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THE BEST SOURCE OF COMPOST FOR TOMATO PRODUCTION: A STUDY OF TOMATO PRODUCTION IN NIGER STATE, NIGERIA

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ABSTRACT: *This study investigated effects of source of compost manure - avian waste (poultry dropping), animal waste (horse droppings), agricultural waste and NPK fertilizer on soil nutrients, growth and yield parameters of two varieties of tomato (IFE-1 and UC-82B). The treatments applied to the soil were 800g of each compost and NPK 15-15-15 fertilizer to 1.8kg of soil in each pot stand. The chemical composition of the compost used was analyzed before addition to the soil. The soil was slightly acidic and marginal in organic matter (OM) and available P. The compost manure treatments increased soil N, P, K, Ca, Mg and pH. Growth and yield parameters such as plant height, number of branches, fruit circumference, fruit weight and number of fruits were significantly ($p>0.05$) increased by the various compost treatments used. The growth and yield parameters of the fruits increased compared to where only NPK fertilizer was used.*

KEYWORDS: Compost manure, organic matter, *garandiforme* tomato and *validum tomato.*

INTRODUCTION

Tomato; *Lycopersicon esculatum* belongs to the family Lycopersicon. Though the site of domestication is uncertain, Peralta and Spooner, (2007), suggested that the south west coast of the tropical South America may be ascribed to be the origin of the crop. This crop has become widely grown around the world because of its importance and value (Adepoju, 2014). Tomatoes are grown both in most home gardens and commercially as one of the words most popular vegetables.

It is America’s most popular home grown vegetable, produced by most homes – at lest more than 90% of home grow the crop (Peralta, and Spooner, 2007; Gao, *et, al.*, 2010). The per capital consumption of tomatoes in the United States is believed to have more than tripled in the last 50 years (Gilber *et. al.*, 2000). Its malleability when frozen has played a major role in the rapid and widespread adoption as an important feed commodity. *Lycopersicon esculatum* is thought to be the direct ancestor of cultivated tomato based on its wide presence in South America. The flowers have been classified into five botanical varieties namely *commune* (common tomato), *cercisiforme* (cherry tomato*)*, *periforme* (pear tomato), *garandiforme* (potato leave tomao) and *validum* (upright tomato), *(*Musa, *et. al.,*; 2009).

Tomato is a very widely used and important vegetable in Nigeria (Ric *et. al.,*; 2001), about 25,000 tones of fresh tomato are produced annually. It is grown for its fruit and is used in varieties of ways for the production of puree pastes, juices, and canned fruit or mixed in chilli sauces (Lagos 1979). Tomato fruit is found to have high amount of vitamin C. The seed contains 22- 29% crude fat; 15 - 28% crude fibre; 5 - 10% ash content and 23 - 34% crude protein (Standarly *et. al.,* 1994).

Tomato will grow anywhere in Nigeria; provided there is regular supply of water, however the crop does well in the savanna zone than the forest zone because disease and pests are less prevalent (Schalk *et. al.,* 1998). Tomato will also do well in the forest zone only with the late rains probably because of the incidence of white flies (*Bemisia tabaci*), this is the vector of the common yellow patch disease.

Productions of tomatoes remain low compared to increase in inhabitants of most nations and since for food – especially in soups where it is used for thickening – is on the increase, it is proper to observe how the production of this all important commodity can be improved upon. As part of crop improvement, it is the use of soils that have optimum nutrients that is used for tomato production. High cost and scarcity of chemical fertilizers to provide the much needed nutrients (NPK) for plant growth means that alternatives have to be explored and hence this study to explore composts from different sources. The study carried out in this work was to meet high demand of tomatoes throughout the year using compost treatment and increase the use of cost effective organic fertilizers e.g. composts or animal droppings.

The objectives of the study are i.) to determine the agricultural and environmental viability of using compost in growing tomato in urban high rise buildings; ii.) assess the effect of compost on the yield of tomato crops and iii.) to compare the results with that of mineral fertilizers.

MATERIALS METHODS

This experiment was carried out in the Horticultural Farm of the Crop Production Department of the School of Agricultural and Agricultural Technology, Federal University of Technology, Gidan Kwano, Minna and on the second floor of the School of Agriculture and Agric technology, Federal University of Technology, Gidan Kwano, Minna. Minna is located on 9°40' N and 6°30' E in the southern Guinea savanna zone of Nigeria. In the years the experiments was conducted - 2011 and 2012, Minna had a mean annual rainfall of about 1200mm. Ninety percent this rain fell between the months of June and August.

Temperature rarely dropped below 22^{o}C. Wet season temperatures averaged about 29^{o}C but the peak was about 40^{o}C between November and December.

Field assessment

Top soil from a depth of 0-20cm was collected from the field and was used to fill plastic pots that had being perforated at the bottom to allow for the draining of excess water. Separately the soil was analyzed for its physico-chemical properties. A total of 30 plastic pots were used for the compost trial.

Sources of compost

The sources of compost were from avian waste (poultry droppings); animal waste (horse droppings); agricultural waste (Agricultural landfills); inorganic fertilizer – 15:15:15 added per stand and a control where no compost or inorganic fertilizers were used. Samples of about 1.00kg of the compost were collected and analyzed. Each of the compost was mixed with the top soil and poured into each of the plastic pots. The experimental treatments comprised two identified tomato varieties obtained from the Minna market. The seeds were sown –three seeds per pot; on the 1st June, 2011 and 14th June 2012. At five days from emergence, the seedlings were thinned to one strong stand per pot. The pots were transferred to the story building and weeded manually twice, at 30 days after sowing and at 50% flowering during which the tomato stands were trailed on the rallings of the building. Pegging. was also carried out (the pegging was for identification). The plastic pots in three replicates were laid out in a randomized complete block design.

Assessment of growth characters.

Observation on growth parameters were conducted on the tagged plants at three weeks interval beginning from the fourth week after emergence (WAE) and continued until harvest. The parameters considered for observation included: number branches on plants; plant height; days to 50% flowering; fruit circumference on each tomato varieties; number of fruits produced per tomato varieties and fruit weight of each tomato plant.

Statistical Analysis

All data collected in the course of the study were analyzed statistically using the Minitab Statistical package Release 16. Means were separated using LSD test (when significant differences were found between treatments). Tables and figures were used to elaborate on salient points.

RESULTS AND DISCUSSION

The nitrogen content of the Avian Waste was much higher (0.255%) than the other two sources of the compost - Animal waste with 0.065% and Agricultural waste with 0.162% - Table 1. The trend in this result is also similar to that of K (cmol/kg) where Avian waste had 0.60%; Animal waste had 0.35% and Agricultural waste had 0.48%. Percent phosphorus contained in Avian waste (8%) was lowest compared to that of Animal waste with 13.5% and the Agricultural waste with 10.2%.

Effect of sources of compost on plant height

The height of tomato plants (Table 2) was not significantly different, though tomato variety UC82B was taller (54.0cm) than Ife -1 (48.7cm). As expected, plant height increased with time during the study period (begin at 15.3cm; 68.2cm and 71.0cm at 3, 6 and 9 WAT) respectively.

The interaction between source of compost; tomato variety and time (weeks after transplanting) was also not significant (P = 0.05) although the difference in height between the source of compost and the tomato varieties was observed, yet this difference was not significant.

Ghobani *et. al.,* (2008), had reported that poultry manure contributed significantly to the health of tomato in their study, compared to that of cattle, sheep or fertilizer. These workers studied the impact of organic amendments and compost on yield of tomato. In another work by Aluerez *et. al.,*. (1995), they reported that plants grown on compost were significantly better than those of the control plots. They concluded that compost amendment to soils, stimulated growth and nutrient up take of tomato plants. In this current study, animal waste was poorest in producing tomato plant height because it appeared to be low in nutrients. Nitrogen for example was low as the compost was made up of more fiber attributable to the types of feed horses were exposed to.

Effect of sources of compost on Number of branches on the tomato plants.

No difference was also observed between the number of plant branches in the two varieties of tomato and also within the sources of compost used (see Fig. 1). Although agricultural waste produced plants with the greatest number of branches (a mean of 9) compared to 8.8 for avian waste; 7.6 for fertilizer, 7.2 for animal waste and 6.3 for the control plots, this was not statistically different.

In general, the mean number or branches increased with the growing time (a natural phenomenon) up till harvesting period. There was a mean of 6.7 numbers of branches at 3 WAT; 7.0 number of branches by the 6 WAT; but increased to an average of 9.8 number of branches by 9 WAT. This result agrees with El-Tantawy (2009), who reported that number of branches significantly increased with increasing maturity of tomato plants. In this work by El-Tantawy (2009), goat dung increased number of branches, plant height, number of leaves, and stem girth. This was attributed to the quicker release of N, P and K than from the other sources of manure. Smith and Ayenigabra (2001) presented a similar result where poultry manure and other sources were used.

The result of differences in the number of branches produced in avian waste compared to that of agricultural waste in this current study is also similar to the result of Smith and Ayenigabra (2001), who reported that the quick release of nutrients from the avian waste could enable the plants to exhibit this trait.

Difference in the circumference of tomato fruits.

Although the circumference of tomato fruits did not differ, tomato variety UC 82B was larger (4.5cm) than Ife – 1 (3.8cm). This result is presented as Fig. 2. Based on the various sources of composted nutrients, avian waste had the highest fruit circumference (8.2 cm.) followed by agricultural wastes (with 3.7 cm), Fertilizer produced the third largest (with 3.5 cm), animal waste produced 3.2cm and the lest was in the control with 2.1 cm.
Although the result of this study did not find any statistical difference in fruit circumference between the two tomato varieties but this result agrees with the findings of Dauda (2003), who suggested that fruit circumference, may increase with increase in manure application. Fruit cracking was observed in fruits of the Ife – 1 and among the avian waste indicating that the nutrient status of amended soils are able to increase the water capacity of the soils used.

Mean weight of tomato fruits as affected by the sources of compost.

The Analysis of Variance for fruit weight of the tomato varieties is presented in Table 4. The observed differences between fruit weights of the two varieties or the sources of compost used were not statistically significant.
Avian waste had the highest fruit weight (63.2kg) and lowest was in the control (7.5kg). There was an increase in the weight of the fruits from Agricultural waste (16.3kg) and that of Animal waste (13.3kg) respectively. These workers had shown that tomato fruits increased in weight with increasing type of manure. The drop in weight of animal waste (13.3kg) agrees with the work of Azarmi *et. al.,* (2008) who also found that fruit weight reduced with increasing sheep manure vermicomposted in the soil.
Table 4 shows the change in fruit weight during the process of study (3, 6 to 9 WAT, 25.3 kg, 31.4kg and 12.6kg respectively). The interaction between source of organic manure and time was marginal but also not significant ($P = 0.05$).

Number of tomato fruits as affected by sources of compost.

The total number of fruits did not differ between the two tomato varieties but a significant difference between sources of compost existed between the sources of compost ($P<0.05$). Avian waste had the highest number of fruits (14.2) while the lowest was for the control (2.7).

The finding of the current study was is in line with Ni (2002) and Aliyu (2000) who opinioned that yield increased with increase in nitrogen or manure rate.
Result of the ANOVA showed a very significant effect of type of compost on plant height. There was a significant difference between the treatments used in this study. Avian waste

produced taller tomato plants (58.8cm, followed by agricultural waste (52.8cm) while the control (no compose or fertilizer) was the poorest (42.1cm).

At 3WAT, the highest plant height recorded was 16.3cm from (Avian waste), the lowest plant height recorded was 13.8cm from animal waste (horse) and the mean of all the treatments was 15.3cm. At 6 WAT, Avian waste was also the highest plant height recorded (50.8cm) and the mean of all the treatment at 6 WAT was 68.2cm. At 9 WAT, Avian waste also had the highest plant recorded (80.3cm), control has lowest plant height recorded (60.3cn) and the mean of all the treatments at 9 WAT was 71.0cm. This result shows that avian waste had a significant effect on plant height.

From table 2, at 3 WAT, avian waste developed the highest number of branches (7.5cm) and fertilizer developed lowest (6.2cm). At WAT, Agricultural waste and fertilizer has the highest number of branches (9.0) and control has the lowest (5.00. at 9 WAT, Agricultural waste has the highest number of branches (12.3cm) and control has the lowest (7.3cm). Agricultural has the lowest (7.3). Agricultural waste has the highest mean number of branches (6.3cm). Therefore this result shows that agricultural waste has the highest effect on number of branches.

From Fig 3, at 2WAT, avian waste has the highest circumference (8,9cm0, controls has the smaller circumference (3.0cm) while animal waste (horse) did not produce fruit at all. At 6 WAT, Avian waste also has the largest circumference (2.1cm). At 9 WAT, horse waste has the largest circumference (7.6cm), fertilizer has the smallest while Agricultural waste and control had no fruit at all.Avian waste has the highest mean circumference 98.2cm) and control has the lowest mean circumference (2.1cm). Therefore the result shows that avian waste has the highest effect on fruit circumference.

From table 4, at 3 WAT, avian waste had the highest fruit weight (74.3g), control has the lowest (9.7g) while animal waste had no fruit at all. At 6 WAT, avian waste also the highest fruit weight (83.8g) and animal waste had the lowest (9.9g). At 9 WAT avian waste still had had the highest fruit weight (31.5g), fertilizer the lowest (1.7g) while Agricultural waste and control had no fruits at all.Avian waste had the highest mean weight (63.2g) and control had the lowest mean weight (7.5g). Therefore this result shows that avian waste has a highest effect on fruit weight than other treatments.

From table 5 above, pots with avian waste had the highest number of fruits (14) which were significantly different from those of the next best Fertilizer – 6.1 and Agricultural waste 5.2. There was no difference between the number of fruits from these latter and that of animal waste that was 3.6 but that was significantly different from the best. The control treatment (no fertilizer or compost was the lest best with 2.7.

At 10 WAT, avian waste still had the highest effect on number of fruits (15.0) while animal had the lowest (2.70). At 11 WAT, avian waste had the highest effect on number of fruit (23.2) while control had the lowest (4.0). During the last harvesting date at 12 WAT, avian waste still had the highest effect on number of fruit (22.8) while control had the lowest (3.7).

DISCUSSIONS

Organic wastes are increasingly being thrown away instead of converting them into commercial composts which can serve as an alternative weed control method for plants. When organic manure was applied at the rate of 800g per pot stand, agricultural waste yielded the highest number of branches (9.3), while avian waste had the highest plant height:fruit circumference; fruit weight; and number of fruits. This infers that avian waste performed better than the rest types of compost. Except for the number of branches where the agricultural waste recorded the highest value (although from the statistical point of view), there was no significant difference in the number of branches, the control treatment (zero) had the lowest yield in virtually all of the record taken, inferring that the highest tomato yield could be extrapolated to field crops gotten from poultry droppings. Application of manure should be recommended although our results cannot be directly used because compost would not normally be applied at the concentration that was used in this experiment.

RECOMMENDATION

Compost from avian wastes can be used to produce good and appealing tomato crops especially if horticultural pots will be used to raise the plants. Though the application of compost to vegetables in fields has generally, but not always, given a significant yield response, it can be recommended that research should be directed towards improving compost quality and the method of application.

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Table 1. The quantity of N:P:K contained in the three sources of compost used in the study

Sources of compost	Animal Waste (Horse dung)	Avian Waste (Poultry dropping)	Agricultural waste (market waste)
% N.	0.065	0.255	0.162
P g/kg	13.5	8.0	10.2
K cmol/kg	0.35	0.60	0.48

Source. 2012/2013 study

Table 2 Mean tomato plant height as affected by different sources of Compost

Treatment	3 WAT	6WAT	9WAT	MEAN
Avian waste (poultry)	16.3	79.7	80.3	58.8
Animal waste (Horse)	13.8	70.7	71.7	52.1
Agricultural waste	14.8	72.0	71.7	52.8
Fertilizer	16.2	67.7	71.2	51.7
Control	15.2	50.8	60.3	42.1
Mean	15.3**C**	68.2**B**	71.0**A**	

Means in the same row followed by the same upper case letters are not significantly different (P = 0.05)

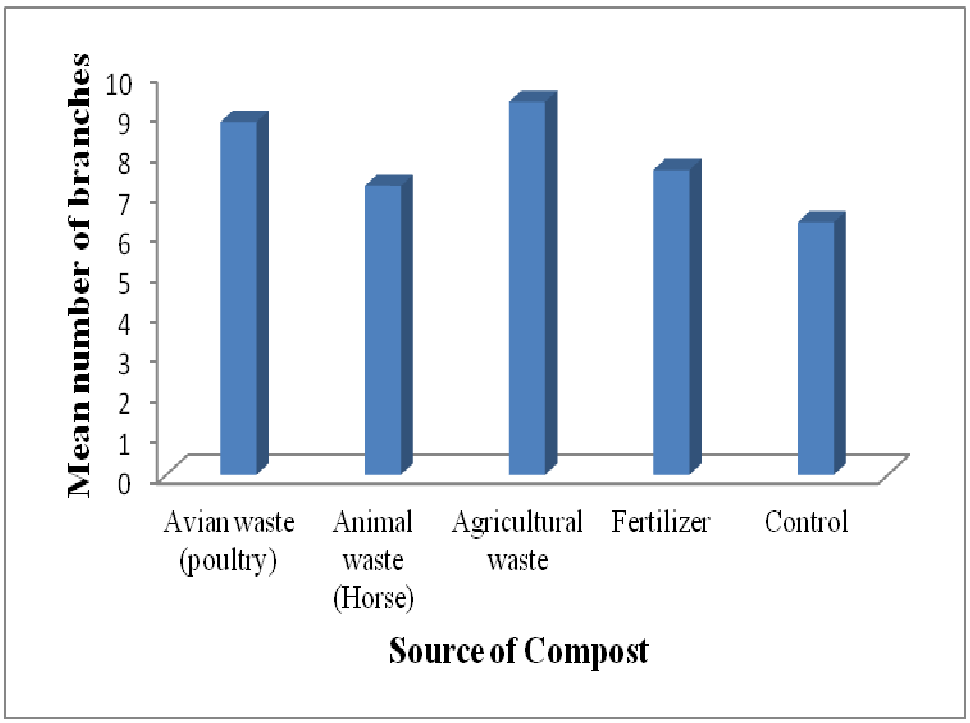

Fig 1. Mean number of branches due to sources of compost

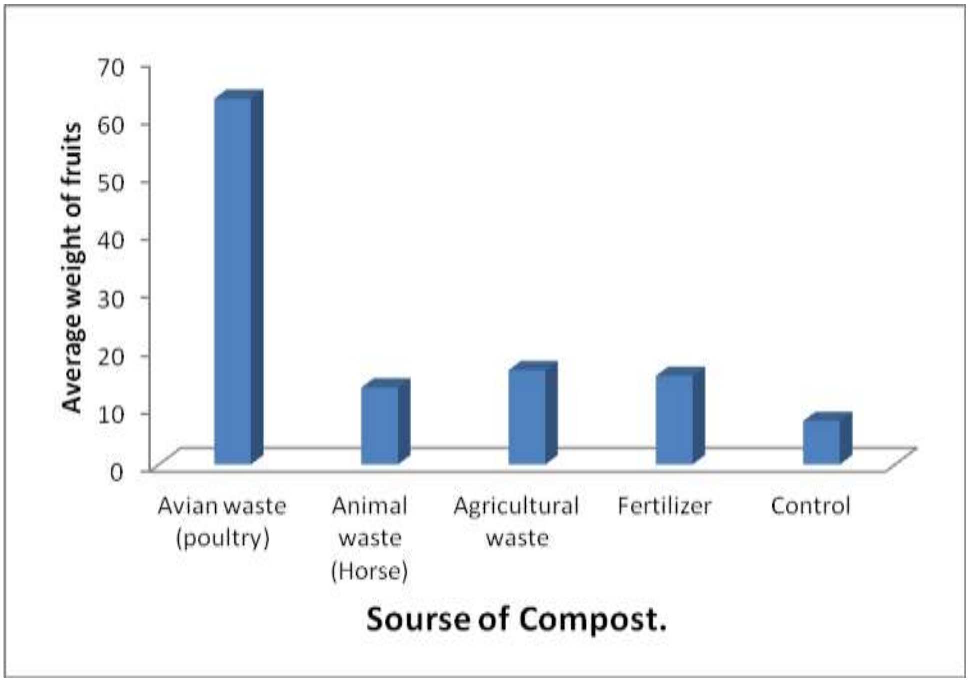

Fig 2. Mean fruit weight from different sources of compost

Table 4 Mean fruit weight (g) as affected by different sources of Compost

Treatment	MEAN
Avian waste (poultry)	63.2
Animal waste (Horse)	13.3
Agricultural waste	16.3
Fertilizer	15.3
Control	7.5
Mean	

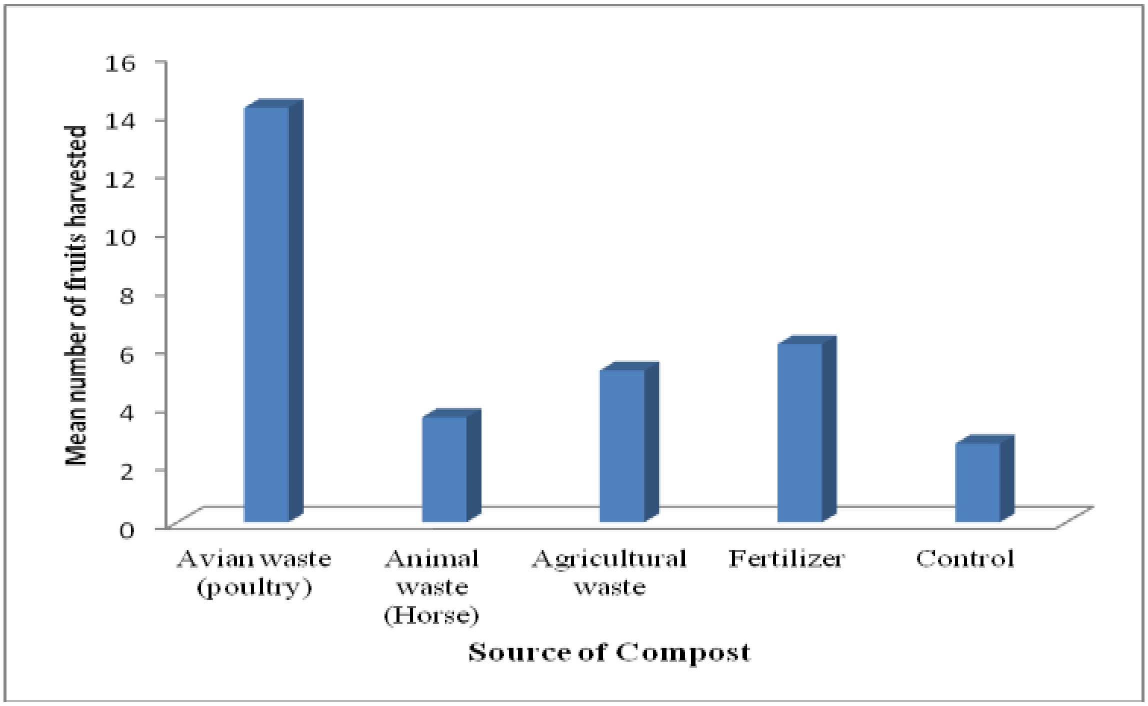

Fig 2. Mean number of fruits from different source of compost

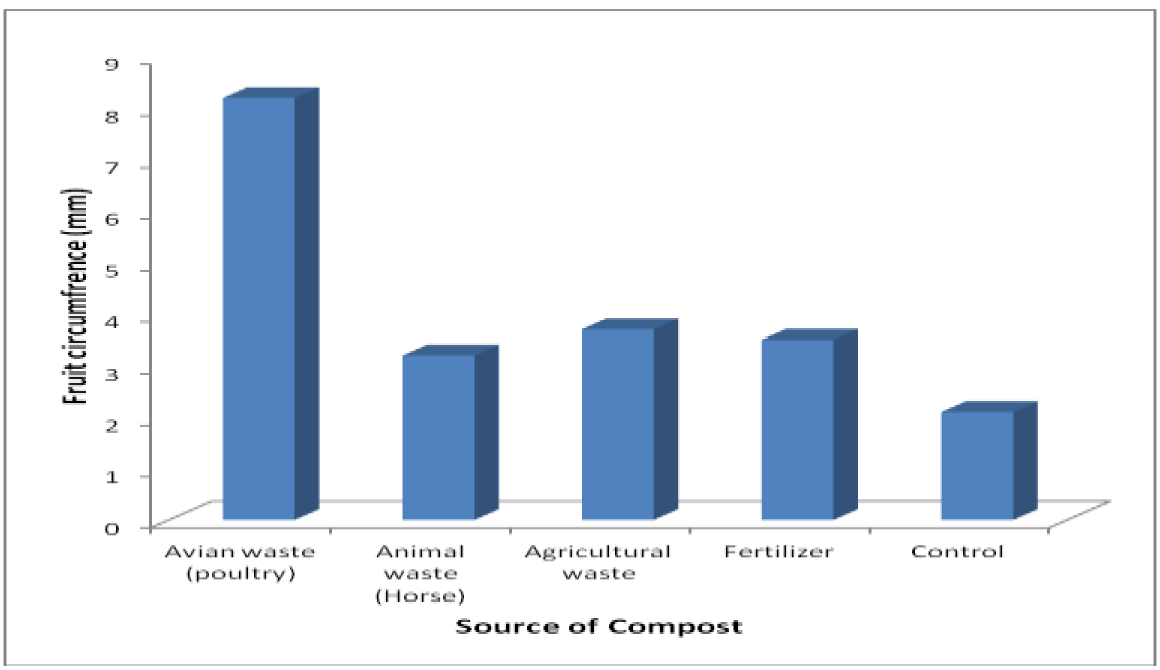

Fig 3. Mean fruit circumference as affected by source of compost