FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 3 No. 1, March, 2019, pp 28 - 32

THE EFFICACY OF POULTRY MANURE ON THE GROWTH AND YIELD OF TWO CAPSICUM SPECIES: *CAPSICUM ANNUUM* AND *CAPSICUM FRUTESCENS*

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ABSTRACT

This study was carried out to determine the efficacy of poultry manure on the growth and yield of *Capsicum annuum* and *Capsicum frutescens*. The treatments include; 0g, 2g, 4g, 6g and 8g of poultry manure per pots containing 3kg of soil. Each treatment had three replicates. The treatments were arranged in a complete randomized block design. Data collected on the growth and yield parameters showed that both species were favoured in terms of growth and yield parameters by the high concentration of poultry manure. The control, which signifies no application of the manure had, generally, the lowest values in terms of growth and yield parameters for both species.

Keywords: Poultry manure, growth and yield parameters, capsicum species, pepper,

INTRODUCTION

The genus Capsicum (pepper) belongs to the family *Solanaceae*. *Capsicum annuum* (L.) and *Capsicum frutescens* (L.) are the two common species representing the genus in Nigeria. *C. annuum* known as 'tatase' locally is a very important fruit vegetable in the tropics and it is ranked as the world second most important vegetable after tomatoes (Olaniyi and Ojetayo, 2010). Locally, *C. frutescens* is known as 'ata wewe' or 'ata eiye' (Tolu and Odunayo, 2008). Although, *C. frutescens* is also widely seen in large parts of the tropics it is also known in a wild state, a quality which makes it different from *C. annuum.* Sweet pepper, bell pepper, cherry pepper and green pepper are the popular species of *C. annuum* been cultivated (Messraen, 1992). Also, unlike *C. frutescens* which could be short-lived perennial, all cultivars of *C. annuum* are annual with usually short growing season. In general, *C. frutescens* fruit are much smaller, erect and conical (2-3 cm long), much more pungent and are usually thin fleshed and with lower vitamin C content (Kocchar, 2009; Christine *et al*., 2014).

Pepper is a valuable crop species of the world. In Nigeria and other parts of the humid and semi-arid tropics it is one of the most important vegetables grown (Aliyu, 2000). It is commonly used as condiments (Alabi, 2006) and the non-pungent species (*C. annuum*) are eaten raw as salads while the stronger flavoured types (*C. frutescens*) are popular in all kinds of cookery as pungent species. The high content of the alkaloid capsaicin ($C_{18}H_{27}O_3$) accounts for the pungency or spicy taste. Medicinally, pepper can be used to prevent and treat cold and fever (Udoh *et al*., 2005). Pepper can be grown in the tropics preferably with a rainfall of 600-1200mm, temperature of about 18-27^0 C, and a sandy loam soil which holds moisture fairly with a liberal supply of organic matter is ideal for the growth of pepper (Udoh *et al*., 2005). Water-logging and excessive rain are some of the impediments to its cultivation (Udoh *et al*., 2005).

Large scale pepper production in Nigeria is mostly found in the northern part under irrigation system during the dry season (September – March). The raining season crop (June – September) suffer serious pest and disease damage, limiting the output during the season (Quinn, 1980). Pepper is also widely cultivated in the south eastern part of Nigeria but with low yield. Low soil fertility is a factor that contributes to the low in yield. Conservation of soil fertility is thus essential for sustainable crop production and increase in yield while organic manuring has been reported to play a vital role in this regard (Jablonska 1990; Ullah *et al*.,2008). Workers like Boateng *et* al., (2009) and De-lannoy and Romain, (2001) have demonstrated the excellence and richness of poultry manure over other manure in their studies. Carbon content, water holding capacity, aggregation of the soil and a decrease in soil bulk density are some of the soil properties enhanced by poultry manure (Weil and Kroontje, 1979). Increase in fresh fruit weight of pepper has been reported by NIHORT following 2% by volume application of poultry manure in combination with 60kg P ha^{-1} (NIHORT 1992). It is with these benefits coupled with the high cost and environmental unfriendly nature of inorganic manure that prompt this experiment of determining the efficacy of poultry manure for species of Capsicum. The objectives of this study was therefore to observe how poultry manure could enhance the growth and yield parameters of the two capsicum species and also to ascertain the suitability of the manure as an ideal substitute to inorganic fertilizers in pepper production.

MATERIALS AND METHODS

Collection of soil, seeds and poultry manure

The study was carried out at the University of Ilorin teaching and research farm located at 4°38.920'E to 4°39.971'E and 8°27.810'N to 8°28.230'N. The soil used to fill the pot is a surface soil (0 – 15cm), but dark in colour indicating the presence of humus. As at the time of collection, the land was lying to fallow. The pepper seeds used in this study were gotten from an Agro-allied store at Maraba, Ilorin, Kwara state. Poultry manure, on the other hand, was obtained from the University of Ilorin faculty of agriculture poultry farm. The study was carried out between May and August, 2015.

Experimental design and treatments

The research followed a randomized complete block design (RCBD) involving five treatments and three replicates for each species. The five treatments were: 0g (control), 2g, 4g, 6g 8g of poultry manure per pot. There were 30 pots altogether, each species having 15 pots. The experimental pots contained approximately well-sieved 3kg of soil. Poultry manure was applied to the soil two days before planting so as to certify and guarantee the decomposition of poultry manure before planting. Four seeds of *C. anuum* and *C. frutescens* each were planted in their respective pots. The pots were watered on a daily basis. Weeding was done on each pot manually by handpicking as soon as the weeds are sighted in the pots.

DATA COLLECTION

One pepper plant was randomly selected per pot for data collection and was tagged for identification. The number of leaves per plant, leaf area, plant height, fruit length and number of fruits per plant were data collected for analysis.

DATA ANALYSIS

Data obtained were subjected to statistical analysis using Analysis of Variance (ANOVA) to determine if the treatments have any significant effect on the parameters measured. Means of significant treatment were further separated using Duncan's Multiple Range Test (DMRT).

RESULTS

Experimental results obtained were represented below in tables.

TABLE 1: Number of leaves of *C. annuum* as affected by the different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	8.00^{b}	8.33^{c}	10.00^{c}	17.67^{b}	23.67^{a}
T_2	9.67^{b}	11.33^{bc}	13.00^{bc}	19.00^{b}	30.00^{a}
T_3	11.00^{ab}	14.00^{ab}	17.00^{ab}	26.00^{ab}	34.33^{a}
T_4	12.33^{ab}	15.00^{ab}	18.00^{a}	29.00^{ab}	39.33^{a}
T_5	15.33^{a}	18.00^{a}	19.00^{a}	36.67^{a}	40.00^{a}
MEAN	11.27	13.33	15.40	25.67	33.47
P-VALUE	0.078	0.002	0.005	0.019	0.183

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955).

Data pertaining to leaf number at different crop growth stage is presented in table 1. Various levels of poultry manure treatment significantly affect *C. annuum* plant at all sampling periods. At 2, 4, 6, 8 and 10 WAP (weeks after planting), significant differences were recorded with increase in week numbers. There was gradual increase in leaf number from 2 WAP to 6 WAP. There was high increase in leaf number as from 8 WAP to 10WAP.

TABLE 2: Plant height (cm) of *C. annuum* as affected by different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	8.00^{c}	10.10^{c}	10.97^{c}	16.00^{b}	16.83^{b}
T_2	8.23^{c}	10.37^{c}	11.70^{c}	16.73^{b}	18.50^{b}
T_3	13.83^{b}	16.67^{b}	17.17^{b}	20.83^{ab}	22.83^{ab}
T_4	15.33^{b}	18.50^{b}	19.17^{b}	23.70^{a}	25.33^{a}
T_5	21.33^{a}	24.47^{a}	24.97^{a}	26.00^{a}	28.33^{a}
MEAN	13.35	16.02	16.79	20.65	22.37
P-VALUE	<0.001	<0.001	<0.001	0.013	0.013

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955)

Data pertaining to leaf area at different plant growth is presented in table 2. Various level of poultry manure treatment significantly ($p>0.05$) affect the *C. annuum* plant height at all sampling periods. Significant difference where noticed from 2WAP to 10WAP in all the treatments through the sampling periods.

TABLE 3: Leaf area (cm^2) of *C. annuum* as affected by the different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	17.29^{b}	18.62^{b}	36.46^{a}	46.28^{b}	47.18^{c}
T_2	20.87^{b}	31.44^{b}	47.32^{a}	59.72^{b}	100.70^{bc}
T_3	41.79^{ab}	55.00^{ab}	63.85^{a}	97.33^{ab}	157.48^{abc}
T_4	57.13^{ab}	65.44^{ab}	68.49^{a}	136.87^{ab}	205.37^{ab}
T_5	92.22^{a}	107.08^{a}	76.56^{a}	223.05^{a}	251.50^{a}
MEAN	45.86	55.52	58.54	112.65	152.45
P-VALUE	0.110	0.076	0.657	0.067	0.019

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955)

Data pertaining to leaf area at different plant growth is presented in table 3. Significant difference was observed between the treatments throughout the growing periods with treatment having the highest concentration of poultry manure with the highest leaf area.

TABLE 4: Number of leaves of *C. frutescens* as affected by different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	7.00^{a}	8.67^{a}	10.00^{a}	13.00^{b}	19.00^{c}
T_2	7.33^{a}	9.33^{a}	11.67^{a}	19.00^{ab}	27.30^{bc}
T_3	7.33^{a}	9.67^{a}	12.33^{a}	22.00^{ab}	35.00^{abc}
T_4	8.67^{a}	11.00^{a}	13.67^{a}	23.00^{ab}	41.30^{ab}
T_5	11.00^{a}	12.00^{a}	14.67^{a}	25.00^{a}	46.30^{a}
MEAN	8.27	10.13	12.47	20.40	33.80
P-VALUE	0.192	0.622	0.635	0.135	0.027

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955).

Data pertaining to leaf number at different crop growth stage is presented in table 4. Various levels of poultry manure treatment significantly affect *C. frutescens* plant at all sampling periods. At 2, 4, 6 WAP, significant differences were recorded with increase in week numbers. There was a sharp increase in leaf number from 8 WAP to 10 WAP.

TABLE 5: Plant height (cm) of *C. frutescens* as affected by the different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	4.17^{c}	8.67^{a}	10.00^{b}	17.10^{b}	20.67^{b}
T_2	6.00^{bc}	9.33^{a}	14.96^{ab}	21.17^{ab}	26.50^{ab}
T_3	6.27^{bc}	9.67^{a}	15.83^{ab}	21.80^{ab}	28.00^{ab}
T_4	8.97^{ab}	11.00^{a}	16.30^{ab}	24.17^{ab}	29.00^{ab}
T_5	11.63^{a}	12.00^{a}	22.33^{a}	29.33^{a}	36.00^{a}
MEAN	7.41	10.13	15.89	22.71	28.03
P-VALUE	0.008	0.622	0.047	0.159	0.048

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955)

Data pertaining to plant height at different growth stage is presented in table 5. Various level of poultry manure treatment significantly ($p>0.05$) affect the *C. frutescens* plant height at all sampling periods. Significant difference where noticed throughout the sampling period.

TABLE 6: Leaf area (cm^2) of *C. frutescens* as affected by the different concentration of poultry manure

TREATMENTS	2WAP	4WAP	6WAP	8WAP	10WAP
T_1	13.49^{b}	18.33^{b}	39.53^{b}	43.77^{b}	79.81^{c}
T_2	15.68^{b}	36.47^{b}	56.20^{b}	75.06^{b}	119.56^{c}
T_3	21.05^{b}	36.60^{b}	67.58^{b}	91.20^{b}	167.73^{c}
T_4	28.39^{b}	37.91^{b}	77.30^{b}	128.51^{b}	359.83^{b}
T_5	75.50^{a}	96.77^{a}	212.88^{a}	285.41^{a}	544.23^{a}
MEAN	30.80	45.22	90.70	124.79	254.23
P-VALUE	0.004	0.011	0.001	0.002	<0.001

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955).

Data pertaining to leaf area at different plant growth is presented in table 6. Significant difference was observed throughout the sampling periods. The treatment with the highest application of poultry manure had the highest leaf area while the treatment with the lowest application had the least leaf area.

TABLE 7: Yield parameters of *C. annuum* as affected by different concentration of poultry manure.

The variables used for this are fruit length and number of fruits per plant. The result is expressed in tables.

TREATMENTS	FRUIT LENGTH(cm)	NUMBER OF FRUITS
T_1	3.32^{b}	3.00^{c}
T_2	4.75^{ab}	3.67^{c}
T_3	6.00^{ab}	8.33^{b}
T_4	6.80^{ab}	12.67^{a}
T_5	8.00^{a}	15.00^{a}
MEAN	5.77	8.53
P-VALUE	0.076	<0.001

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955).

TABLE 8: Yield parameters of *C. frutescens* as affected by different concentration of poultry manure.

TREATMENT	FRUIT LENGTH(cm)	NUMBER OF FRUITS
T_1	3.40^{b}	3.00^{c}
T_2	4.80^{ab}	5.67^{bc}
T_3	5.60^{ab}	7.33^{b}
T_4	7.00^{a}	9.33^{ab}
T_5	7.30^{a}	11.67^{a}
MEAN	5.62	7.40
P-VALUE	0.067	0.003

Within column means followed by same letters are not significantly different at $p \leq 0.05$ (Duncan, 1955).

DISCUSSIONS

The experiment centres on the efficacy of poultry manure on *C. annuum* and *C.frutescens*. Generally, the study found out that high application of poultry manure is favourable for the growth and yield of both species assessed. This result agrees with the reports of Stevenson and Ardakani, (1972) and Udoh *et al*., (2005) who established that organic manure can improve soil chemical and physical properties which enhance growth and development, in addition to releasing nutrient to the soil. Table 1 and Table 4 show the effect of poultry manure concentration on the number of leaves of both species. There was increase in leaf number with increased weeks after planting across-the-board.

Tables 3 and 6 showed that leaf area, for both species, increases with the level of poultry applications as the plants grow to maturity. At 10 WAP, T5 recorded the highest value and the lowest value recorded by the control experiment. The observed increase in the size of leaf area implies that there is an effective utilization of nutrients from the soil. This result is in consonance with Aliyu (2003) and this confirms the ability of poultry droppings to supply the required Nitrogen contents needed by pepper plants to improve their growth and general performance (Alabi, 2006).

For plant height, the results obtained from the study showed that it was significantly affected by the different levels of poultry manure. The comparison of treatments' means at 10 WAP (Table 2 and 5) reveals that maximum plant height was recorded from pots where 8g of poultry manure was applied, followed by T4, then T3 and then T2 and the lowest value recorded for control treatment. These results are in accordance with the findings of Alabi (2006).

Additionally, poultry manure contains nutrient elements associated with high photosynthetic activities and thus promoted root and vegetative growth (Jahn *et al*., 2004). It is therefore not incomprehensible that the number of leaves, plant height and leaf area increased with increased application of poultry manure. Poultry manure is also rich in Nitrogen, which is known to enhance physiological activities in crops thereby improving the synthesis of photo-assimilates (Aliyu, 2000).

Application of poultry manure resulted in an increased number of fruits per plant, longer fruits and fresh fruit yield (table 7 and 8). This could be attributed to the fact that the poultry manure supplied essential nutrients for enhanced productivity (Gupta and Shukla, 1977; Takahanci *et al*., 1979). Overall, yield components tend to increase with increased application of poultry manure. This tally with Aliyu (2003) and Ikeh *et al* (2012).

However, as reported by researchers like Mitchel *et al.* (1978), accumulation of heavy metals by both plants tissue and soil is possible by applying poultry manure above agronomic rate leading to an adverse effect on crop growth and performances. In addition, very high rate of poultry manure may release phototoxic quantities of ammonia and nitrate salts which may adversely affect soil micro-organisms responsible for mineralization of plant nutrients (Weil and Kroonje, 1979).

CONCLUSION

It is from the results of the experiment that it is concluded that it is not wrong to say that poultry manure is a very good substitute to inorganic fertilizer in cultivating pepper as increasing rate of application of the manure translated to increased productivity both in growth and yield parameters observed. The results are helpful for agricultural practice to optimize the amount of manure per area to obtain the most efficient growth effect. Also, there is a global trend towards organic farming, the use of poultry manure as a substitution for inorganic fertilizer will help to achieve this aim.

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