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Influence of poultry manure on the performance of bell pepper (*Capsicum annum L*)

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Abstract: A pot experiment was conducted at the Botanical garden of University of Ilorin to evaluate the influence of different concentration of poultry manure on the growth and yield of bell pepper *(Capsicum annuum*). The experiment was a Randomized Block Design with six treatments and three replicates. The treatment details include T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings. Data were collected on Plant height, stem girth, Number of leaves, Leaf area, Number of flowers, chlorophyll contents as well as yield parameters was carried out at the end of the experiment. The result depicts a significant increase in the plant height, numbers of leaves per plant, leaf area, stem girth as well as yield parameter in the plant treated with 2.0 kg poultry manure when compared to the control plants. In conclusion, 2.0 kg poultry manure application should be adopted for soil nutrient amendment in bell pepper cultivation if optimum yield is to be achieved.

Keywords: poultry droppings; fruit circumference; fruit length; number of leaves; stem girth; stem height

INTRODUCTION

Bell pepper (*Capsicum annuum* L.) is a very important member of the Solanaceae family (Ademoyegun et al., 2011). It is a widely cultivated vegetable crop known for its nutritional value, culinary versatility, and high market demand (Ekhumelo & Olatunji, 2015). Bell peppers are rich in essential vitamins and minerals, making them a nutritious addition to the diet. They are an excellent source of vitamins C and A, providing antioxidants that support immune function, eye health, and overall well-being (Ekhumelo & Olatunji, 2015). In Nigeria, bell pepper production is often limited by several constraint including the use of low quality seeds, substandard fertilizer, lack of irrigation, poor pest and disease management, poor weed management practices and poor soil fertility etc. (Olorunmaiye, 2008; Adediwura et al., 2020). However, declining soil fertility emerges as a significant constraint. This challenge is attributed to the crops' specific requirements for a range of essential micro and macro elements, including Nitrogen, Phosphorous, Potassium, Calcium, Sodium, Iron, Zinc, and Copper (Alabi, 2006). These elements play crucial roles in ensuring proper growth and nourishment of the bell pepper plants. In the savannah region of Nigeria, bell pepper production faces significant challenges due to the prevailing grassland and scattered forest vegetation (Olaniyi & Ojetayo, 2010). These natural landscapes limit the availability of suitable arable land, and coupled with factors such as poor soil fertility resulting from soil leaching and erosion, pose substantial constraints on agricultural activities (John et al., 2004). One key concern is the urgent need to enhance soil nutrient levels to meet the demands of bell pepper crops successfully. Researchers have explored various approaches, including the use of organic fertilizers like animal waste, domestic sewage and composts, which can improve soil

fertility by providing essential nutrients (Fajainmi & Odebode, 2007). In addition, studies have investigated the use of inorganic fertilizers such as NPK 15:15:15 and NPK 150:90:90 to supply specific nutrients and support bell paper growth in the region (Abu et al., 2011). Furthermore, some research has examined the complementary use of both organic and inorganic fertilizers, seeking to harness the benefits of each to achieve optimal soil nutrient balance (Adediwura et al., 2020). However, despite these documented efforts, there remains a scarcity of research directly comparing the effectiveness of different concentration of poultry manure fertilizers for bell pepper production in the region. Such comparative studies are crucial for identifying the most efficient and sustainable soil fertility management practices for bell pepper crops in the savannah region. Thus, the present study therefore seeks to examine the effects of different concentration of poultry manure on the growth and yield of bell pepper (*Capsicum annuum* L).

MATERIALS AND METHODS

This experiment was carried out in 2016/2017 cropping season at the Botanical Garden of the Department of plant Biology, University of Ilorin, Kwara State, located on latitude 8° 29.8'N and longitude 4°32.53'E. Soil samples were randomly collected using soil auger from depth of 0-30 cm across the botanical garden of Plant Biology prior to transplanting and taken to Department of Plant Biology Laboratory University of Ilorin to analyze for the physicochemical parameters. Manure was sourced from the poultry house along University road, Tanke, Ilorin which operated a deep litter system type. Samples were treated by drying under shade for two weeks before taken to the lab to analyze for NPK and other element like Na, Mg, and Calcium to determine their percentages. The poultry droppings collected were carried to the Department of Plant Biology and weighed using a sensitive weighing balance into six different rates. Eighteen 6-L calibrated plastic pots were perforated at three points at the bottom to ensure drainage and well filled with 12.5 kg of soil each. The eighteen pots were randomly allotted to the six experimental treatments, that is T_1 = Control (without poultry droppings), T_2 = 0.5 kg poultry droppings, T_3 = 1.0 kg poultry dropping, T_4= 1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings giving 3 replications per treatment laid out in a Randomized Block Design.

A portion of well drained was located in the Biological garden, prepared and used for the nursery of pepper seedlings ahead of transplanting. Viable and healthy seeds of bell pepper were broadcast on the freshly prepared nursery soil, watered and covered with palm fronds under a raised booth to keep the soil humid. Pepper Seedlings were ready for transplanting at three to four weeks. Transplanting of the seedlings of *Capsicum annum* were made in each pot from the nursery with the use of hand trowel. Two (2) seedlings of *Capsicum annum* were transplanted in each pot after being carefully removed from the nursery.

Watering was done manually on a daily basis except when it rained. Weeding was done on each pot manually by handpicking any weed sighted in the pot. Low concentration of cypermethrin at 10 ml in 10 L of water was sprayed on the pepper shoot when insect infestation was noticed. Harvesting was done regularly as soon as the fruits were with red pilaf. Data collected on growth, yield and quality performance includes Plant height, Number of leaves per plant, Leaf area, Stem girth, and yield component such as Number of fruits per plant, Fresh weight of the fruit, Fruit length, Stalk length, Fruit diameter and Estimation of chlorophyll content. Data collected were subjected to analysis of variance (ANOVA) using Statistical Package for Social Science (SPSS) version 23.0 and means were separated using Duncan's Multiple Range Test (DMRT) at 5% level of probability. Data collected were presented in table format as means of three replicates.

RESULTS AND DISCUSSION

The result obtained for plant height, stem girth, number of leaves, leaf area, number of

flower is shown in Tables 1, 2, 3, 4, 5 At 2 weeks after transplanting (WAT), a significant highest ($p<0.05$) plant height, stem girth, number of leaves, and leaf area was recorded in plant treated with 2.0 kg of poultry droppings when compared to the control plant and increased steadily till 12 weeks after transplanting. It is worthy of note that the control plant recorded a significant low-

Table 1. Effects of poultry droppings on plant height (cm) of *Capsicum annuum*

	WEEKS AFTER TRANSPLANTING					
Treatments	2	4	6	8	10	12
T_1	15.90[a]	19.50[b]	23.00[c]	26.73[d]	31.74[f]	37.00[f]
T_2	15.53[b]	17.67[c]	21.83[d]	28.33[c]	33.33[d]	42.33[d]
T_3	14.23[e]	15.67[e]	19.43[f]	24.33[f]	32.33[d]	39.33[e]
T_4	13.06[f]	17.00[d]	21.50[e]	25.77[e]	34.33[c]	44.70[c]
T_5	14.43[d]	19.90[a]	28.83[a]	40.00[a]	48.80[a]	54.67[a]
T_6	14.86[c]	17.80[c]	27.17[b]	33.00[b]	43.67[b]	49.33[b]

Value with the same letter(s) along the same column are not significantly different at (P>0.05);
T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

Table 2. Effects of poultry droppings on stem girth (mm) of Capsicum annuum

	WEEKS AFTER TRANSPLANTING					
Treatments	2	4	6	8	10	12
T_1	1.86[c]	2.45[a]	2.91[a]	3.68[a]	3.97[b]	4.03[b]
T_2	2.02[b]	2.21[b]	2.87[b]	3.46[b]	4.01[a]	4.14[b]
T_3	1.89[c]	2.16[b]	2.51[c]	3.09[c]	3.54[c]	4.00[b]
T_4	1.63[d]	1.79[c]	2.48[c]	2.82[d]	3.23[d]	3.98[b]
T_5	1.84[c]	2.26[b]	3.05[a]	3.65[a]	4.14[a]	4.31[a]
T_6	2.32[a]	2.48[a]	2.84[b]	3.18[c]	3.95[b]	4.03[b]

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

Table 3. Effect of poultry droppings on the number of leaves of *Capsicum annuum*

	WEEKS AFTER TRANSPLANTING					
Treatments	2	4	6	8	10	12
T_1	19.33[e]	36.67[e]	6.33[e]	48.67[e]	50.00[f]	50.67[e]
T_2	23.00[d]	37.00[e]	9.67[a]	61.33[d]	62.00[e]	61.00[c]
T_3	25.33[c]	41.67[c]	7.67[c]	66.00[c]	67.00[c]	67.33[b]
T_4	26.67[b]	47.00[b]	7.00[d]	72.67[b]	70.67[b]	68.00[b]
T_5	32.67[a]	54.67[a]	8.67[b]	80.67[a]	84.00[a]	81.00[a]
T_6	25.33[c]	38.67[e]	8.00[c]	73.33[b]	64.33[d]	57.67[d]

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

est plant height (37.00 cm), stem girth (4.03 mm) and number of leaves (50.67). Significant highest plant height (54.67 cm), stem girth (4.31 mm), number of leaves (81.00), leaf area (19.68 cm^2) and number of flowers recorded in plant treated with 2.0 kg of poultry dropping could be attributed to more concentration of nutrient or mineral which is readily available and easily absorbable to the plant leading to faster growth and development (Khandaker et al., 2017). Significant highest plant height, stem girth, number of leaves and leaf area recorded in plant treated with 2.0 kg of poultry dropping beyond 2 WAT could be attributed to improved soil conditions (moisture retention, soil structure and aeration and increase nitrogen availability) following the poultry droppings application. (Yadav et al., 2013) This result aligns with the finding of Aliyu, (2000) who attributed the vegetative growth of pepper to high Nitrogen content. Ndaeyo et al. (2012) also reported an increase in the vegetative growth of peeper with application of poultry dropping. Similar results were also reported by Fagimi & Odebode (2007) in a study on the effects of poultry droppings on pepper Veinal Mottle virus yield and agronomic parameters of pepper in Nigeria.

The result obtained for the chlorophyll content of *capsicum annum* is shown in Table 6. Significant highest chlorophyll content was recorded in plot treated with 2.0 kg of poultry dropping before (0.91) and after (0.45) flowering stage while the least was observed in the control plot (0.42-0.19) The increased chlorophyll content in plant treated with 2.0 kg of poultry dropping could be

Table 4. Effects of poultry droppings on the leaf area (cm^2) of *Capsicum annuum*

WEEKS AFTER TRANSPLANTING						
Treatments	2	4	6	8	10	12
T_1	7.81^{d}	12.10^{b}	13.60^{c}	15.06^{c}	15.81^{c}	16.08^{ab}
T_2	10.49^{a}	11.35c	12.74^{d}	14.00^{d}	14.33^{d}	14.45^{bc}
T_3	7.18^{d}	7.66^{d}	8.63^{e}	9.62^{e}	10.19^{e}	10.57^{cd}
T_4	5.98^{f}	6.84^{e}	7.48^{f}	8.59^{f}	9.41^{f}	9.84^{d}
T_5	9.07^{b}	14.53^{a}	15.26^{a}	18.46^{a}	19.15^{a}	19.68^{a}
T_6	8.22^{c}	12.14^{b}	13.81^{b}	17.02^{b}	17.10^{b}	12.24^{bc}

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

Table 5. Effect of poultry droppings on the number of flowers of *Capsicum annuum*

	WEEKS AFTER TRANSPLANTING			
Treatments	6	8	10	12
T_1	2.67^{c}	6.00^{c}	3.33^{d}	0.67^{d}
T_2	0.00^{f}	3.33^{d}	3.67^{c}	4.33^{a}
T_3	0.67^{e}	2.33^{e}	4.33^{b}	3.33^{b}
T_4	1.33^{d}	7.00^{b}	1.00^{e}	0.00^{e}
T_5	7.33^{a}	14.67^{a}	4.67^{a}	1.67^{c}
T_6	3.33^{b}	6.00^{c}	4.67^{a}	0.67^{d}

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

Table 6. Effect of poultry droppings on the chlorophyll content of *Capsicum annuum*

TREATMENTS	Before Flowering	After flowering
T_1	0.42[a]	0.19[a]
T_2	0.49[a]	0.14[a]
T_3	0.74[a]	0.23[a]
T_4	0.5[a]	0.17[a]
T_5	0.91[a]	0.45[b]
T_6	0.52[a]	0.17[a]

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

adduced to more nutrient availability received by the plant (Khandaker et al., 2017). Chlorophyll component is made up from Nitrogen and it is functioning in promoting vegetative growth and green coloration of plant foliage which lead to an effective photosynthesis rate of the pepper (Omokaro & Ajakaye, 1989). Yadav et al. (2013) stated that application of organic fertilizer is an excellent base for the establishment of beneficial free living and symbiotic microbes and it increases the total microbial population, nitrogen fixing bacteria and actinomycetes which increased microbial activity, improves the availability of soil phosphorus and nitrogen.

The yield parameters considered during the experiment revealed that plant treated with 2.0 kg poultry dropping recorded significant highest ($p<0.05$) number of fruits (13.33), fruit fresh and dry weight (112.57 and 23.50 respectively), length of stalk (2.58), length of fruit and circumference (4.72 and 6.15 respectively) when compared to the control plants (2.00, 14.24, 3.10, 1.56, 2.26 and 3.40 respectively) (Table 7). Significant highest component yield in poultry manure treated plants could be adduced to the fact that the plants were exposed to greater light interception on account of a greater leaf area which lead to a higher accumulation of photosynthetic assimilates which contributed immensely to the higher component yields when compared to the control (Adediwura et al., 2020). The results are to some extent in agreement with Khandaker et al. (2017) who observed an improvement in yield parameter of *Capsicum annuum* with increasing nitrogen contents in organic fertilizer.

CONCLUSION

The importance of pepper is worth noting and remains one of the agricultural products that most of the time completes most people diet (food). Its

Table 7. Effects of poultry droppings on yield parameters of *Capsicum annuum*

Treatments	Number of Fruits	Weight of Fresh Fruits	Weight of dry Fruits	Length of Stalk	Length of Fruit	Circumference of Fruit
T_1	2.00[e]	14.24[f]	3.10[f]	1.56[bc]	2.26[d]	3.40[a]
T_2	7.00[c]	48.26[e]	12.59[e]	1.84[bc]	3.36[e]	5.26[a]
T_3	10.00[b]	82.03[b]	17.34[b]	1.88[abc]	3.75[d]	5.52[a]
T_4	9.67[b]	81.57[c]	15.89[c]	2.32[ab]	4.62[b]	6.59[a]
T_5	13.33[a]	112.57[a]	23.50[a]	2.58[a]	4.72[b]	6.15[a]
T_6	6.33[d]	63.69[d]	13.31[d]	1.73[bc]	4.13[c]	4.78[a]

Value with the same letter(s) along the same column are not significantly different at (P>0.05); T_1 = Control T_2 = 0.5 kg poultry dropping, T_3 =1.0 kg poultry dropping, T_4 =1.5 kg poultry droppings, T_5 = 2.0 kg poultry droppings, T_6 = 2.5 kg poultry droppings

yield is of a great concern to many farmers and there is need to improve on the various measures of its production with the use of poultry dropping.

This Study however shows that poultry droppings have significant effect on the vegetative growth, the fruit yield, the weight (dry and fresh) and the chlorophyll content of bell pepper particularly at pot treated with 2.0 kg concentration. At such, the poultry droppings of 2.0 kg should be best recommended to the farmers as it produces the highest yield of bell pepper. It is therefore recommended that 2.0 kg rate of poultry manure in 12.5 kg of soil should be applied to pepper for optimum growth and yield in the study area.

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