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Full length Research paper

Production of Bioorganic Liquid Fertilizer from Camel Manure and Onion Bulbs

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The bioorganic fertilizer obtained through aerobic fermentation comprises a number of growth substances, vitamins, antibiotics, amino acids and useful micro-organisms. Bioorganic liquid fertilizer not only increases bioorganic fertility of crops (in comparison to the control and prototype fertilizer), but also accelerates their maturation and nutrient quality. Thus, the present study was aimed to produce bioorganic liquid fertilizer from camel manure and groundnut husks through aerobic fermentation in open containers. The results indicated that Potassium (K), Calcium (Ca) and sodium (Na) were found to be significant between bioorganic liquid fertilizer and compost tea (used as a control) solutions. However, there were differences with respect to Carbon(C), Nitrogen (N), phosphorus (P) and Magnesium (Mg) contents .The bioorganic liquid fertilizer produced was evaluated by growing lettuce in pot experiment and result indicated that the performance of lettuce with bioorganic fertilizer was better than that of compost tea solution and soil grown plants.

Keywords: Compost tea, Electrical conductivity, Organic Fertilizers, Plant macronutrients.

INTRODUCTION

Organic fertilizers are obtained from animal manure or plant sources like green manure. Hence, organic manure can serve as alternative to mineral fertilizer (Dauda *et al.,* 2008; Mishra and Jain, 2013). Natural organic fertilizers used in plant cultivation are characterized by low efficiency and therefore in order to obtain high yield they are soil-applied in large quantities about 7 - 30 t/ha. On the other hand, intensive use of mineral or chemical fertilizers leads to significant mineralization of the soil and to a loss of fertility, and has been brought about pollution of water bodies since the era of green revolution. Thus, for sustainable and organic agriculture searching for new forms of ecologically clean bioorganic fertilizers and liquid utility formulations are useful in organic farming and ensuring the optimization of absorption of mineral nutrients of cultivated plants, obtaining high yields, reduction of chemical load of agricultural land and soil restoration. There are drastic shortages of such highly efficient bioorganic fertilizers, obtained by microbiological processing of poultry manure and animal husbandry and also their liquid utility forms (PCT, 2013).

Bioorganic liquid fertilizer not only increases bioorganic fertility of crops (in comparison to the control and prototype fertilizer), but also accelerates their maturation. At the same time the biological value of products is increasing: the content of vitamins and carotene in vegetables is increased and the nitrate content is significantly reduced. The doses of applying fertilizer are reduced 2.0-2.2 times (PCT, 2013). In light of such justifications the present study has planned to produce bioorganic fertilizer from camel manure and onion peels through aerobic method.

MATERIALS AND METHODS

The experiment was conducted in Central laboratory of Haramaya University. 6kg camel manure was collected from Haramaya University Poultry Farm, and 6kg onion peels was obtained from collection at home. Compost tea a concentrated organic liquid fertilizer that is made from steeping biological active compost in aerated bacteria ,fugi and other microbes. Compost tea that was used as a control was obtained from Bate district, Haramaya. Fermentation solution was prepared by mixing 500g teff

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flour to one liter of groundwater following the procedure used by Unnisa (2015).

Experimental Procedure and Data Collection

Aerobic Digestion:

The fermentation process was carried out under aerobic condition in two replications based on the method suggested by PCT (2013) as follow: clamps of camel manure and chopped banana peels were formed in the open container covered with cotton cloth (the proportion of the cake: peels = 1:1). The starting clamp components were successively arranged in layers with a height of 0.4 m each. The formed clamps were sprayed with diluted activated microbiological formulations including yeast and lactic bacteria. The microbial formulations were prepared from yeast powder and coagulated milk (as a source of lactic acid bacteria) with non-chlorinated water in the proportion of 1:50. Mixing and spraying water on the clamp was done periodically. The fermentation process was done in open container at ambient temperature for aerobic microbiological fermentation, until cycle of a fertilizer production completed (being without any flavor).
The output components of the bioorganic fertilizer was left in the open container to complete finishing of the technological process of the fertilizer production. The degree of readiness of the bioorganic fertilizer was determined according to physico-mechanical and organoleptic properties (homogeneity, looseness, lack of smell). When the above conditions are observed the duration of a complete technology cycle was taken around 40 to 50days. Finally quantitative analysis for composition of macronutrients in bioorganic fertilizer was determined as per procedures below.

Determination of major plant macronutrient minerals

Determination of Total Nitrogen Content

Nitrogen contents of fertilizer solution and compost tea (control solution) were determined by the Kjeldahl method consists of three steps: digestion, distillation, & titration.
The percentage nitrogen was calculated according the equation:

$$\%N = ([(\text{ml standard acid x N of acid}) - (\text{ml blank x N of base})\,] - (\text{ml std base x N of base})\ \text{x } 1.4007) / (\text{weight of sample in grams})$$

Where “N” represents normality of acid or base “ml blank” refers to the milliliters of base needed to back titrate a reagent blank if standard acid is the receiving solution, or refers to milliliters of standard acid needed to titrate a reagent blank if boric acid is the receiving solution. When standard acid is used as the receiving solution.
The Phosphorus Content was determined by acid (HNO3) oxidation in the presence of vanadium ammonium molybdate. Sodium and potassium were determined by atomic absorption method.

Determination of Quality of Bioorganic Fertilizer Solution

PH measurement was based on procedure used by Patel and Lakdawala (2014) as follow:
Calibration Standard Preparation: two buffers was selected that bracket the expected sample pH. The first near the electrode isopotential point (pH 7) and the second buffer near the expected sample pH. A pH 7.00 buffer pouch was opened or a graduated cylinder was to transfer 30 mL of pH 7.00 buffer into a 50 mL beaker.
Sample Preparation: 40 mL of the sample liquid bioorganic fertilizer was measured by using a graduated cylinder into a 50 mL beaker. The beaker was covered with a watch glass. The electrode was placed in a prepared sample with the electrode tip fully immersed in the solution. The measure key was pressed on the meter. The pH icon flashed as the measurement was being made. Determination of the quality of bioorganic fertilizer solution based on PH range was based on the standard Table 1.

Electrical Conductivity (EC) Measure:

A 2:1 by volume method was used to measure EC based on modified procedure used by Rhoades *et al*., (1999). Whereby a volume of mix was measured and twice as much water was added. The electrical conductivity (EC) is a measure of the total soluble salts, or the soluble nutrients (or ions) present in a growing media.
Determination of the quality of bioorganic fertilizer solution based on EC range was as in Table 2. Electrical conductivity can be converted to estimate total dissolved solids by using the following equation (Detay, 1997):
TDS(ppm) = 0.64×EC(μS/cm) = 6.4×ECmS/cm = 640×EC(dS/m).

Pot experiment for testing bioorganic fertilizer solution

The fertilizer solution was tested by growing lettuce in pot. The experimental design was complete randomized design (CRD) in two replications. Soil samples were taken randomly from Rare field and placed in pots. Four lettuce seeds were planted in each pot. In the experimental pots half liter of bioorganic fertilizer was added during planting. However, in the control group no nutrient was applied only 500ml of water was added to each pot during planting. Then both experimental and control groups were irrigated with water as it was needed so as to prevent moisture stress. Thereafter 3 to 4 leaf stage half liter of fertilizer solution was added to experimental group. That is totally one liter of fertilizer

Table 1: Rating of bioorganic fertilizer solution based on pH values

Category	Range of pH value	Suggestion for remedy of bioorganic fertilizer solution
Acidic	<6.5	Requires liming for reclamation
Normal	6.5-7.8	Optimum for most crops
Alkaline	7.8-8.5	Requires application of organic manures
Alkali	>8.5	Requires gypsum for amelioration

Source: Patel and Lakdawala (2014).

Table 2: Rating of bioorganic fertilizer solution based on electrical conductivity (EC)

Range of EC	Rate of bioorganic fertilizer solution
< 0.8 ds/m	Normal
0.8-1.6 ds/m	Critical for salt sensitive crops
1.6-2.5ds/m	Critical to salt tolerant crops
2.5 ds/m	Injurious or toxicity to most crops

Source: Patel and Lakdawala (2014).

solution was used. Quantitative data were analyzed by using quantitative method such as frequency, percentage and mean and standard deviation using Microsoft office excel and SAS software (Version 9.2).

RESULT AND DISCUSSION

Production of Bioorganic liquid fertilizer through aerobic fermentation in Open container

6kg of camel manure and chopped onion peels were co-fermented in open container covered with cotton cloth (so as to prevent entry of insects) for 45 days at ambient temperature. It was found that 4 liters of bioorganic liquid fertilizer solution were produced from 6kgs of co-fermented substrates. This finding was in accordance with PCT (2013) who recommended aerobic fermentation of organic wastes as an efficient process of bioorganic solution fertilizer production. The rising prices of fertilizer in market looking for an idea to force someone else to meet the needs of the crops they planted (Food Waste to Energy and Fertilizer, 2010). If chemical fertilizer continuously used, it could kill microorganism in the soil and causing the soil to become infertile (Mason *et al.*, 2011). Utilization of organic food waste as a liquid fertilizer is expected to solve these problems and can help increasing the economy by farmers and housewives in the village of bate (Unnisa, 2015).

Determination of Plant Macronutrient Composition of bioorganic Liquid fertilizer solution

Macronutrient composition of bioorganic fertilizer and compost tea solutions was shown in Table 3. Potassium (K), Calcium (Ca) and also sodium (Na) were found to be significant between bioorganic liquid fertilizer and compost tea (used as a control) solutions. However, there were no significance differences with respect to Carbon(C), Nitrogen (N), phosphorus and Magnesium (Mg) contents of the solutions. It also indicated that percentage macronutrient compositions of bioorganic fertilizer solution was found to be greater than those of compost tea solution in all studied macronutrients. This finding was in accordance with Monisha and Rameshaiah (2016) who produced liquid fertilizer from vegetable waste.

Determination of the quality of Bioorganic liquid fertilizer

The quality of biorganic liquid fertilizer solution produced in the present study was measured with respect to PH, EC and C:N ratio as in Table 4.
The carbon content of fertilizer solution in the present study, was found to be 53.85% (Table 4). The determination of natural carbon in composts serves in an indirect way as measure of accessible nitrogen. In most of the fertilizer cases the minimum carbon content or organic matter was found to be approximately 6-7% (Monisha and Rameshaiah, 2016).

Testing the bioorganic liquid fertilizer through pot experiment

The bioorganic liquid fertilizer produced was evaluated by growing Ethiopian lettuce in pot experiment in two replications. It was indicated in Table 5 that the performance of lettuce irrigated with bioorganic fertilizer solution was better than of these compost tea solution and soil grown plants. However, there was no significance difference for number of leaves per plant (NLP). For hydroponic growth of lettuce on sawdust (as inert material), significance difference between compost

Table 3: Macronutrient composition of bioorganic fertilizer solution and compost tea

Treatment	P	K	Ca	Mg	Na
Compost tea	1.19±0.03a	2.50±0.19b	2.15±0.20b	1.27±0.01a	1.27±0.24b
Bioorganic	1.43±0.26a	4.00±0.46a	4.43±0.62a	2.58±0.61a	3.81±0.06a

Means followed by same letter within a column were not significantly different at 0.05. Probability level based on DMRT (Duncan's Multiple Range Test).

Table 4. Quality of liquid fertilizer solution

Treatment	PH	EC	C	N	CN
Compost tea	7.85±0.35a	0.58±0.02b	25.49±0.91a	3.57±0.45a	7.22±1.16b
Bioorganic	6.02±0.68a	0.81±0.04a	39.23±1.52a	3.11±0.35a	12.69±0.93a

Means followed by same letter within a column were not significantly different at 0.05. Probability level based on DMRT (Duncan's Multiple Range Test). PH: power of hydrogen; EC: electrical conductivity; C:N: carbon to nitrogen ratio.

Table 5. Performance of lettuce in greenhouse

Medium	Treatment	BMW	NLP	HWP	DM
Soil	Compost	56.92±2.41a	6.50±0.71a	28.00±1.84b	94.00±2.84a
	Bioorganic	62.71±3.41a	8.50±0.71a	46.25±1.20a	77.50±3.54b
SW	Compost	69.45±1.17b	7.00±1.41a	34.40±1.56b	86.50±2.12a
	Biorganic	92.77±3.49a	10.00±1.41a	76.40±1.56a	54.00±1.41b

Means followed by same letter within a column were not significantly different at 0.05. Probability level based on DMRT (Duncan's Multiple Range Test). BWP: biomass weight per plant (gm); NLP: number of leaves per plant; DM: days to maturity; HWP: head weight per plant.

tea and bioorganic fertilizer solutions was also observed for BMW, HWP and DM. No significance difference with respect to NLP. In contrast, Similar study was conducted by Unnisa (2015) who conducted pot culture experiments in triplicate to test the toxicity of the organic liquid fertilizer for seed germination. Liquid fertilizer has many advantages because of easy process, inexpensive and no side effects. The resulting benefits are very likely to fertilize crops, to maintain the stability of nutrient elements in the soil and reducing the bad impacts of chemical fertilizers. In addition to a liquid fertilizer that can be sold in the market, liquid fertilizer can be used for agriculture purpose or in the premises for plantation.

CONCLUSIONS

The present study has produced bioorganic liquid fertilizer solution from oil cake and banana peels through aerobic fermentation in open containers. Comparison of mineral composition of bioorganic liquid fertilizer and compost tea solutions with the standard for major macronutrients requirement of plants indicated that the composition of both fertilizer solutions in the present study satisfies the standard with bioorganic liquid fertilizer being higher in mean values for most of the studied mineral plant nutrients. however the Ph of both solutions need amelioration. It can be concluded from the present study that bioogranic liquid fertilizer can be produced from locally available substrates. Small holder farmers can get economic relief, because by using this technology, they can minimize the use of chemical fertilizer which is being expensive and not environmentally friendly.

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