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Short Communication

EFFECTS OF DIFFERENT LEVELS OF SEWAGE SLUDGE ON THE GROWTH AND YIELD OF SWEET PEPPER (*Capsicum annuum*) IN A TYPICAL OXISOLS OF NIGERIA

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ABSTRACT
The study was conducted to evaluate the effects of different levels of sewage sludge on the growth and yield of sweet pepper in an oxisols of Delta State, Nigeria. Samples of sewage sludge were collected from soak – away pits of the boy's hostel of the Delta State University, Anwai campus, dried and composted. The sewage sludge was weighed and applied at the rates 10, 20, 30, and 40 t/ha^{-1} in a plot size of 6 x 6m^2 with six plots per block in a randomized complete block design replicated three times. Four plants of sweet pepper were transplanted after four weeks of nursery into the main plots. Data were collected at 2, 4, 6, 8, and 10 weeks after transplanting (WAT). Growth parameters evaluated were plant height; number of leaves; plant girth; total leaf area and number of fruits at 8 and 10 WAT. Tissue assaying and heavy metals concentration were also analyzed to ascertain their status. Results of the study showed that growth parameters determined, were not significantly different ($P > 0.05$) at 2 – 4 weeks after transplanting. However, at 6 – 10 weeks after transplanting, there were significant differences in treatments with sewage sludge at 40 t/ha^{-1} having the highest plant height of 25.3 cm, number of leaves of 32.0 / plant, total area leaf of 506.8 and total number of fruits of 4.7 / plant at 10 WAT. The heavy metals concentration of the sewage sludge was within the permissible limit. However, there is need for effective monitoring and screening to ensure that only treated sewage sludges are used.

KEYWORDS: Effects, Sewage Sludge, Sweet Pepper (*Capsicum annuum*), Oxisols.

INTRODUCTION

The agronomic efficiency of synthetic fertilizers is becoming low due to its leaching, decomposition, luxury consumption and toxicity caused by heavy applications. Because of the prohibitive cost of mineral fertilizers, and its unavailability when needed, many poor resource farmers in Nigeria have resorted for better alternative in improving the fertility status of their soil to sustain production. According to Akinrinde *et al*, (2000), the use of organic residues in the forms of animals, plants or sewage sludge have constituted a low input technology to sustain crop production especially in the tropics. In most advance countries of the world, the use of treated sewage sludge as a means of increasing the fertility of the soil has been intensified. Obiagwu (1989), reported that depending on the rate of application, organic matter generated from sewage sludge may increase the C:N ratios by phytotoxic microbes and improve the soil physical properties thereby reducing or increasing the ability to urease enxyme to utilize the added urea to soil.

Treloges and Chusasavath (2003) have also reported that land application of sewage sludge affects soil properties through a reduction in bulk density, crusting, erosion, increase in aggregate stability; hydraulic and electrical conductivities water holding capacity; soil pH; organic matter content; plant nutrients and microbial and enzymatic activities. However, the favourable physical attributes of sewage sludge not withstanding, Fagbenenro, (2000) has reported that the use of sewage sludge could lead to the accumulation of toxic levels of heavy metals like Lead (Pb), Cadium (Cd), nickel (Ni) and Cronium (Cr) in crops grown on soils amended with it. With specific references to crops grown on sewage sludge, it has been reported by Obiagwu (1989), that by simple digestion and composition of sewage sludge, it could be made safe to handle and may be applied uniformly to the soil to provide some desirable characteristics. Warman and Rudd (1999), have also reported increase in yield of barley and maize following digested sewage sludge application.

In Delta State of Nigeria, the use of sewage sludge is so restricted in most occasions because of its pathogenetic considerations and high metal content usually associated with it. With the increasing high cost of mineral fertilizers which has made it unaffordable to most farmers, the exploitation of other organic sources especially those that are easily accessible and available thus become necessary. Most commonly used organic materials include those of animal wastes especially poultry droppings. But with the bird flu incidence in our society, the use of sewage sludge provides an alternative. It is therefore the objective of this study to evaluate the effects of different rates of sewage sludge on selected growth and yield parameters of sweet pepper (*C. annum*) in a typical oxisols of Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Anwai – Asaba Delta State of Nigeria. It is located at latitude 06^0 10'N and longitude 06^0

49'E with a mean annual rainfall of 1500mm, annual, temperature of 32^0C and relative humidity of 60%. The soils of the areas are highly weathered, low in clay content, and belong to the low– activity non – sticky clay type (Kaolinite). The available fertility data of the area as reported by Egbuchua, (2007), showed that the soil is moderately acidic with a pH of 6.4, the total organic matter and nitrogen contents were low 14.23 gkg^{-1} and 0.8 gkg^{-1}. The soils are also characterized by low content of basic cations such as Ca^{2+}, Mg^{2+}, and K^+, and Na hence it is typically of low natural fertility.

Experimental layout and Design

The experiment was laid out in a manually cleared plot size of 6 x 6 m^2 with six plots per block and replicated three times. The experimental design used was the randomized complete block design (RCBD). The sewage sludge which formed the main treatment was collected from soak – away pit of the boy's hostel of the Delta State University Anwai Campus, Asaba. This was dried and composted for six days and later applied at four rates of 10, 20, 30 and 40 tonnes per hectare. After application, the sewage sludge was manually incorporated into the soil before planting was made. Four plants of sweet pepper were transplanted to each of the plots and data taken at 2, 4, 6, 8 and 10 weeks after transplanting. The growth parameters taken were plant height which was measured using meter rule, the leaf area index was measured by multiplying the length and width of the broadest part of the leaf with a factor of 0.75 (Ayolagha *et al,* 2000). The plant girth was measured using a thread and a meter rule, number of branches and leaves were determined respectively by hand counting. Tissue assaying and heavy metals concentration were determined using Atomic Absorption Spectrophotometer.

Statistical analysis.

Yield data was analyzed using analysis of variance (ANOVA) and means separated using LSD at 5% level of probability.

RESULTS

Plant height

Table 1 shows the effects of different levels of sewage sludge on plant height (cm) of sweet pepper. There was no significant difference ($P < 0.05$) with treatment applied at 20 t/ha having the highest value of 18.3 cm. Plant height was generally found to increase at 8 and 10 WAT with the highest value of 25.3 cm obtained at 20 kg/ha sewage sludge application. This was closely followed by 24.0 cm obtained at 30 kg/ha treatment, showing no significance difference.

TABLE 1. Effects of different rates of sewage sludge on plant height (cm^3)

Treatment (t/ha^{-1})	Weeks after transplanting (WAT)				
	2	**4**	**6**	**8**	**10**
10	7.8	10.0	14.0	17.3	19.7
20	7.9	10.9	15.5	20.0	22.0
30	8.7	11.4	18.3	22.7	24.0
40	8.5	10.9	15.6	21.3	25.3
LSD	1.9	1.3	1.6	4.3	8.2

Number of leaves.

Table 2 shows the effects of different levels of sewage sludge on the number of leaves / plant. At 2 WAT, there was no significant difference ($P>0.05$) at the various levels of application. The same trend was observed at 4 WAT. However, at 6 – 8 WAT the highest mean values of number of leaves were obtained at 30 kg/ha sewage sludge application. At 10 WAT, there was a fluctuation in response to treatments as there were no significant differences observed.

TABLE 2. Effects of different rates of sewage sludge on the number of leaves/plant

Treatment (t/ha^{-1})	Weeks after transplanting (WAT)				
	2	**4**	**6**	**8**	**10**
10	5.1	7.7	13.7	18.3	18.3
20	5.5	7.8	17.3	26.3	27.7
30	5.6	10.7	17.7	24.3	23.0
40	6.2	11.0	20.0	34.0	35.0
LSD	2.4	1.9	7.4	9.8	9.1

Total leaf area

Table 3 shows the total leaf area as affected by different levels of application of sewage sludge. The results show a significant difference ($P < 0.05$) of total leaf area at 2 WAT. At 4 – 10 WAT, the total leaf area was found to increase significantly with the highest mean value of 506 cm^3 obtained at treatment 30 t/ha rates of application.

TABLE 3. Effects of different rates of sewage sludge on total leaf area (cm^3)

Treatment (t/ha^{-1})	Weeks after transplanting (WAT)				
	2	**4**	**6**	**8**	**10**
10	8.5	41.1	71.8	192.4	209.8
20	12.9	52.1	124.9	322.7	308.6
30	12.9	92.8	129.3	430.6	506.0
40	14.3	92.8	66.5	149.4	506.8
LSD	12.2	18.2	66.5	149.3	148.8

Number of fruits

Table 4 shows the number of fruits per plant taken at 8 and 10 WAT. The results showed that the highest number of fruits per plant were obtained at 8 WAT in treatment application of 30 kg/ha. At 10 WAT, there was a significant increase in the number of fruits. However, there was no significance different at 20 and 30/ha rates of application in which the values for the number of fruits obtained were 4.3 and 4.7 respectively. There was also no significance difference at 10 WAT with treatment at 0 and 10 t/ha in which 1.3 and 1.3 of fruits were obtained respectively.

TABLE 4. Effects of different rates of sewage sludge on the number of fruits/plant

Treatment (t/ha^{-1})	8 and 10 Weeks after transplanting (WAT)	
10	0.4	1.3
20	0.6	1.7
30	2.0	4.3
40	2.8	4.7
LSD	2.19	2.34

Heavy metal concentration

Table 5 shows the results of heavy metals concentration in the sewage sludge used for the study. The results showed that apart from iron (Fe) which is an essential trace element required for the growth of plant with the highest concentration of 98.76 mgkg^{-1}, other heavy metals evaluated have values within the torelarable limits for plants and human consumptions.

TABLE 5. Heavy metal concentration of sewage sludge on the plant sweet pepper (*Capisum annum*)

Heavy metals pmm	Values	World std (mgkg)
Lead (Pb)	48.6	1.5
Cadium (Cd)	1.03	1.0
Mecury (Hg)	0.05	0.5
Iron (Fe)	98.76	300
Cronium (Cr)	1.01	13
Nickel (Ni)	0.05	80

DISCUSSION

The significant increase in plant height, number of leaves and total leaf area at 6 – 10 weeks after transplanting to the time of harvest, could be due to a delay in the release of nutrients from the sewage sludge as the sludge need to undergo decomposition and mineralization before nutrients can be released for crop absorption. Similar results have been reported by Mbagwu (1985), and Mwale *et al.,* (2000) respectively. Highest plant growth and yield parameters were obtained at 30 t/ha application rates. This is in line with the reports of Mankar and Ruin (2001).

The non significant differences observed at 2 – 4 weeks after transplanting could be attributed to a number of factors, such as transplanting stress as a lot of time was needed by the plant to overcome the stress, and slow mineralization of the sewage sludge at the initial stage of application. The same trend of response was observed by Aliu (2003) in a similar study. The potentials for excessive crop uptake of heavy metals from sewage sludge were of great concern in this study. There have been general concern of pathogenecity and undesirable metal accumulation in soils and plants. There was no observed general pattern of the heavy metals concentration in the sewage sludge used in the study. The observed concentrations were within the permissible level established by FAO/WHO (1984) as international approved limits. Analysis of sewage sludge indicated the presence of Lead (Pb) and Cronium (Cr). However, reports have shown that lead (Pb) is not taken up by plants to any degree and thus plants are not a major risk pathway for ingesting Lead (Pb) (Miller and Miller 2000).

CONCLUSION

Sewage sludge has the capacity to supply nutrients for sustained crop production. The results of the study revealed that the highest plant height, number of leaves; total leaf area and number of fruits were obtained at 30 t/ha^{-1} application than other application rates. Generally, the capacity of the different levels of sewage sludge to increase sweet pepper growth was in this order: 40, >30 > 20 > 10 t/ha^{-1}, respectively. This implied that at higher application rates, the tendency of sewage sludge to supply plant available nutrients is assured. The result also revealed that the concentration of heavy metals in the sewage sludge were within the permissible limit.

RECOMMENDATIONS

Because of the increasing use of sewage sludge as an alternative source of mineral fertilizers to increase yield output, there is need for effective monitoring to ascertain heavy metals concentration of sewage sludge use in crop production. This is because heavy metals contained in biosolids are easily immobilized by plants due to their strong association with organic matter.

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