Growth Response and Fruit Quality of Different Animal Manure on Hot Pepper.

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Abstract
The study investigated the effects of piggery manure, poultry manure and cow dung on the growth and yield of hot pepper (Capsicum frutescens). The seedlings of Capsicum frutescens were planted on different treatments. Animal waste was applied to the top soil for two weeks before seedlings transplanting for mineralization to take place. Treatments were arranged in Complete Randomized Design (CRD) with three replicates. Data collection commenced two weeks after seedling transplanting. The data generated were subjected to Analysis of Variance (ANOVA). The treatment with piggery manure had the best performance on the vegetative growth parameter assessed on the number of fruit, fresh fruit weight and dried fruit weight, treatment with piggery manure also was significantly different among the treatment used with the value of 11.44, 4.29 and 28.62 respectively. It is therefore, concluded that top soil and piggery manure had the best optimal growth and yield of Capsicum frutescens. The proximate analysis results also revealed that samples with piggery manure contained the highest amount of vitamin C, calcium, phosphorus, total available carbohydrate and moisture content. It is recommended that piggery manure should be used for raising Capsicum frutescens seedlings for best height, stem development, leaf production, number of fruits, fruit weight and quality based on the study.

Keywords: *Capsicum frutescens, Animal manure, Top soil, Fruit quality, CRD.*

INTRODUCTION

Pepper (*Capsicum spp*) is an economically important crop belonging to the family Solanaceae. It originated from South and Central America where it is still under cultivation (Pickersgill, 2007). The major centre of diversity is Brazil where representatives a tall cited levels are found (Nadem *et al*., 2014).Peppers are considered the first spice to have been used by human beings and there is archaeological evidence of pepper and other fossil foods from a early as 6000 years ago (Dias *et al*.,2013). The genus Capsicum has five domesticated species (*C. annuum, C. frutescens, C. chinense, C. pubescens and C .baccatum*) of which *C. annuum* is the most widely cultivated species worldwide (Andrews, 2004). Pepper was introduced into Europe by Columbus and other early new explorers in the sixteenth century and cultivation spread throughout the world (Andrews,2004). It is a small perennial shrub characterized by white or greenish-white corolla, one or more pedicels at anode with varying fruit sizes and shapes (Pickersgill, 2007). The crop can also be distinguished by its pungency which varies with cultivar but generally higher in smaller fruit types than larger thick-fleshed types.

Pepper grows relatively quick with a maturity period of 3-4months. In Ghana, it is grown in home gardens and convenient it smear settlements often as inter crop but It is now grown as a mono crop on large scale by both peasant and commercial farmers. (Pickersgill, 2007) has stated the derived savanna and northern savanna agro-ecologies are best suited for hot pepper

production with an annual rainfall of 600-1250mm. Major chili pepper producing countries include China, Mexico, Turkey, which produce about 70% of the total world- wide production (Yoon *et al.*, 2008). Ghana was ranked the 11th largest producer of pepper in the world and the 2nd largest producer in Africa with an estimated total production of 88,000 metric tons in 2011 which accounted for $96,397 (FAOSTAT, 2011). Pepper (*Capsicum frutescens* L.), an annual herb or shrub with many branches, belongs to the Solanaceae family .The unripe fruits are green or purple in color but turn red, orange, yellow or brown when ripe (Yoon *et al.*, 2006).

Pepper is an important crop species in the world. It is one of the most important vegetables grown in Nigeria and other parts of the humid and semi-arid tropics (Aliyu and Yahyah, 2011). It is commonly used as condiments (Alabi, 2006) and the non-pungent species (*Capsicum annum*) are eaten raw as salad while the stronger flavored types (chilies) are popular in all kinds of cookery as pungent species. It is a loused in seasoning sauces and soup and other dishes. As a medicinal plant, pepper is used in the prevention and treatment of cold and fever (Yoon *et al*., 2006).

The very hot varieties of pepper (Chilies) have a high content of the alkaloid capsicum which imparts the pungency or spicy taste. Pepper like other vegetables contribute nutritiously with nutrients that may be lacking in other food materials hence improve food intake (Pickersgill, 2007) .Pepper can be grown up to sea-levels of 3,000m in the tropics, preferably with a rainfall of 600-1200mm. It is sensitive to water logging and excessive rain (Yoon *et al*., 2006) and thrives best in relatively warm climate with a temperature range of 18-27^0 C. A sandy loam soil which holds moisture fairly well it liberal supply of organic matter is ideal for growth of pepper (Yoon *et al*., 2006). Presently, pepper is widely cultivated in Southeastern Nigeria but the yield is low and low fertility status of the soils has been advanced as a serious factor. Maintenance of soil fertility has been established as a prerequisite for sustainable crop production and increase yield while organic manure has been reported to play a vital role in this regard (Pickersgill, 2007).

The use of organic manure has been reported to enhance soil productivity, increase the soil organic carbon content, soil micro-organism, improves soil structure, the nutrient status of the soil and enhance crop yield (Pickersgill, 2007; Yoon *et al*., 2006; FAOSTAT, 2011). However the use of animal manure will reduce environmental hazard and inconveniences caused by its odour to the environment.

Poultry manure, cow manure and piggery manure are very good source of organic matter and play a vital role in soil fertility improvement as well as supplying primary, secondary, and micronutrients for crop production. In view of the increasing concern for the environment, attempts to further increase yield by increased inorganic fertilizer applications has not met with favorable response. The global demand for organic produce has also added to the use of organic fertilizer and other agrochemicals for increased agriculture productivity. Therefore, the present study is to assess the effectiveness of three different animal manures on yield and quality of pepper.

MATERIALS

Materials and tools used

The materials and tools used for the experiment are: *Capsicum frutesence* seeds,Planting container,Ruler,Recording book,Top soil,Poultry manure,Polythene bag,Germination box,Weighing balance (to weigh the top soil),Vernier caliper,Hoe,Hand trowel,Paper tape,Wheel barrow,Pen,Maker,Piggery manure and Cow manure

METHODS

Soil Collection and Preparation

The soil was collected within the school premises, federal college of forestry, Jericho, Ibadan. The soil was spread in an open area for air drying and it was passed through 2mm meash sieve to remove non-soil materials. A sub sample of soil was taken to the laboratory for soil analysis. 2.5kg of soil was weighed into a pot each for planting and animal manure was weighed at different kg.

Experimental procedure

The seed of *Capsicum frutescens* were sown in a germination box filled with top soil, palm front was used to cover the seed to prevent direct sunlight from heating the seed. The seed germination occurred after 5 days of sowing and was under culture for three weeks. The manure (piggery, poultry and cow dung) were taken to the laboratory and weighed out in replicate using a sensitive weighing balance of 1kg , 2kg, 3kg and 4kg of piggery, poultry and cow dung manure respectively . The manure was mixed with the top soil and watered every day to allow for the commencement of mineralization the seedling of *Capsicum frutescens* were transplanted into polythene pot.

Nursery operation

A ground nursery measuring 1.8m by 3.0m was used for raising the seedlings. The nursery site was cleared of grasses and hoed to at fine tilt. Cured organic manure was thoroughly mixed with the top soil and watered to field capacity .Seeds was in rows spaced at about 10cm apart to a planting depth of about 2cm, a day after nursery bed preparation the seed was covered with fine sand, watered lightly and mulched; furthermore, routing nursery maintenance practice was performed until seedlings was transplanted with ball of earth to the experimental pots while weeding was done manually with the use of hoe.

Treatments

The treatments in the experiment are:
T_0 – Top soil (Control)
T_1 – 1kg of piggery manure + Top soil
T_2– 2kg of piggery manure +Top soil
T_3 – 3kg of piggery manure + Top soil
T_4 – 4kg of piggery manure + Top soil
T_5 –1kg of poultry manure + Top soil
T_6 –2kg of poultry manure + Top soil
T_7 – 3kg of poultry manure + Top soil
T_8 – 4kg of poultry manure + Top soil
T_9 – 1kg of cow dung + Top soil
T_{10} – 2kg of cow dung + Top soil
T_{11} – 3kg of cow dung + Top soil
T_{12} – 4kg of cow dung + Top soil

Data collection

Data collection commenced 2 weeks after seedlings transplanting. Reading were taken every week, parameters assessed were Plant height, stem diameter, number of leaves, number of fruit, weighting of fruit and Proximate analysis of fruit.

DATA ANALYSS

All data obtained was analyzed using Genstat Statistical Software package and was subjected to Analysis of Variance (ANOVA). Means was separated using least significance difference (LSD) The at 5% level of significance.

Statistical Model used is $y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

Where y_{ij} = jth observation in group *i*

μ = grand population mean

α_i = effects of group *i*

ε_{ij} = random error (Samuel *et al*., 2012)

Chemical analysis

Pre plant soil analysis: - chemical characterization of topsoil for zinc (Zn), maganate (Mn), Iron (Fe), sodium (Na), copper (Cu), potassium (K), carbon (Ca) was determined. Physiochemical analysis of poultry manure, piggery manure and cow dung was subjected to analysis: copper (Cu), zinc (Zn), iron (Fe), manganite (Mn) nitrogen, T.P, T/N, sodium (Na), phosphorus, potassium (K), calcium (Ca), magnesium (Mg) was determined.

Physio-Chemical Results of Soil and animal wastes Used for the Experiment.

PARAMETERS	SOIL (%)	PIGGERY	POULTRY	COW DUNG	
Fe	240.0	3100.0	2760.00	1210.00	
O.C (%)	3.83	-------	------	- -----	-
O.M (%)	6.60	-------	---	----	1.30
TN (%)	0.30	1.62	0.93	0.10	
K (mol/kg)	0.20	0.33	365.00	0.02	
Na (mol/kg)	0.75	0.19	1.694	0.82	
Ca (Cmol.kg)	122.60	7.42	64.10	2600.00	
Mn (mol/kg)	174.0	267.0	-------	0.410	
P (Mg/kg)	20.20	0.924	------	12.40	
Cu	34.00	23.20	------	47.40	-
Zn	1078.0	107.40	1.48	------	-
Sand%	74.50	---------	0.06	------	
Clay%	19.00	-----	365.00	-------	
Silt%	6.50		42.10		

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RESULTS AND DISCUSSIONS

The table below showed the effect of piggery, poultry manure and cow dung on the stem girth of Capsicum frutescens after assessment. It was observed that *Capsicum frutescens* treated with 4kg of piggery manure + top soil (T_4) had the highest performance with an average mean of 0.423d while *Capsicum frutescens* treated with 1kg of cow dung + top soil (T_9) had the least performance with an average mean of 0.103b

The result from mean separation also indicates that *Capsicum frutescens* treated with 4kg of piggery manure + top soil gave the highest significant effect by carrying the letter “d”. Least mean carries the first letter “a”.

Mean separation of the growth response on the stem girth of *Capsicum frutescense*

Treatment	Weight (kg)	Girth
Control	-	0.110fg
T_1	1	0.225c
T_2	2	0.105c
T_3	3	0.108b
T_4	4	0.423d
T_5	1	0.343b
T_6	2	0.113ab
T_7	3	0.113bc
T_8	4	0.118abc
T_9	1	0.473a
T_{10}	2	0.103b
T_{11}	3	0.113ab
T_{12}	4	0.125d
LSD		0.009

NOTE: Means with the same letter are not significantly different from another

The table below showed the effect of piggery, poultry manure and cow dung on the number of leaves produced by *Capsicum frutescens* after assessment. It was observed from the table that *Capsicum frutescens* treated with 4kg of piggery manure + top soil (T_4) had the highest number of leaves with an average value of 15.57a while *Capsicum frutescens* treated with 1kg of cow dung + top soil (T_9) had the lowest performance with an average mean of 0.473a
The result from mean separation also indicates that *Capsicum frutescens* treated with 4kg of piggery manure + top soil gave the highest significant effect by carrying the letter "f". Least mean carries the first letter "a".

Mean separation of the growth response of organic manure on the leaf number of *Capsicum frutescens*

Treatment	Weight (kg)	Leaves
Control	-	10.75def
T_1	1	9.88f
T_2	2	11.63cde
T_3	3	11.69cde
T_4	4	15.57f
T_5	1	12.07bcd
T_6	2	12.29bc
T_7	3	10.97def
T_8	4	12.69bc

sT_9	1	10.38ef
T_{10}	2	13.29b
T_{11}	3	13.07bc
T_{12}	4	15.38a
LSD		1.503

NOTE: Means with the same letter are not significantly different from another
The table presented below shows the effect of piggery manure, poultry manure and cow dung on the height of Capsicum frutescens. It was also observed that plant treated with 4kg of piggery manure + top soil(T_4) had the best plant height with an average value of 8.46f followed by plant treated with 4kg of poultry manure with an average value of (7.91ab) while plant treated with 1kg of piggery had the least plant height It was revealed that *Capsicum frutescens* treated with 4kg of piggery manure gave the highest significant effect.

Mean separation of the growth response of organic manure on height (cm) of *Capsicum frutescens*

Treatment	**Weight (kg)**	**Height**
Control	-	4.40ef
T_1	1	3.89f
T_2	2	6.62bc
T_3	3	5.78cde
T_4	4	8.46f
T_5	1	5.29cdef
T_6	2	6.84bc
T_7	3	6.06cd
T_8	4	7.91ab
T_9	1	4.78def
T_{10}	2	5.55cde
T_{11}	3	6.28cd
T_{12}	4	5.75cde
LSD		1.634

NOTE: Means with the same letter are not significantly different from another
The table below shows that application of cow manure at 4kg perform best in the fresh fruit weight, dried fruit weight and number of fruit per plant with the value of 6.72,1.96 and 21.82

respectively. Applications at 1kg perform the least with the value of 3.27, 0.95 and 10.58 respectively. Therefore, the more cow dung is being added to the soil, there is an increase in the yield and quality of *Capsicum frutescen*

YIELD AND WEIGHT OF *Capsicum frutescens* AS INFLUENCED BY COW DUNG

Treatments	Fresh fruit weight (g)	Dried fruit weight (g)	No of fruit per plant
1kg	3.27	0.95	10.58
2kg	4.62	1.34	14.92
3kg	5.78	1.67	18.65
4kg	6.76	1.96	21.82

The table below shows that application of poultry manure at 4kg perform best in the fresh fruit weight, dried fruit weight and the numbers of fruit per plant with the value of 9.22,3.33 and 25.62 respectively. Applications at 1kg perform the least with the value of 4.40, 1.58 and 12.23 respectively. Therefore, the more poultry manure is being added to the soil, there is an increase in the yield and quality of *Capsicum frutescens*

YIELD AND WEIGHT OF *Capsicum frutescens* AS INFLUENCED BY POULTRY MANURE

Poultry	Fresh fruit weight (g)	Dried fruit weight (g)	No of fruit per plant
1kg	4.40	1.58	12.23
2kg	6.35	2.29	17.65
3kg	7.76	2.80	21.58
4kg	9.22	3.33	25.62

The table below also shows that application of piggery manure at 4kg perform best in the fresh fruit weight, dried fruit weight and number of fruit per plant with the value of 11.44,4.29 and 28.62 respectively. Applications at 1kg perform the least with the value of 6.61, 2.47 and 16.53 respectively. Therefore, the more piggery manure is being added to the soil, there is an increase in the yield and quality of *Capsicum frutescent*.

YIELD AND WEIGHT OF *Capsicum frutescens* AS INFLUENCED BY PIGGERY MANURE

Piggery	Fresh fruit Weight (g)	Dried fruit Weight (g)	No of fruit per plant. (g)
1kg	6.61	2.47	16.53
2kg	8.10	3.03	20.26
3kg	10.05	3.76	25.13
4kg	11.44	4.29	28.62

As depicted in table below, piggery manure, has the highest moisture content (65.175%) followed by cow dung (60.12%), poultry (56.16%) and control (48.23%) respectively.

Cow dung has the highest protein content (18.29%) among the samples; this variation may be attributed to the content of the sample.

For total available Carbohydrates this trend was followed; piggery>poultry>cow dung>control (25.67%>23.46%>17.13%> 12.54%)

The Vitamin C content also followed this trend; piggery>poultry>cow dung>control (83.20%>67.25%>62.50%>54.32%).

For Calcium this trend was followed; piggery>cowdung>control>poultry(40.24%>32.67%>22.96%>18.26%).

For Phosphorus; piggery>poultry>control>cow dung (18.36%> 16.21%> 12.92% > 10.24%)

PROXIMATE ANALYSIS

Proximate	Piggery	Cow dung	Control	Poultry
Moisture Content (%)	65.17	60.12	48.23	56.16
Crude protein (%)	17.44	18.29	10.32	13.46
Total available Carbohydrate (100g)	25.67	17.13	12.54	23.46
Vitamin C (mg/100g)	83.20	62.50	54.32	67.25
Calcium (mg/100g)	40.24	32.67	22.96	18.26
Phosphorus (mg/100g)	18.36	10.24	12.92	16.21

CONCLUSION

The treatment used had positive influence on the growth of hot pepper. The result has shown that piggery manure at 4kg and top soil had the best performance in response to all the vegetative parameters accessed. And also piggery manure at 4kg and top soil did significantly different in terms of numbers of leaves, stem diameter height, fresh fruit weight, dried fruit weight and number of fruit per plant among the treatment accessed.

The result also revealed that samples with piggery manure contain highest amount of Vitamin C, Calcium, Phosphorus, total amount of Carbohydrates and moisture content while sample treated with cow dung is richest in Protein among all the animal waste used.

RECOMMENDATION

It is recommended that piggery manure should be used for raising *capsicum frutescens* for best height stem development leaf production and good quality of hot pepper

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