ISSN 2347-6893

Effects of Banana Compost on Growth, Development and Productivity of Sorghum bicolor Cultivar (Tabat)

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ABSTRACT

The research was targeted to determine the effect of organic fertilizer prepared from the composting of banana waste on growth, development, morphologically and productivity of Sorghum bicolor 'cv (Tabat)'. In order to convert huge of banana residues parts wastes and to reduce the chemicals fertilizers pollution, the banana compost was used on Sorghum bicolor in this study. This type of organic fertilizer detected magnitude of morphological changes on different parts of the plant used in this experiments. The other uses of the banana compost were the improvement of texture, structure, water holding capacity, permeability and productivity of the soil. The experiments were conducted at the green house of the Department of Biological and Biotechnology and Environmental Science, Al Neelain University, Khartoum, Sudan. In these experiments banana compost was used at different levels (10g , 20g and 30g) for each 500g of clay soil, which were equivalents to 1 ton, 2 tons and 3 tons per fedan respectively. Two controls, control virgin soil and control with recommended nitrogen level were used. The results showed that the treatments with 3 tons banana compost level had its significant ($P < 0.05$) over the both controls with a maximum growth rate in the plants morphology as well as length of the plants of 11.9cm. and the mass productivity of one gram.

Keywords

Banana compost; Sorghum bicolor; Virgin soil; Control of Nitrogen level

Academic Discipline And Sub-Disciplines

Biology

SUBJECT CLASSIFICATION

Biological fertilizer

TYPE (METHOD/APPROACH)

Greenhouse experiments

Council for Innovative Research

Peer Review Research Publishing System

Journal: JOURNAL OF ADVANCES IN BIOLOGY

Vol .8, No.2

www.cirjab.com , editorsjab@gmail.com

ISSN 2347-6893

INTRODUCTION

Banana residues being organic in nature are rich source of macro and micronutrient that can be recycled to prevent their disposal in environment, thus sustaining the balance between economic development and environmental protection (1).Therefore compost is an organic matter that has been decomposed and recycled as a fertilizer for soil amendment. The disposal of large volume of waste materials can be an expensive and environmentally threatening operation, however, if alternative uses can be found, disposal costs can be avoided and added economic value can be obtained from the usage of waste materials (2-3). After fruit harvest, the vegetative part of banana are dumped away having a total nutrient contents. Banana plant as a whole waste contain almost 50% nutrient (4). Many strategies are being adopted to dispose organic, yet it has to be safer for environment and sustainable for nutrient conservation. The composting technology is the rapid break down of organic matter by the act of organisms, which produces humus (5). It is regarded as fully sustainable practice, since it aims at both conservation of environment, human health, safety and economically convent production. Composted material has more concentration of nutrient, narrower C:N ratio free from pathogens and other potential contaminants that cause pollution (6- 7). In corporation of chemical fertilizers in composted materials improve its efficiency and reduce losses (8). Application banana waste improves soil structure, texture, aeration, water holding capacity, porosity, increases stress tolerance and also reduces the use of chemical fertilizers (9) thus saving huge amount of foreign exchange incurred for import of fertilizers (10). Compost plays a central role in maintaining key soil functions and is essential determinant of soil fertility and resistance to erosion (11). The compost reduces were used as artificial fertilizers, and the amounts of waste added to land fill sites compost is considered to be an environmentally safe, agronomic ally advantageous, and relatively cheap organic amendment which stimulates soil microbial activity and crop growth (12- 13- 14). Compost is excellent source of plant available nutrient and their addition to soil could maintain high microbial populations and activities (13). Composting has been recognized as a low cost and environmentally sound process for treatment of many organic wastes (15).

The banana plant is a large herb (tree)belonging to the family Musaceae, very tender stem which is a cylinder of leaf-petiole sheaths, reaching a height of (6-6.5 m) and arising from a fleshy rhizome or corm. Suckers spring up around the main plant forming a clump or "stool", the eldest sucker replacing the main plant when it fruits and dies, and this process of succession continues indefinitely. The amount of banana waste reached on million tons per year from total banana cultivated area (16). This tremendous amount is an environmental and economic problems facing bananas farm (17). Reapplied banana waste to the plant after harvest was reported, such banana trash used as mulch to maintain soil moisture (I8). Bananas have a great economic impact as one of the most popular fruits and for its high nutritive value. Banana plays an important role in tropical economic as cash export and complementary food in local sets. Besides, we can use banana waste as a natural fertilize alternative to manufactured fertilizers. These chemical fertilizers are considered as air, soil and water polluting agent during production and utilization (19).

Fertilizers generally contribute to the accumulation of soil acidity. Chemical fertilizers may cause the breakdown of the symbiotic relationships between plants roots and Mycorrhiza, and can cause problem for natural habitats and for human health if they are washed of soil in to water courses or leached through soil in to ground water (20). Consequently, banana has drawn the attention of researchers and banana growers to use the organic fertilizers which are safe for human, animal and environment as a partial substitute for mineral source. Thus it is preferred to avoid pollution and to reduce the costs of chemical fertilizers (21). Banana plant can be used to generate energy through decomposition (22), and used as a good composting material (23). Banana waste materials are rich in nutrient and minerals (20- 24). Fertilization is an important and limiting factor for growth and productivity of plants because plants remove large amounts of nutrient from the soil. Among these nutrients, nitrogen is considered the prime nutrient for growth of plants. Nitrogen has many functions in plants life, being a part of proteins, Nitrogen is an important constituent of protoplasm it is responsible for biosynthesis of enzymes, nucleoproteins, amino acids, amines, amino sugars, polypeptides, chlorophylls and encourages cell divisions (25). The use of waste product is one of corner stones of organic farming (26). This means returning back to the soil, all manures and plant residues produced on the farm in the best form possible, with minimum loss and maximum stability of nutrients. (26- 27) showed that organic manures are the most important fertility amendments farmer supply and they give priority to plants. The various positive effect of applying bio-fertilizer were attributed to its own from different nutrients, higher percentage of proteins, and natural plant growth regulators such as cytokines. In addition, they contain active microorganism hydrolyzing the insoluble in soluble ones and they have greater amount of symbiotic and non-symbiotic bacteria. Biological fertilization plays an important role in improving growth of plants (28).

Soil organic matter is a major source of plant nutrient (29). And also improves physical properties of soil, such as soil porosity, structure, and water holding capacity (30). Soil organic matter management therefore is very important for the development of sustainable low – input agricultural system and for the improvement of soil quality (31). In many cropping system little or no crop residue is returned to the soil. This leads to decline in soil organic matter content and sub sequent a decline in crop yields, bio mass production (32). Due to the lowest decomposition rate of organic matter and low fertility status of soils, especially low phosphorus content, it is recommended that organic resource be first composted to increase nutrient availability and decrease the C: N ratio before application in the field (33).

Materials and Methods:

This study was carried out at the green house of Department of Biology and biotechnology and Enviromental Science, Faculty of Science and Technology, Al-Neelain University. The study was aimed to see the effect of compost formed from banana trees on the growth and development of Sorghum bicolor cv (Tabat). 500g of clay soil in each bag having 4 seeds of Sorghum bicolor were used. The banana compost were added on different weight (10g , 20g and30g) equivalents to

one ton, 2 tons and 3 tons /fedan respectively. All seeds were sown in the same date, the irrigation was constant, daily . The study included three experiments, in each one there are three replicates and there are two controls with NPK

recommended fertilizer doses to the silt soil, and control untreated soil (virgin soil). The experiments were taken 4 weeks. The identified fresh weight and dry weight of the plant were taken at the room temperature. The general measurements and observation (color, length and growth rate) of the plants were recorded.

Banana compost production:

The method of (34) was adopted for production of compost. The preparation of compost was done in two steps. The selected banana wastes, animal manure, and other crop residues were used as composting material. The first step, which took place during the rainy season, consisted of putting the organic in pits for aerobic decomposing the organic materials were progressively added depending on their availability in the banana waste. The pit size was 3m x 3m x 1.2m, during this first step; water from rain fall was enough to maintain required moisture in the decomposing material. In the second step, which took place during dry season, the decomposing materials in the pits were placed in to heaps for further decomposing. The heaps were built with successive stratums of decomposing material derived from the pits. In addition, grasses were added to increase the availability of carbon as an energy source for decomposer microbes in the decomposing material and also to increase the quantity of the compost. The mean size of the heaps depended on the quantity of available material. The heaps were watered every week minting moisture level at 60% and retained for 90 days retention period.

Analysis of soil and nutrient of banana wastes :

Soil used in this study was obtained from the Blue Nile bank. The soil sample was analyzed by atomic absorption spectrophotometer, Model VGP made in U.S.A (35) method was used for the analysis of nutrient of banana wastes.

Statistical Analysis:

Analysis of variance (ANOVA) followed by Duncan's Multiple Range as outlined by (36).

Results and Discussion:

Table 1: Nutrient content of fresh, compost, banana wastes and silt soil:

Nutrient	Leaves	Pseudo stem	Rhizome	peels	Silt(nm) Soil	Banana Compost
Nitrogen (%)	2.5	2.8	3.0	2.6	0.2	3.0
Phosphorus (%)	0.4	0.4	0.5	0.6	0.9	0.93
Potassium (%)	4.0	4.2	4.4	3.5	0.7	4.2

The raw material of banana (leaves, pseudo stem, rhizomes, peels and silt soil were tested for their nutrient content. Table (1) showed that the amount of NPK of compost banana wastes, gave the highest values compared to that of silt soil and other parts of banana. The results were agree to that obtained by (37).

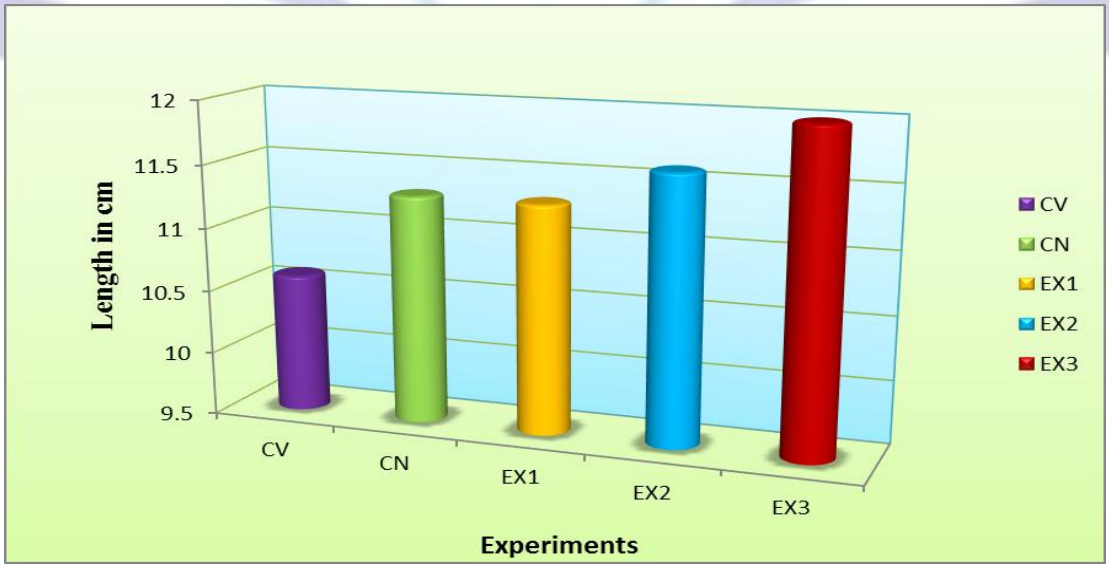

Figure 1: The variation in the length of Sorghum bicolor in each experiment in centimeter.

ISSN 2347-6893

Where: CV =control virgin soil, CN =control with recommended nitrogen practices. EX1=compost 1ton/fedan, EX2=compost 2 ton/ fedan and EX3=compost 3 ton/fedan

The results in figure (1) were showed the effect of compost prepared from banana on the length of Sorghum bicolor cultivar (Tabat) and the impact was evident in the graph. The results revealed that in the maximum length of plants was obtained by the plants treated by banana compost at 3 ton/fedan (500g of soil) (11.90 cm.) , compared to that of 10.5 cm and 11.2 cm for control of virgin soil and control with nitrogen respectively. These results showed that they were statistically significantly ($P < 0.05$).This findings are agree to the study of (38) on Basari banana, (27- 39).

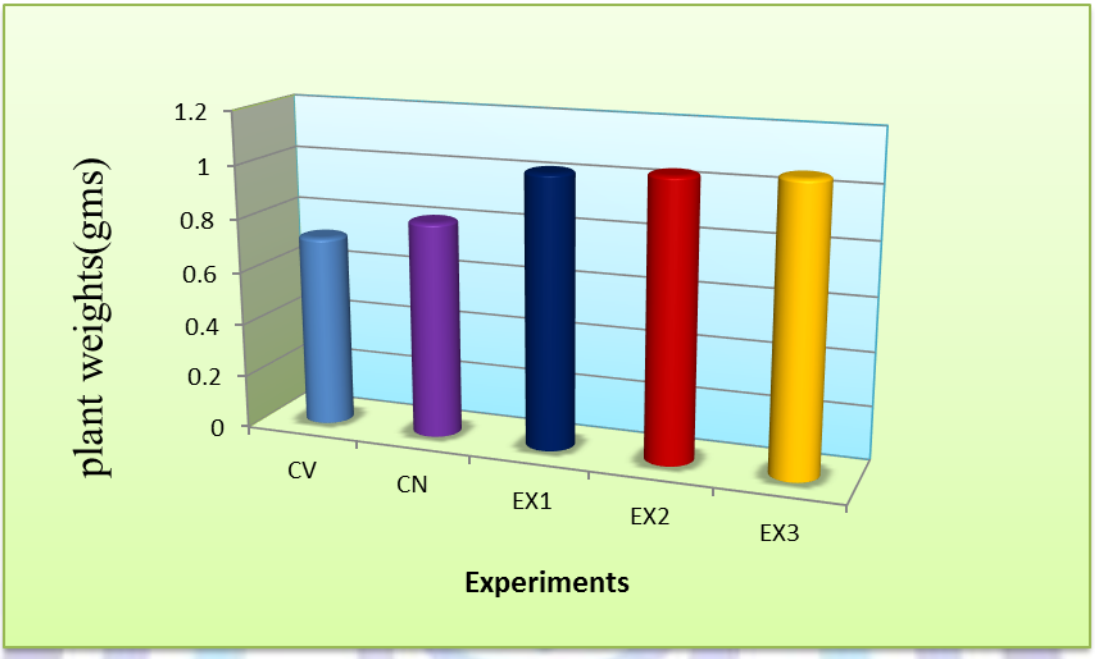

Figure2: Dry weight of Sorghum bicolor in grams.

Where: CV= Control virgin soil, CN= control with nitrogen, EX1=compost 1ton/fedan, EX2=compost 2 ton/fedan, EX3=compost 3 ton/fedan.

The effects of banana compost on biomass of the plants were shown in figure (2) and the impact is evident in the graph. The results of this study were compared with both control plants (control virgin soil and control with nitrogen). The maximum plants average (one gram) was obtained in the experiment at the rate of 3 ton /fedan. The results showed that they were statistically significantly ($P < 0.05$). The variation in growth and morphological changes were seen in plate (1- 2). Variation in growth was determined by taking the length of plants at different periods of time. This finding was similar to the results of work by (40)

Also we found that it was improved soil properties and plant growth and production. Similar result obtained by [34] Productivity described in the figures 1&2. Also these results are in concordance with the results obtained by (1). These results were also shown in the photos that were given in the plates 1 & 2.

ISSN 2347-6893

Plate 1: Show the plant experiment compared with control virgin soil at the three replication of each experiment R1, R2 & R3

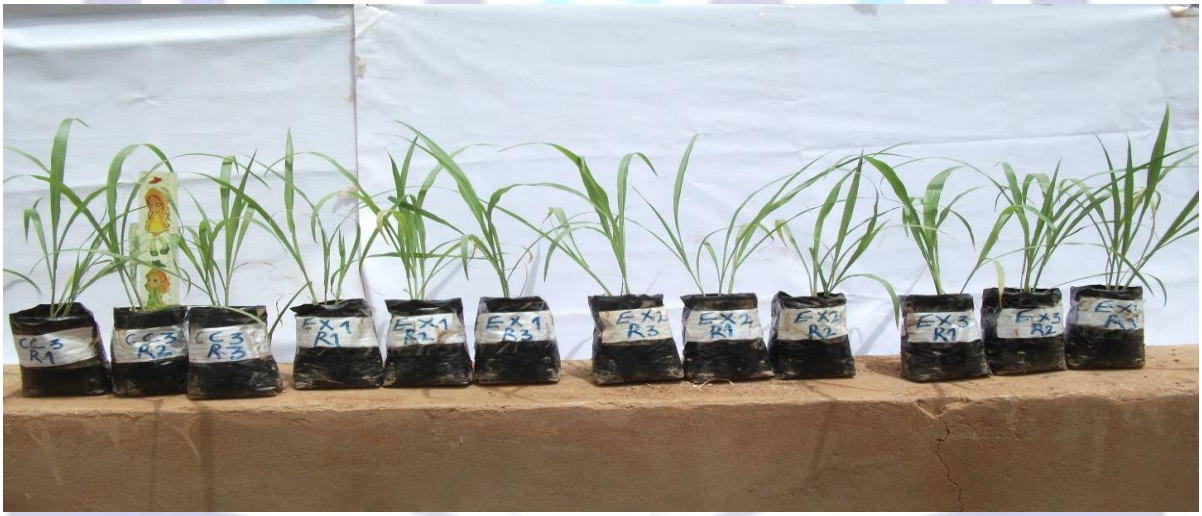

Plate 2: Show the plant experiment compared with control with nitrogen at the three replicates of each experiment R1, R2, &R3.

Conclusion:

Based on the finding of this study we conclude that, compost amendment improves soil, chemical, and physical properties. Soil organic matter may not be significantly influenced by compost application in this short term experiment. Long term experiment is necessary to show such an effect. However the application of compost resulted in a significant increase in crop production and mitigates the negative effect off seasons sowing. The use of compost, therefore, is a sound technology for combating soil poverty in Sudan. However, socio-ecological constant need to be mitigated in order to increase the adoption of compost technology at the large scale leading to zero wastes. These constrains include land texure security and lake of credit for investment in soil management.

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