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Production of Organic Fertilizer by Vermi-Composting Method

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Abstract

To obtain organic fertilizer of high NPK content by employing the vermi-composting technique. The sample which we used consists of various organic wastes, dungs and waste water sludge. And the earthworm employed for vermi composting process was Eisenia foetida. As a result of vermi composting process the fertilizer obtained consists of 2.15% nitrogen, 2.10% phosphorous and 2.15% potassium. Also a case study on the growth of red spinach plant was observed by blending the organic fertilizer with that of the chemical fertilizer and compared with the growth of the blended proportion with biological fertilizer.

Keywords: Organic wastes, Eisenia foetida, vermi-composting.

Introduction

In the past 20 years due to population pressure, urbanization, industrialization, and mechanized agricultural activities, organic waste materials have been accumulated in the environment as Solid Organic Waste (SOW)[1]. On one hand tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients available in SOW. Treatment of Solid Organic Wastes have therefore become an essential part of life almost all over the world. The compost prepared from organic materials using earthworms is a low cost and eco-friendly technology called vermicomposting. The fine granular peat-like end product, vermicompost that is produced is reported to contain elevated levels of nitrogen, phosphorus, and potassium (NPK) in available form. Because of this, the vermicompost when applied or supplemented in soil improves crop growth and yield[2]. The earthworms, the drivers of many processes in soil, apart from the known vermicomposting, are also found to enhance phytoextraction of metals from contaminated soils. In addition, vermicompost which was produced by the joint action of earthworms and microbes, contains nutrients in available form with increased amount of microbial activity[3]. The vermicomposting results in the increase of microbial diversity and activity dramatically and the vermicompost produced could be a source of plant growth regulators produced by interactions between microorganisms and earthworms, which could contribute significantly to increased plant growth, flowering, and yields[4]. Thus, vermi composting technique was employed on the organic wastes. And the organic fertilizer obtained was tested for the growth of red spinach plant so that the usage of chemical fertilizers can be drastically reduced and there by the growth of the crop, fertility of soil and rotation of crops can be increased[5].

Material and Methods

The organic waste employed for vermi composting consists of about 500 gm of cow dung, 1 kg of rabbit dung, 500 ml of municipal sludge, 300 gm of fresh mango and banana leaves, 100 gm of onion peels, 750 gm of black soil and 1 kg of Eisenia foetida earthworm. This sample was kept for 30 days for the action of vermin composting process to take place. The NPK content was tested regularly for the 7th, 14th, 21st and 30th day. At the end of 30th day the NPK content was found to be as 2.15% of Nitrogen, 2.10% of Phosphorous and 2.15% of Potassium. Also a case study on the growth of red spinach plant was conducted. For this case study we used four samples, in which in the Ist sample contains 3 kg of black soil alone. And the IInd sample contains 3 kg of obtained organic fertilizer and soil. And the IIIrd sample contains 2 kg of obtained organic fertilizer and 1 kg of azospirillium fertilizer along with soil. And the IVth sample contains 2 kg of obtained organic fertilizer and 1 kg of urea fertilizer along with soil. And the result shows a comparable increase in the height of red spinach plant by the blended proportion of organic fertilizer with chemical fertilizer.

Procedure for the Estimation of NPK Content: Preparation of Triacid Extract: Procedure: One gram of the sample was weighed in a 250 ml conical flask. 15 ml triacid mixture was added and the mouth of the flask was covered with funnel. The contents were digested over a sand bath at 180 - 200˚C until dense white fumes of H_2SO_4 and $HClO_4$ were evolved. A brown greenish scum of Mno_2 may appear with HClO4 but it redissolves in the conc. H_2SO_4 at the end of the digestion and a clear solution was obtained. Then it was diluted with distilled water and filtered through whattman number 41 filter paper and filtrate was collected in a 250 ml volumetric flask. The conical flask was washed with small amounts of hot water and the washings of filter paper were also added. The residue on the filter paper was washed and the washings were continued till the filtrate runs free of chloride (test with silver nitrate solution). The volumetric flask was cooled under tap water and the volume was made upto 100 ml with distilled water. This triacid extract was used for the analysis of nutrients except nitrogen in the given samples[6].

Estimation of Total Phosphorous: (Vanadomolybdate Yellow Colour Method): Procedure: 5ml of the triacid extract was pipetted out into a 25ml volumetric flask. 5ml of bartons reagent was added and the volume was madeup with distilled water. Thirty minutes was allowed for the development of yellow colour and the intensity of colour was measured in a photoelectric colorimeter using blue filter after adjusting the transmittance of the meter to 100 with a blank. The colour was stable for 24 hours. From the standard curve the concentration of P was deduced and from that value, the percentage of total phosphorous content of the manure was calculated[7].

Preparation of Standard Curve: About 0.4390 g of pure KH_2PO_4 was dissolved in water and the volume was made upto 1000 ml with distilled water. This was the stock solution representing 100 ppm.

5 ml of 100 ppm was diluted to 250 ml → 20 ppm
10 ml of 100 ppm was diluted to 250 ml → 40 ppm
15 ml of 100 ppm was diluted to 250 ml → 60 ppm
20 ml of 100 ppm was diluted to 250 ml → 80 ppm
25 ml of 100 ppm was diluted to 250 ml → 100ppm

The intensity of colour in a photoelectric colorimeter was measured using blue filter. The readings were plotted against concentration to get the standard curve.

Estimation of Total Potassium: Procedure: 5 ml of the triacid extract was pipetted out into 25 ml volumetric flask and the acid was neutralized with ammonium hydroxide (the piece of red litmus put into the flask turns to blue). The volume was made up with distilled water. The solution was mixed well to make it homogeneous. The concentration of K in the solution was measured by using flame photometer. The concentration of K of the solution can be deduced from the standard curve and the percentage of potassium in the manure can be calculated[8].

Preparation of Standard Solution: 1.907 g of KCl was dissolved in one litre of distilled water. This gives 1000 ppm of K. 100 ml of 1000 ppm K solution diluted to one litre and it will give 100 ppm solution. From this various standards were prepared ranging from 10 to 100 ppm.

Estimation of Total Nitrogen: Procedure: About 0.25 g of sample was weighed and transferred into a dry kjeldahl flask and 30 ml of conc.H_2SO_4 was added containing 1 g of salicylic acid. The contents were mixed well and allowed to stand for at least half an hour with frequent shaking. 5 g of crystalline sodium thiosulphate ($Na_2S_2O_3.H_2O$) was added and shaked well. It was digested over a low flame until frothing ceases. Then 10 g of K_2SO_4 and 1 g of $CuSO_4.5H_2O$ was added and heated strongly until the liquid in the flask turns green[9].

Table-1
Standard Solution Preparations

Conc. Required (ppm)	Volume to be pipetted out from 100 ppm stock solution (ml)	Volume to be made up (ml)
10	10	100
20	20	100
30	30	100
40	40	100
50	50	100
60	60	100
70	70	100
80	80	100
90	90	100

Distillation: 300 ml of 0.1 N H_2SO_4 was taken in a beaker and few drops of methyl red indicator was added. The beaker was kept under the delivery end of the distillation unit. The tip of the delivery tube should be immersed in the standard acid contained in the beaker as otherwise some quantity of evolving ammonia may get lost.

40 ml of NaOH was added to the distillation flask and the flask was stoppered immediately. The distillation was started. Uniform boiling was ensured. The distillation was continued until the distillate runs free of ammonia, and then the the delivery tube was detached, and rinsed it with distilled water and the rinsed was collected in the beaker. Then back titration was done against 0.1N KOH. The quantity of N/10 H_2SO_4 was noted down. Using this value, the nitrogen content was calculated.

Results and Discussion

Test Analysis Data on NPK Content: Test analysis data on NPK content is given in table 2. The observation in the growth of the crop is determined by the height of the plant. And by the end of observation, the plants height is given in table-3.

Table-2
Variation of the %NPK Content with respect to no. of days

No. of days	% of Nitrogen	% of Phosphorus	% of Potassium
0	0	0	0
7	0.61	0.53	0.49
14	1.11	0.93	0.89
21	1.81	1.69	1.97
30	2.15	2.10	2.15

Table-3
Height of Growth for various samples

S.No.	Sample No.	Test	Height of Growth	Duration
01	I	Only soil	30cm	2months
02	II	Soil + Organic fertilizer	34cm	2months
03	III	Organic + Bio-fertilizer+ Soil	38cm	2months
04	IV	Organic + Chemical fertilizer+ Soil	43cm	2months

Test on the Growth of Red Spinach Crop:

Figure-1
Growth of Red Spinach Plant

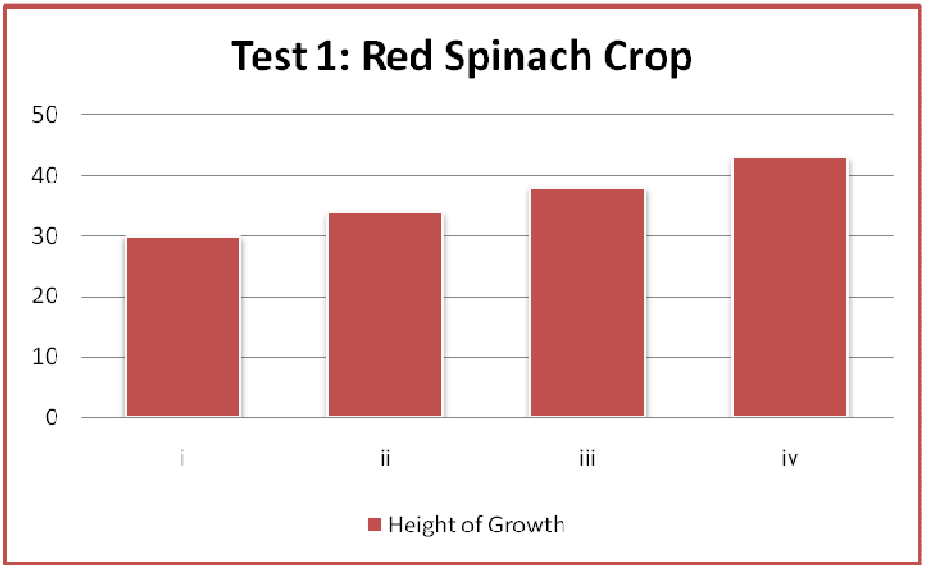

Figure-2
Height of Growth for Red Spinach Plant

Thus from the interpretation of the graph, it is very clear that the Spinach crop had showed a greater growth rate by the addition of organic fertilizers along with chemical fertilizers.

Conclusion

Thus from the above interpretations it was observed that the addition of waste water sludge and rabbit dung had a major effect on the percentage compositions of nitrogen, phosphorous and potassium. Also the red spinach plant favours a better growth by the blended proportion of organic fertilizer with chemical fertilizer with organic fertilizer as a major composition that supports the growth of the crop.

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