COMPARATIVE GROWTH AND YIELD RESPONSE OF SWEET PEPPER (*Capsicum annum* Linn) TO POULTRY MANURE AND INORGANIC LIQUID FERTILIZER

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ABSTRACT

This project was carried out to investigate the growth and yield response of sweet pepper (*Capsicum annum)* to organic fertilizer (poultry manure) and inorganic fertilizer (NPK liquid Fertilizer). The experiment was conducted at Horticultural Research and Training plot of Federal College of Forestry, Jericho, Ibadan, Nigeria during the rainy season of 2018. The experimental design was 2x5 factorial replicated three times and was laid out in a completely randomized design (CRD). The treatments in the experiment were as follows which involves the use of poultry manure T1 (250g), T2 (500g), T3 (750g) and T4 (1000g) and NPK liquid fertilizer at T1 (2ml), T2 (4ml), T3 (6ml) and T5 (8ml) in 8kg of soil with T0 as the control. The parameters assessed include plant height, stem diameter, number of leaves, number of fruit and fruit weight. From the experiment carried out, seedlings that were treated with 4ml of NPK liquid fertilizer did best in plant height, number of leaves and stem diameter at 6th week of assessment with the average mean of 13.70cm, 15.70, and 9.32 respectively. The treatments that received 500g of poultry manure gave the highest number of fruits and the highest weight with an average mean of 13.50 and 304.0g respectively. On the other hand, treatments that received 8ml of NPK liquid fertilizer produced the highest number of fruits and fruit weight with an average mean of 12.00 and 283.0g. It can therefore be recommended that poultry manure applied at 500g of poultry manure and 8ml of NPK liquid fertilizer is suitable for the production of sweet pepper.

Keyword: Sweet Pepper, Foliar Fertilizer, Poultry manure, Growth, Yield.

INTRODUCTION

Sweet pepper or Bell pepper (*Capsicum annum* L.) popularly known as "King of spices" is a genus of flowering plants in the nightshade family *Solanaceae* and is native to Mexico with secondary centre of origin at Guatemala and Bulgaria. Sweet peppers differ from common hot peppers in size and shape of the fruit, capsaicin content and usage. The fruits are non- pungent and have been widely used in immature or green stage as vegetable for stuffing or for salads. Sweet pepper locally called "tatase" is a very important vegetable after Tomatoes (Olaniyi and Ojetayo, 2010). It has increased in popularity, value and importance over a long period, thus making it an indispensable part of the daily diet of millions of Nigerians. Pepper is normally used as a spice in the preparation of soup and stew when cooked with tomatoes and onions. It can also be used as a condiment and extensively in flavoring of processed meat, coloring certain food preparation and also used for medicinal purposes (Alabi, 2006; UGCE, 2009).

Arising from the need to increase production of this crop for all year round supply of the commodity thereby enhancing food security. In order to obtain high production of sweet pepper, there is the need to augment the nutrient conditions of the soil to meet the crop requirement and maintain the fertility conditions of the soil. Maintenance of soil fertility has been established as a prerequisite for sustainable crop production and increased yield, while organic manuring has been reported to play a vital role in this regard (Jablonska, 1990).

Fertiliser is a material that is added to the soil to supply one or more elements required for plant growth and development (Masarirambi et al., 2012). The major three elements are nitrogen, potassium and phosphorus, the secondary elements are calcium, sulphur, magnesium and other elements are boron, manganese, iron, zinc, copper and molybdenum (De, 1988). Fertilisers enhance the natural fertility of the soil or replace the chemical elements taken from the soil by harvesting, grazing, leaching or erosion. Nitrogen, phosphorus and potassium (NPK) fertilisers have different concentrations of the elements needed by the plants for their growth and development. Nitrogen, as well as phosphorus, plays an important role in fruiting, seeding and good quality development of plants. Potassium promotes formation of strong straw, with resultant decreased incidence of lodging in plants. Foliar fertilizers exhibit a secondary fertilizing role, which determines a significant increase of the productive consumption for soil elements and soil-applied elements without substituting root fertilization methods, where foliar fertilizers are supplementary in balancing and optimizing the fertilization system applied to crops (Moursy, 2013).Poultry manure is a valuable fertilizer and can serve as a suitable alternate to chemical fertilizer. Poultry manure application registered over 53 per cent increases of N level in the soil, form 0.09 per cent to 0.14 per cent and exchangeable cations increase with manure application (Boateng et al., 2006). In agriculture, the main reasons for applying poultry manure include the organic amendment of the soil and the provision of nutrients to crops (Warren et al., 2006). Poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant (Onwu et al., 2014).

This project was carried out to investigate the growth and yield response of sweet pepper (*Capsicum annum)* to organic fertilizer (poultry manure) and inorganic fertilizer (NPK liquid Fertilizer).

MATERIALS AND METHOD

The experiment was conducted at Horticultural Research and Training plot of Federal College of Forestry, Jericho, Ibadan, Nigeria during the rainy season of 2018.

METHODOLOGY

The seeds of *Capsicum annum* were acquired from the Nigeria Institute of Horticultural Research (NIHORT), Ibadan and were raised in a germination box for four weeks using top soil. Transplanting was done to 8kg plastic pots filled with soil collected and sieved to separate all unwanted materials contained. The poultry manure was collected fresh at the Poultry Farm of the College and were air dried for 7 days before application to the 8kg of soil were measured into a plastic pot. The NPK liquid fertilizer was purchased from Agricultural Input shop at Agbeni, Dugbe, Ibadan. The air dried poultry manure was applied and mixed together with the soil at variable rates three days before transplanting while the NPK liquid fertilizer was being applied on the leaves every two weeks after transplanting. The application of NPK liquid fertilizer was prepared by diluting the rates in 100cl of water and applied with hand sprayer. Before the application of the poultry manure, the physical and chemical status of the soil were determined using the laboratory procedure of soil analysis.

TREATMENT

The experimental design was 2x5 factorial replicated three times and was laid out in a completely randomized design (CRD). The treatments in the experiment were as follows;

Poultry manure at

$PMT_{1=}$ 8kg of soil +250g of poultry manure
$PMT_{2=}$ 8kg of soil +500g of poultry manure
$PMT_{3=}$ 8kg of soil +750g of poultry manure
$PMT_{4=}$ 8kg of soil +1000g of poultry manure

NPK liquid fertilizer at

$NPKT_1$ = 2 ml of liquid fertilizer +1 liter of water
$NPKT_2$ = 4 ml of liquid fertilizer+ 1 liter of water
$NPKT_3$ = 6 ml of liquid fertilizer + 1 liter of water
$NPKT_4$ = 8 ml of liquid fertilizer + 1 liter of water
T0 = control

Parameters assessed:

The following growth parameters of plant height (cm), number of leaves and stem diameter (mm) were assessed at 2, 4 and 6 weeks after transplanting while yield component parameters of harvested number of fruits and fresh fruit weight were also assessed.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) and means was separated using Least Significant Difference (LSD) at 5% level of probability.

RESULTS

Table 1: Physical and chemical result of soil used for the experiment and proximate analysis of poultry manure

PARAMETERS	SOIL	PARAMETERS	POULTRY MANURE
pH (H_20)	6.31		
Organic Carbon (O.C) %	1.50	O.C%	6.34
Organic Mineral (OM) %	2.58	O.M%	10.94
Total Nitrogen (TN) %	0.13	TN%	0.55
K (Cmol/kg)	0.099	K%	1.61
Na (Cmol/kg)	4.52	Na%	0.11
Ca (Cmol/kg)	0.10	Ca%	2.7
Mg (Cmol/kg)	0.07	Mg%	0.002
Mn (mg/kg)	130	Mn%	0.0002
Cu (mg/kg)	2.6	Cu%	0.000
Zn (mg/kg)	12	Zn%	0.002
Fe (mg/kg)	60	Fe%	0.000
P (mg/kg)	3.05	P%	0.12
% Sand	86.5		
% Clay	9		
% silt	4.5		

The physicochemical properties of the soil at the experimental site from Table 1 indicate that Sand constituted the major particle size fraction in the soil followed by clay and silt. The soil therefore has sandy clay texture. The pH of the soil revealed that the soil was lightly alkaline (6.31). The essential nutrients in the soil are as follows nitrogen (0.13%), phosphorus (3.05mg/kg) and potassium (0.099Cmol/kg) which are lower than the poultry manure and NPK foliar fertilizer nutrient content. Hence the application has the capability to enhance the nutrient staus of the soil.

Growth response of sweet pepper to organic and inorganic fertilizers.

Table 2: Effect poultry manure and NPK liquid Fertilizer on plant height.

Treatments	2WAT	4WAT	6WAT
PMT1(250g)	6.40	7.67	15.33
PMT2(500g)	5.33	6.67	10.27
PMT3(750g)	5.67	7.87	12.57
PMT4(1000g)	7.43	10.67	13.00
NPKT1(2ml)	4.67	5.97	10.60
NPKT2(4ml)	5.70	6.60	13.70
NPKT3(6ml)	4.37	5.37	8.50
NPKT4(8ml)	2.93	3.60	7.70
CONTROL	4.63	5.43	10.80
LSD	2.38*	2.63*	7.02^{NS}
CV(%)	21.3	18.4	31.7

*= significant at 5% level of probability; WAT = weeks after transplanting.

The table presented above reveals the effect of poultry manure and NPK Liquid fertilizer on increase in height of Sweet pepper. At week 2, 4 and 6, it was observed that seedlings of Sweet pepper treated with 4 ml NPK Liquid fertilizer produced the highest height within the varying volumes of NPK liquid fertilizer applied with an average value of 5.70cm, 6.60cm and 13.70cm respectively. On the other hand, seedlings treated with 1000g of poultry manure at

week 2 and 4 had the best performance within the varying quantities of poultry manure applied as well as among all the treatments with an average mean of 7.43cm and 10.67cm respectively. At week 6, the results obtained showed that seedlings treated with 250g of poultry manure performed best overall in terms of height increase with an average mean of 15.33cm both within and among the treatments.

Table 3: Effect of poultry manure and NPK liquid Fertilizer on number of leaves.

Treatments	2WAT	4WAT	6WAT
PMT1(250g)	6.33	9.33	29.30
PMT2(500g)	5.33	8.33	41.70
PMT3(750g)	3.67	6.67	26.00
PMT4(1000g)	3.67	6.00	25.30
NPKT1(2ml)	4.07	8.00	11.30
NPKT2(4ml)	5.33	9.67	15.70
NPKT3(6ml)	4.00	6.33	12.00
NPKT4(8ml)	4.00	5.67	11.70
CONTROL	4.00	7.33	11.70
LSD	2.90^{NS}	5.48^{NS}	7.24*
%CV	36.2	40.7	44.9

*=significant at 5% level of probability; WAT=weeks after transplanting.

Table 3 presented above reveals the effect of poultry manure and NPK liquid fertilizer on leaf production of Sweet pepper. At week 2, 4 and 6, it was observed that seedlings of Sweet pepper treated with 4 ml NPK Liquid fertilizer produced the highest leaf production within the varying volumes of NPK liquid fertilizer applied with an average value of 5.33cm, 9.67cm and 15.70cm respectively. On the other hand, seedlings treated with 250g of poultry manure at week 2 and 4 had the best performance within the varying quantities of poultry manure applied as well as among all the treatments with an average mean of 6.33 and 9.33 respectively. At week 6, the results obtained showed that seedlings treated with 500g of poultry manure performed best overall in terms of increase in leaf production with an average mean of 41.70 leaves both within and among the treatments.

Table 4: Effect of poultry manure and NPK liquid Fertilizer on the Stem diameter

Treatments	2	4	6
PMT1(250g)	0.68	1.30	2.16
PMT2(500g)	0.92	1.84	3.82
PMT3(750g)	0.74	1.44	3.22
PMT4(1000g)	0.46	0.76	2.18
NPKT1(2ml)	0.36	0.97	1.63
NPKT2(4ml)	0.79	1.32	2.41
NPKT3(6ml)	0.62	1.17	2.86
NPKT4(8ml)	0.25	0.58	1.63
CONTROL	0.19	0.42	1.22
LSD	0.08*	0.12*	1.03*
%CV	15.4	18.2	23.6

*=significant at 5% level of probability; WAT=weeks after transplanting.

The table presented above reveals the effect of poultry manure and NPK liquid fertilizer on increase in stem diameter of Sweet pepper. At week 2 and 4, it was observed that seedlings of Sweet pepper treated with 4 ml NPK liquid fertilizer produced the highest stem diameter

within the varying volumes of NPK liquid fertilizer applied with an average value of 0.79cm, and 1.32cm respectively. On the other hand, seedlings treated with 500g of poultry manure at week 2, 4 and 6 had the best performance within the varying quantities of poultry manure applied as well as among all the treatments with an average means of 0.92cm, 1.84cm and 3.82cm respectively. At week 6, the results obtained showed that seedlings treated with 500g of poultry manure performed best overall in terms of stem diameter increase with an average mean of 3.82cm both within and among the treatments

Table 5: Effect of poultry manure and NPK liquid Fertilizer on number and weight yield of sweet pepper fruits.

Treatments	No. of Fruits/plant	Weight
PMT1(250g)	11.50	228.0
PMT2(500g)	13.50	304.0
PMT3(750g)	11.75	257.0
PMT4(1000g)	12.00	238.0
NPKT1(2ml)	12.25	230.0
NPKT2(4ml)	11.00	234.0
NPKT3(6ml)	10.75	250.0
NPKT4(8ml)	12.00	283.0
control	8.07	98.06
LSD	0.67*	23.1*
%CV	12.8	16.2

*=significant at 5% level of probability; WAT=weeks after transplanting.

The table presented above reveals the effect of poultry manure and NPK liquid fertilizer on the fruit yield and weight of Sweet pepper. At the 9th week of assessment, it was observed that treatments that received 500g of poultry manure gave the highest number of fruits and the highest weight with an average mean of 13.50 and 304.0g respectively. On the other hand, treatments that received 8 ml of NPK liquid fertilizer produced the highest number of fruits and fruit weight with an average mean of 12.00 and 283.0g

DISCUSSION

From the investigation, fertilizers had a considerable influence on growth and yield of sweet pepper. The two treatments showed significant difference on growth and yield of sweet pepper. One of the ways by which soil nutrients can be boosted is by the application of organic and inorganic fertilizer as also stated by Dauda *et al., (*2008).

Response to NPK liquid fertilizer application

Pepper is a healthy feeder on NPK and therefore requires a liberal application (Berke et al., 2005). The significant response of growth components such as plant height, stem diameter and number of leaves could be attributed to the fact that among various nutrients, nitrogen is very important for sweet pepper growth and reproduction. In addition, the response in terms of vegetative growth may be due to the role of nitrogen on the synthesis of chlorophyll, enzymes and protein which increases the vegetative growth. The plant height, number of leaves and stem diameter increased with increased application of NPK liquid fertilizer. This could be attributed to the increase in nitrogen, phosphorus and potassium. Similar result was reported by Lawlor *et al.* (2001) and Calyle (1998).

Response to poultry manure

The growth components such as plant height, number of leaves and stem diameter were significantly affected by poultry manure fertilization. The significant response to poultry manure at 500 and 1000g might be as result of improved nutrient supply, as well as positive manipulation of soil physical properties such as moisture retention, soil structure and aeration. Moreover, poultry manure contains essential nutrient element associated with high photosynthetic activities and thus promoted root and vegetative growth (John *et al.,* 2004). Similar result with respect to increase in vegetative growth in treatment that receives high poultry manure rates was reported by Frank (1965). Studies have shown that application of poultry manure to pepper leads to an increase in plant height, leaf area index and number of branches (Olson *et al.,* 1971). Tisdale and Nelson (1975) noted that crop response to poultry manure application is affected by nutrient reserve in the soil and that crop response to fertilizer application in soil with low nutrient content than soils with high nutrient reserves. Dauda *et al.* (2008) reported that poultry manure promotes vigorous growth, increases meristematic and physiological activities in plant due to supply of plant nutrients and improvement in soil properties. This often results in synthesis of more photosynthesis which are used in producing fruits. The response of poultry manure to growth and yield components such as number of leaves and branches, number of fruits per plant, fruit diameter, fresh fruit yield could be attributed to the ability of poultry manure to supply N and K and gradually these nutrients slowly leading to longer period of supply, that induced sustained luxuriant growth. Better storage of large reserve of assimilate produced was enhanced. Also the ability of manure to improve the physical and chemical properties of the soil ensures stress free crop development hence high yields were recorded. This observation agrees with the findings of Aliyu and Kuchinda (2002), Aliyu (2002), Dauda *et al*. (2005) and Anon (2007) who reported that nutrients in manures most especially nitrogen and other nutrients become available more slowly and a considerable amount is still available towards the latter part of the growing season.

CONCLUSION

Sweet pepper responded well both to organic and inorganic fertilizer. Growth characters of sweet pepper were significantly improved by application of poultry manure at 500g and 1000g, while growth characters of sweet pepper were significantly improved by application of NPK liquid fertilizer at the rate of 4ml.

RECOMMENDATIONS

On account of how excellently poultry manure performed on the growth and yield of sweet pepper as observed in all parameters assessed, it is therefore recommended that poultry manure should be used in the production of sweet pepper at the rates 500g. It could also be suggested that, 8ml of NPK liquid fertilizer should be used for the production of sweet pepper. Based on the result of this experiment, further research should be carried out on the effect of higher concentration of nitrogen liquid fertilizer on the growth and yield of sweet pepper.

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