	3.8	3.7
CH+GM	3.9	3.9	0.4	0.3	3.4	3.8
LSD (0.05)	0.8	1.2	NS	NS	1.2	1.5

SG+CD = Spent grain+Cow dung
SG+PM = Spent grain+Poultry manure
SG+GM = Spent grain+Goat manure
CH+CD = Cocoa husk+Cow dung
CH+PM = Cocoa husk+Poultry manure
CH+Gm = Cocoa husk+Goat manure
NPKF = NPK (15-15-15) fertilizer at 200 kg ha^{-1}

Table 3: Effect of animal manure amended spent grain and cocoa husk on growth of early and late tomato plant.

	Plant height (cm)		No. of branches		Leaf area/ plant	
Treatment	Early	Late	Early	Late	Early	Late
Control	66.0	72.3	4.5	4.7	78.4	88.4
NPKF	68.1	80.1	7.2	10.5	100.2	103.6
SG+CD	71.5	76.8	5.2	6.7	102.2	110.2
SG+PM	89.9	84.5	8.5	7.7	112.4	114.1
SG+GM	78.7	81.3	5.6	8.9	100.6	100.2
CH+CD	72.9	76.3	7.1	6.9	111.3	131.3
CH+PM	79.3	82.2	6.5	8.1	115.3	131.3
CH+GM	79.3	79.9	6.6	7.7	95.2	100.9
LSD (0.05)	5.8	NS	2.3	4.2	10.1	9.2

SG+CD = Spent grain+Cow dung

Table 4: Effect of animal manure amended spent grain and cocoa husk on fruit yield of early and late tomato plant

	No of fruits/plant		Fruit yield t/ha	
Treatment	Early	Late	Early	Late
Control	12.1	10.0	7.1	8.2
NPKF	14.7	13.7	31.2	25.3
SG+CD	14.6	14.1	29.1	31.4
SG+PM	16.1	15.6	32.4	42.6
SG+GM	15.0	14.5	30.2	38.4
CH+CD	14.8	14.3	36.2	40.5
CH+PM	17.3	17.7	38.2	43.7
CH+GM	14.3	14.9	34.3	37.1
LSD (0.05)	0.9	4.3	6.8	10.0

SG+CD = Spent grain+Cow dung
SG+PM = Spent grain+Poultry manure
SG+GM = Spent grain+Goat manure
CH+CD = Cocoa husk+Cow dung
CH+PM = Cocoa husk+Goat manure
CH+Gm = Cocoa husk+Goat manure
NPKF = NPK (15-15-15) fertilizer at 200kg ha^{-1}

were 83.4, 101.9, 106.6 and 114.2 cm^2. The values for numbers of fruit were 11.0, 14.2, 15.0 and 15.6, while the values for fruit yield were 7.7, 28.3, 34.0 and 38.3 t ha^{-1}. Therefore tomato yield increased in the order control < NPKF < amended SG < amended CH. The fruit yields given by CD, PM and GM amended CH and PM and GM amended SG were similar and significantly higher than value for NPKF (Table 4).

The increases in growth and yield of tomato given by animal manure amended plant residues is consistent with increased N and K concentrations of tomato plant.

A study of saxena *et al.* [15] had shown that N and K respectively dictated yield of tomato and their effects were more striking than that of P. the highest and similar mean values of yield given by amended CH and SG is attributable to highest leaf K and leaf N recorded for CH and SG respectively. Analysis data of CH and SG showed that they had relatively high values of leaf K and N, respectively. The CH has been used as source of K for maize [10]. Among the eight treatments compared, CH+PM and SG+PM, respectively gave highest values of fruit yield. This is also consistent with the fact that PM is known to have highest concentrations of N and P and least C:N and C:P ratios compared with GM and CD [7], The above attributed of PM would have enhanced decomposition of the crop wastes and quicker release of nutrients for tomato uptake.

Amended CH and SG gave higher fruit yield than NPKF. Compared with control, NPKF, amended SG and amended CH increased mean fruit yield by 268, 342 and 397%, respectively. This could be due to more nutrients released from the crop materials such as Ca and Mg. In addition to application of N, P and K fertilizers [15], applications of Ca and Mg were also found to increase yield of tomato [16, 17].

CONCLUSIONS

Crops wastes such as spent g\rain and cocoa husk combined with poultry, cow and goat manures at equal rates to give 25 t ha^{-1} were effective in increasing N and K concentrations, growth and fruit yield of tomato significantly. The amended of the crop residues with poultry manure increased fruit yield than NPK fertilizer. Crop and animal wastes could be combined and used as organic fertilizer. Animal manure amended crop wastes can substitute for chemical fertilizer in cultivation of tomato.

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