Original Research Paper

Volume-8 | Issue-9 | September-2018 | PRINT ISSN No 2249-555X

Biotechnology

INFLUENCE OF SOME MANURES (ORGANIC AND INORGANIC) ON THE GROWTH AND YIELD OF BELL PEPPER (*CAPSICUM ANNUUM LINN*).

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ABSTRACT This study was conducted to determine the effect of some organic and inorganic manures on the optimal growth and yield of bell pepper (Capsicum annuum L.) so as to form a reliable basis for selection of the most appropriate manure as growth improvement strategy. The seedlings were raised in a germination polythene pot filled with top soil and the seeds germinated/seedlings emerged at the 6th day after planting. The design of the experiment was a complete randomized design (CRD) consisting of four treatments (NPK 15:15:15 at 36kg/ha, pulverized poultry manure (PPM) at 500kg/ha, pulverized cow dung at 500kg/ha and top soil as control). The treatments were assigned randomly and replicated three times. The morphological parameters assessed include: plant height, leaf count, collar girth and number of branches while the yield indices evaluated were number of flowers, number of fruits and weight of fruits (fresh and dry). The data collected were subjected to analysis of variance (ANOVA) and significant differences were observed among the treatments at 5% probability level ($P \leq 0.05$). NPK emerged as the best manure, this was followed by poultry droppings, cow-dung manure and the least was the control (top soil).

KEYWORDS :

1.0 INTRODUCTION

Organic manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition and subsequent mineralization. The art of collecting and using wastes from animal, human and vegetable sources for improving crop productivity is as old as agriculture. Organic manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Naturally occurring or synthetic chemicals containing plant nutrients are commonly called fertilizers. Organic manures with low nutrient content per unit quality have longer residual effect besides improving soil physical properties compared to chemical fertilizer with high nutrient contents. Animal manures contribute more to the soil than just nitrogen, phosphorus and Potassium and continuous use of organic manures build organic matter in soil and improve soil structure. This modification of soil structure helps to improve water holding capacity, aeration, friability and drainage (Njoroge, 1999; Vanlauwe *et. al.* (2012); Kareem, 2014; Kareem, 2017) In addition, many trace nutrients needed for optimum plant growth are available in organic manures. Plant nutrients are also released more slowly and over a longer period of time than those from most commercial or synthetic fertilizers.

Manures enrich the soil and replenish nutrients used by crops. Although the word "manure" most often refers to any kind of fertilizer, including inorganic fertilizers. Inorganic manures are compounds that are not derived from plant, animal or other organic nutrients and added to the soil for plants growth and yield. Inorganic manures are fertilizers mined from mineral deposits with little processing (e. g. lime, potash, or phosphate rock) or industrially manufactured through chemical processes e. g. N.P. K. ratio can be 15 – 15- 15 or 5 – 10- 10 and urea is sold as a 46 – 0 – 0 dry fertilizer. Inorganic fertilizers vary in appearance depending on the process of manufacture (Greensil, 1964). The particles can be of many different sizes and shapes (crystals, pellets, granules or dust) and the fertilizer grades can include straight fertilizers (containing one nutrient element only), compound fertilizers (containing two or more nutrients usually combined in a homogenous mixture of chemical interaction) and fertilizer blends (formed by physically blending or mixing mineral fertilizers to obtain desired nutrient ratios).

Pepper is now of widespread acceptance around the world as a food source of spices, though it was first domesticated in Mexico-South America/Southern North America (Wikipedia, 2001) and it has many species/varieties (Greensil, 1964). It provides essential antioxidant vitamins (e.g. vitamins A, B6, C, K) and minerals such as potassium and magnesium (Udoh et. al., 2005) Red peppers belong to the oldest and most important natural colorant of foods. Peppers are considered to be a good source of various nutritional compounds such as carotenoids from paprika products. The motive behind this study is to evolve a reliable growth improvement strategy from the use of some organic and inorganic manures which can also ensure optimal yield of bell pepper (*Capsicum annuum L.*).

2.0 MATERIALS AND METHOD

This experiment was conducted at the Department of Plant Science and Biotechnology, Faculty of Science, Adekunle Ajasin University Akungba Akoko, in Akoko South-West Local Government Area of Ondo State, Nigeria. It is within longitude 56°34' and latitude 29°55′, the altitude is about 2044m above sea level with an arid and semi-climate. This area lies in the tropical vegetation which is of typical rainforest type. However, frequent and prevailing human activities have disrupted the natural ecosystem which was initially a thick forest. Some of the prevailing activities include bush burning, intensive/continuous farming and uncontrolled deforestation. It receives an annual rainfall ranging between 1500mm -2000mm and a mean annual temperature of 30°c. Polythene pots were procured from the University Horticultural Center, the polythene bags were perforated at the base to prevent flooding/water logging and filled with loamy soils. Fresh/matured fruits of *Capsicum annuum* were collected from Ado-Ekiti in Ekiti State, Nigeria. Seeds were extracted manually by squeezing the fruit to release the seeds which were then air-dried. The soil type used for the experiment was top-soil for the raising of the seedlings and later the seedlings were transplanted to the permanent site (big polythene pots filled with top soil). The nature of the experiment was a complete randomized design (CRD) consisting of four treatments and three (3) replicates (T°: 0kg/ha as control, T1: 36g of N.P.K 15.15.15 at 40kg/ha, T2: 108g of cow dung manure (dried, pulverized and sieved prior to application (500t/ha), T3: 108g of poultry droppings manure (dried, pulverized and sieved prior to application (500 t/ha).

The seeds were planted/sown (by broadcasting in a big polythene pot with top soil) and watered immediately after planting. Continuous watering (in sprinkles) twice a week was ensured to keep the soil in good condition (at field capacity). After germination/seedling emergence, watering was reduced to once a week and the seedlings were nursed for four (3) weeks prior to transplanting. The pricking-out (transplanting) of the seedlings into separate/big polythene pots at the rate of one seedling per pot/bag was done at the beginning of the fourth week. Top dressing was applied according to treatments and watering was carried out as needed. The tending operations carried out at different stages of growth in order to provide a healthy environment for their growth/development include weeding, watering and insect control. Weeding was done at 3rd, 6th and 9th weeks after transplanting to prevent weed competition for nutrients which could have led to environmental stress and stunted growth of the crop (Kareem, 2015). Watering: was carried out twice in a day due to absence of rainfall by using watering can to sprinkle the water. With regard to disease control, a mixture of 15g copper Oxychloride and 15g dithane M25 (85%WP) in 5 liters of water was applied at weeks 2, 4, 6 and 9 to all treatments as a curative measure to control the bacteria causing leaf spot (*Xanthomonas campestris* Pv Vesicatoria) in the study site.

Pertaining to germination/seedling emergence, growth and yield

parameters, germination/seedlings' emergence percentage determination was done by dividing the initial number of seeds that germinated by the total number of seeds planted/sown and expressed as a percentage (i.e. multiplied by 100), germination rate was determined by noting or recording the day which germination occurred (when seedling emerged). In case of the morphological growth parameters, plant height was measured from the soil level to the terminal bud using a meter rule; this was done at two weeks' interval till the end of the study. Number of leaves was obtained by physical counting and recording the values based on treatments and ditto to number of branches. The stem collar girth was measured with the aid of a venier caliper at 3cm height above soil level. With regard to the yield parameters, number of flowers was determined by counting manually (based on each treatment and its replicates, number of fruits was also determined by manually counting the number of fruits produced per treatment (average of 3 replicates) and fruit fresh weight was determined in the laboratory immediately after harvesting. Fresh and dry weights of the fruits were measured in grammes by using the meter Pc 180 sensitive weighing balance. After data collection (based on the above mentioned growth and yield parameters), the data were subjected to statistical analysis of variance (ANOVA) techniques to determine if there were significant differences among the treatments.

3.0 RESULTS AND DISCUSSION

Germination/seedlings' emergence commenced on the 4th day after sowing in loamy soil. A total number of 70 seeds of the bell pepper (Capsicum annuum) were sown and 94% germination/seedlings' emergence was observed at the 6th day after sowing. However, the seedling emergence did not take place at once but in trickles in accordance with earlier observation made by Nwoboshi (1982) and Kareem et. al.,(2005a). It was between the 4th and 6th day after sowing. With regard to plant height, there were no significant differences among the Capsicum annuum plants from different treatments (at P≥0.05, Table 1 below).

Table 1: Mean Plant Height of C. *annuum* Seedlings from Different Treatments

Period	T_0	T_1	T_2	T_3
WEEK 2	13.10±1.25[a]	15.37±0.85[a]	14.27±0.15[a]	14.17±0.67[a]
WEEK4	17.70±0.95[a]	18.87±1.46[a]	18.60±0.74[a]	19.87±0.74[a]
WEEK6	23.80±3.51[a]	20.47±0.58[a]	16.00±0.89[a]	20.53±2.70[a]
WEEK8	33.00±6.01[a]	22.50±4.44[a]	28.17±2.39[a]	32.37±4.00[a]
WEEK10	34.67±6.76[a]	25.23±5.33[a]	27.83±2.73[a]	33.73±5.57[a]
WEEK12	37.33±6.43[a]	34.10±2.40[a]	33.67±4.19[a]	40.97±5.75[a]
WEEK14	43.27±6.12[a]	38.73±3.44[a]	44.33±3.09[a]	50.70±7.64[a]
WEEK16	45.63±6.36[a]	39.07±4.65[a]	45.87±3.22[a]	52.60±7.81[a]
TOTAL	248.50±31.03	241.34±23.11	228.74±17.40	264.94±34.95
MEAN	31.06±3.89	26.79±2.89	28.59±2.18	33.12±4.37

In Table 1 above, values with the same alphabet as superscript were not significantly (P≥0.05) different ((T°: 0kg/ha as control, T1: 36g of N.P.K 15.15.15 at 40kg/ha, T2 :108g of cow dung manure (dried, pulverized and sieved prior to application (500t/ha),T3-108g of poultry droppings manure (dried, pulverized and sieved prior to application (500 t/ha).

In terms of the number of leaves of C. annuum plants, significant differences (P≤0.05) were observed from different treatments (Table 2 below)

Table 2: Mean Number of Leaves for C. annuum from Different Treatments.

Period	T_0	T_1	T_2	T_3
WEEK 2	7.42±0.51[a]	8.27±0.91[a]	7.20±0.85[a]	7.03±0.37[a]
WEEK4	11.93±0.52[a]	12.93±1.62[a]	11.10±1.20[a]	12.77±0.26[a]
WEEK6	46.70±16.60[a]	22.00±8.89[a]	25.50±8.74[a]	28.17±13.30[a]
WEEK8	75.27±24.78[a]	59.20±25.33[a]	54.47±19.65[a]	64.87±26.68[a]
WEEK10	51.20±24.47[a]	160.93±82.18[a]	151.53±31.30[b]	163.53±21.31[b]
WEEK12	155.77±4.35[a]	228.70±8.25[a]	162.37±8.09[b]	164.10±17.93[b]
WEEK14	160.93±6.71[a]	231.20±22.47[a]	177.93±12.50[ab]	184.63±29.18[ab]
WEEK16	173.33±29.70[a]	258.60±18.07[a]	179.87±21.71[a]	193.70±40.29[a]
TOTAL	682.55±107.64	1181.83±170.72	799.97±102.84	818.80±149.32
MEAN	85.32±13.46	147.73±21.34	99.99±12.86	102.35±18.67

In Table 2 above, values with the same alphabet as superscript were not significantly (P ≥ 0.05) different. Also values that had two different alphabets as superscript (Xab) were different but not significantly different. The values with different alphabets as superscript were significantly different.

The highest mean number of leaves (147.73) was recorded for C. annum plants under treatment T1 followed by those from treatment T3 with mean value of 102.35, then treatment T2 with mean value of 39.99 while T0 (control) had the lowest mean value. Similarly, there were significant (P≤0.05) differences in the collar girth of Capsicum annuum plants among different treatments

Table 3: Mean of Collar Girth for C. *annuum* from Different Treatments.

Period	T_0	T_1	T_2	T_3
WEEK 2	3.65±0.83[a]	3.44±0.70[a]	3.11±0.64[a]	3.63±0.89[a]
WEEK4	4.81±0.87[a]	4.81±0.46[a]	4.22±0.71[a]	4.49±0.87[a]
WEEK6	5.38±0.59[a]	6.11±0.55[a]	4.68±1.06[a]	5.92±1.21[a]
WEEK8	6.82±0.41[a]	6.56±0.55[a]	5.97±0.81[a]	7.06±1.08[a]
WEEK10	6.97±0.46[a]	8.49±2.12a	6.54±0.82a	6.87±1.36a
WEEK12	7.36=0.56	8.63±0.51[a]	6.47±0.86[a]	8.01±1.75[a]
WEEK14	7.34±0.41[a]	8.06±0.41[a]	7.07±0.82[a]	8.12±1.07[a]
WEEK16	8.35±0.43[a]	9.74±0.51[a]	7.81±0.79[a]	8.77±1.14[a]
TOTAL	50.51±4.56	55.84±5.81	52.94±6.52	52.87±9.37
MEAN	6.31±0.57	6.98±0.73	6.62±0.82	6.61±1.17

In the above Table 3, values with the same alphabet as superscript were not significantly (p ≥ 0.05) different. Also values that had two different alphabets as superscript (Xab) were different but not significantly different while the values with different alphabets as superscript were significantly different.

The maximum mean collar girth (6.98) plant-1 was obtained from the T1 while the lowest value (6.31) was gotten from treatment T0. Pertaining to the number of branches, significant differences (at P≤0.05) were observed among the different treatments (Table 4 below).

Table 4: Mean Number of Branches for C. annuum from Different Treatments.

Period	T_0	T_1	T_2	T_3
WEEK 2	1.37±0.70s[a]	1.10±0.59[a]	1.27±0.64[a]	1.17±0.73[a]
WEEK4	2.77±1.39[a]	3.37±0.79[a]	2.57±0.34[a]	2.60±0.86[a]
WEEK6	9.77±3.72[a]	15.53±2.71[a]	8.87±1.99[a]	16.03±4.87[a]
WEEK8	13.20±3.92[a]	21.93±2.74[a]	10.03±2.52[a]	18.20±5.95[a]
WEEK10	16.03±3.12[a]	26.03±8.37[a]	12.30±3.28[a]	21.67±7.34[a]
WEEK12	17.27±2.73[ab]	31.93±4.58[a]	10.27±6.07[a]	24.43±7.12[ab]
WEEK14	18.63±3.67[a]	37.70±0.74[a]	19.60±1.82[b]	21.10±0.80[b]
WEEK16	20.93±5.10[b]	44.00±4.65[a]	16.43±2.79[b]	26.77±6.75[b]
TOTAL	99.97±24.35	181.59±25.17	140.74±19.45	131.97±34.42
MEAN	12.50±3.04	22.70±3.15	17.60±2.43	16.50±4.30

In the above Table 3, values with the same alphabet as superscript were not significantly (p ≥ 0.05) different. Also values that had two different alphabets as superscript (Xab) were different but not significantly different while the values with different alphabets as superscript were significantly different.

The maximum mean number of branches (22.70) plant-1 was obtained from T1 while T0 (control) had the lowest value (12.50). Flowering commenced at sixth week after transplanting and significant (P≤0.05) differences were observed in the number of flowers of Capsicum annuum plants among different treatments.

Table 5: Number of Flowers for C. *annuum* from Different Treatments.

Period	T_0	T_1	T_2	T_3
WEEK6	0.75±0.25[a]	2.08±0.83[a]	1.85±0.56[a]	1.17±0.44[a]
WEEK8	0.92±0.83[b]	2.83±1.09[a]	0.75±0.29[b]	0.83±0.30[b]
WEEK10	2.08±0.60[c]	6.42±0.22[a]	3.75±0.63[bc]	5.00±0.52[ab]
WEEK12	1.92±0.79[b]	7.42±2.17[a]	2.67±0.46[b]	2.16±82[b]
WEEK14	1.83±0.63[a]	4.58±0.42[a]	3.42±1.45[a]	3.33±0.44[a]
WEEK16	3.25±0.14[b]	5.02±0.76[ab]	5.58±1.06[a]	5.75±1.29[a]
TOTAL	12.87±4.54	40.34±7.03	27.44±5.76	26.5±4.57
MEAN	1.61±0.57	5.04±0.88	3.43±0.72	3.31±0.57

In the above Table 5, values with the same alphabet as superscript were not significantly (P ≥ 0.05) different. Also values that had two different alphabets as superscript (Xab) were different but not significant while

the values with different alphabets as superscript were significantly different.

The highest mean number of fruits (5.15) plant-1 was recorded from the T1 while the lowest values were obtained from the T0 treatment (control).There were significant (P≤0.05) differences among the - Capsicum annuum plants from different treatments (Table 6 below)

Table 6: Mean Number of Fruits for C. annuum from Different Treatments

Period	T_0	T_1	T_2	T_3
WEEK8	2.08 ± 0.36^{b}	9.17 ± 0.98^{a}	1.50 ± 0.38^{b}	2.08 ± 0.87^{b}
WEEK10	2.42 ± 0.22^{b}	5.17 ± 0.60^{a}	2.50 ± 0.52^{b}	3.33 ± 0.58^{b}
WEEK12	2.17 ± 0.42^{a}	4.67 ± 0.46^{a}	3.08 ± 0.36^{b}	3.25 ± 0.52^{ab}
WEEK14	2.42 ± 0.44^{a}	3.42 ± 1.01^{a}	3.00 ± 0.29^{a}	3.67 ± 0.46^{a}
WEEK16	4.08 ± 1.25^{b}	5.75 ± 0.29^{a}	4.67 ± 0.83^{ab}	5.17 ± 0.56^{ab}
TOTAL	16.17±2.61	41.18±4.72	21.25±3.77	25.65±4.47
MEAN	2.02±0.33	5.15±0.59	2.66±0.47	3.21±0.56

In table 6 above, values with the same alphabet as superscript were not significantly ($P \geq 0.05$) different. Also values that had two different alphabets as superscript (Xab) were different but not significantly different while the values with different alphabets as superscript were significantly different [(T°: 0kg/ha as control, T1: 36g of N.P.K 15.15.15 at 40kg/ha, T2 :108g of cow dung manure (dried, pulverized and sieved prior to application (500t/ha),T3-108g of poultry droppings manure (dried, pulverized and sieved prior to application (500 t/ha)].

It was observed that the application of organic and inorganic fertilizers had a considerable influence on the vegetative growth of this crop. The highest mean number of leaves plant-1 (147.73) was recorded from the treatment T1 containing 36kg/ha fertilizer of N P K 15:15:15. This was followed by T3500kg/ha (poultry droppings) and T2 500kg/ha (cow dung) manures possibly due to higher nutrient status of N P K in T1. The lowest number of branches and leaves were observed in T0 (control) probably due is the fact that it had the lowest nutrient status among the treatments. On the other hand, application of inorganic manure was more effective than the application of organic manures. These results were in conformity with some earlier findings [Rahman et. al. (1998), Kareem and Adegoke (2015), Kareem and Akindele (2015)] who observed that the vegetative growth and yield of berry, soya bean and garden egg (respectively) increased profoundly with the application of inorganic fertilizers followed by organic manures. Also the flowering and fruiting pattern of bell pepper were positively influenced by sources of nutrients applied. The maximum number of flowers (5.04) plant-1 was produced by treatment T1 so also the maximum number of fruits (5.15) plant-1 was recorded in treatment T1. In all the indices, the lowest values were obtained from T0 (control). It was treatment T1 that also had the maximum value of fresh fruit weight (27.41Kg) and the maximum dry fruit weight (1.99Kg).

Incontrovertibly, organic manures could maintain good/ healthy soil condition but were slow in releasing adequate nutrients timely (Palomaki et. al., 2002; Aliyu, 2002) as opposed to inorganic fertilizer application which could adversely affect soil organic matter especially at higher/abnormal rates and when the application is on continuous basis. The result revealed that the maximum fruit yield (36kg/ha) was recorded from plant grown with the T1 (NPK) treatment followed by T3 (500kg/ha) poultry manure treatment followed by T2 (500kg/ha) cow dung and the lowest was obtained from T0 (control: only top soil), The reason for this type of result could be attributed to the rapid release of nutrients by the inorganic fertilizer applied (Dwevid et. al., 2002). It is pertinent to mention here that continuous addition of chemical fertilizer should be avoided because soil organic matter decreases with increasing inorganic fertilizer application but increases with all types of organic manure applications (Said, 1997). In all the parameters considered, the lowest values were obtained from the control (To) due to its low nutrient status. Based on the results obtained, it was NPK 15:15:15 fertilizer that mostly increased/improved plant growth and yield indices.

4.0 CONCLUSION

NPK 15:15:15 fertilizer can be applied to seedlings of bell pepper (Capsicum annuum) in order to increase their growth rate and yield. The level of the fertilizer must be at prescribed/recommended rates in order to avoid the burning of the plant and application should be at least 6cm away to/from the base of the stem of the plant. Farmers who prefer inorganic fertilizer should apply 500kg/ha-1 of NPK 15:15:15 and those who practice organic agriculture should apply 40t/ha-1 of poultry droppings or cow dung in order to enhance pepper yield.

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