VERMICOMPOSTING WITH THE EARTHWORM EISENIA WITH VARIOUS ORGANIC MATERIALS

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Abstract

Aim of the study is to learn more about vermicomposting process, which includes steps like building a station for vermicompost, importing an earthworm for compost (Eisenia), as well as producing vermicompost from dry grass clippings, cow manure, as well as rice straw. The vermicompost created is of tremendous benefit to ultimate user such as farmer, who can use it to substitute chemical fertilisers and get best price for organic produces by utilizing locally available composting materials. Eisenia is used for vermicomposting with three different treatments: grass, rice straw grass, and rice straw. During the process, the pH, humidity, and temperature are all recorded. After two (02) and four (04) months. Sigma Plot 12.0 is used to perform statistical analysis on the results. The temperature is in the range of 1–36 °C for all three therapies, the humidity is between 79.5 to 99.5 percent, as well as the pH fluctuated between 5.5–7.5 before stabilising upon 59th day. Mixture of the rice straw as well as the grass produced the most vermicompost (105 kg/m2), followed by grass (102.5 kg/m2) and rice straw (87 kg/m2).

Key words: Cow manure, Dry grass clippings, Earthworm Eisenia, Organic, Rice straw, Vermicompost

Introduction

Vermicomposting is the practise of turning agricultural waste into high-quality compost using earthworms. Worm cast and decayed organic matter are the main components of vermicompost. Vermicomposting aids in the transformation of agricultural waste (waste, animal faeces, and household waste) into highly nitrogen fertilisers for plants and soil. Vermicompost is a natural alternative to chemical fertilisers that is abundant in micronutrients. It is also an outstanding development supporter as well as defender for crop vegetations. Since it is simple to prepare, vermicompost is now an essential part of organic farming systems. Vermicompost leads to organic enrichment attempted to study vermicomposting, but found no substantial findings. Suriname hasn't done any studies in this field since then. Vermicomposting and its effect on vegetable production need further investigation, particularly because vermicomposting investigation would deliver farmer with an environmentally sustainable fertiliser as well as aid in the agricultural sector's transition to a green future.

Application of technology is aid in cost control in agriculture that has risen in recent year, adding to farmers' burdens in terms of pesticides as well as chemical fertilisers. As a result, cost of manufacture has risen dramatically. Usage of organic fertilisers such as vermicompost is an important resolution to the crisis, as it replaces chemical input in crop yield as well as minimise monetary costs, while also resulting in organic produce that commands a higher selling price. If people's living standards rise across the world, there is an increasing market for organic food, which is grown using only natural pesticides and fertilisers and is thought to be healthier for consumers and better for the climate. The agriculture sector in Suriname is primarily reliant on imported chemical inputs, such as chemical fertilisers and pesticides, which come at a high cost. Substituting organic inputs, such as vermicompost, for chemical fertilisers will give a boost to organic farming systems. As a result, the aim of this study is to establish besides improve technologies for producing high-quality.

The effects of liming and microorganism inoculation on total sulphur, certain heavy metal and calcium, (Cu, Zn, besides Pb) concentrations in various biological waste are investigated. Vermicomposting is found to be an important expertise aimed at disposing of biological substrates such as MSW (municipal solid waste) that had an advanced concentration of heavy metals. To the original biological substrates lime is added that increased the total calcium and total sulphur content of vermicomposting substantially (P 0.05). When microorganisms are inoculated, the heavy metal content of final products is slightly decreased (P 0.05) when opposed to the control. Fungal strains are found to be more efficient than B strains in the detoxification of heavy metals [4]. An analysis of the global state-of-the-art on vermicomposting is discussed, along with the highlights of the authors' studies.

The effects of vermicast on plant growth are also discussed. The paper examines the suitability of various earthworm organisms for 'bioprocessing' various forms of organic waste. The paper also summarises the findings of studies on the effect of vermicasts generated in reactors fed with aquatic weeds or agro-waste on plant growth, which are relatively few and far between [6]. For the earthworm Eisenia foetida, regression equations are given. Every year, more than one million tonnes of coffee pulp is processed in Colombia [7]. Nutrient, as well as quality availability is investigated. The findings revealed that the depth of the bed had little effect on the C and N contents, but that time had an effect on both. During vermicomposting, low values of humic-like compounds and a rise in the fractionation ratio. There is an improvement in available Mg, Ca, and P after the earthworms ate the pulp, but a decline in K [9].

Literature Review

A. A. Ansari *et al.* explain the aim of this research is to use bio dung and vermicomposting to treat organic left-over (grass, water hyacinth, water hyacinth + grass) on a wide scale (grass, water hyacinth, water hyacinth + grass) in three separate amalgamation. T3 had the most efficient pre-digestion of organic left-over by aerobic as well as anaerobic rottenness, according to the findings. The temperature of bio dung unit increased to a high of 37/51/5 °C before steadily falling to a constant of 35/25/1.75 °C, resulting in a decrease of agricultural waste free of toxic microbes. T1 had a temperature of 28/26/2.19 °C during the vermicomposting phase, followed by T2 with 27/31/0.80 °C and T3 with 26/94/0.68 °C. Three units had a pH of 6.81 0.18, which is close to neutral. The C:N ratio is brought down to the necessary amount (12/41/3.71). Due to the favoured delectableness of earthworm Eisenia foetida towards mixed composting substance, vermicomposting caused in tall vermicompost output. The findings showed that the vermicompost is nutrient-dense, as well as that the amounts of these nutrients in the compost varied as the process progressed until they reached their optimal absorptions for plant development [1].

R. M. Atiyeh *et al.* studied about the outcome of humic acid produced by earthworms investigated. In the initial trial, humic acids are isolated utilizing the typical alkali/acid fractionation method as well as united with a soilless vessel medium to produce a variety of 0.5, 49.5, 99.5, 149.5, 199.5, 249.5, 499.5, 999.5, 1999.5, and 3999.5 milli gram of humate/kg mixture of dry weight of vessel medium, with tomato seedling grownup. In the subsequent trial, cucumber seedling is grown in a mixture of humates isolated from pig manure and food waste vermicompost combined with vermiculite at concentrations of 0.5, 49.5, 124.5, 249.5, 499.5, 999.5, and 3999.5 milli gram of humate/kg of dry weight of the vessel medium. To guarantee that all variations in development replies are non-nutrient-mediated, all cucumber as well as tomato seedlings are irrigated daily available. The addition of all kinds of vermicomposting-derived humic acid to any kind greatly improved height as well as leaf area of tomato and cucumber plants. Plant growth improved with the humic acid concentrations introduced into the medium up to a certain proportion, but this varied depending on the plant type, vermicompost source, and container medium design. Treatments of plants with 49.5-499.5 mg/kg humic acids continued to improve plant growth, but concentrations of 49.5-499.5 mg/kg humic acids also resulted in substantial reductions in plant growth. The hormone-like action of humic acids from vermicompost or plant growth hormones adsorbed onto the humates is most likely responsible for these growth responses [2].

P. S. Chaudhuri *et al.* investigated one of the main sources of urban solid iste is household kitchen waste. Domestic waste in India is mainly organic in nature and accounts for 70 to 80 percent of municipal solid waste. Per day, a four-person household produces 0.5-0.75 kg of kitchen waste. In the current state of environmental destruction, vermicomposting technology allows useful resources such as manure to be recovered from biodegradable iste. Vermicomposting is the practise of making vermicompost by stabilising agricultural iste with the help of earthworms. The mechanism of vermi-stabilization is caused by bacterial decay of biological matter within the intestine of earthworm, which means that the undigested excreta of earthworms does not decompose quickly. Vermicomposting of a variety of wastes is becoming more common around the world.

However, there are few studies on the chemical modifications that occur during the degradation of organic waste by the earthworm's action. The aim of this study is to log the chemical changes that occur in a stepwise manner during the composting of kitchen waste by an indigenous earthworm species. This research is needed to determine the vermi-stabilization period for harvesting high-quality compost from a particular type of waste [3].

C. A. Edwards *et al.* experimented about the ordinary capacity to colonise biological waste, high rate of organic matter intake, absorption, and assimilation, resistance to an extensive variety of short life cycles, ecological conditions, durability and tolerance to handling and high reproductive rates, epigeic species of earthworms have a lot of potential for vermicomposting. Just five earthworm species are widely utilized in vermicomposting: Dendrobaena veneta, Eisenia fetida, Eisenia andrei, besides to a minor degree, Perionyx excavates, as well as Eudrilus Eugenia. This chapter summarises the characteristics and life histories of eight common earthworm species [5].

Methodology

Design

The study included several phases, including the construction of, the composting from Guyana, the processing from, rice straw cow manure, as well as dry grass clippings. In a shaded field, a vermicompost station of $3 \times 10 \times 8$ m^3 ($h \times l \times w$) is installed. The vermitech Pattern is used to set up the vermicomposting units at the vermicompost station. Containers for culturing the earthworms is made out of concrete units measuring 150 x 100 x 60 cm^3. Drainage holes (2x2 cm^2) are drilled into the concrete units to aid better water drainage. To maintain a comfortable atmosphere, the station's roof is built of zinc sheets with isolation paper underneath. The vermicompost station's walls are made of wired mesh to allow for air flow. The first sheet of the culture bed (Fig. 1) is prepared: To ensure adequate drainage, a vermi-bed layer of broken bricks is laid down first, followed by a layer of sand 5.9–7.6 cm thick. Second layer: moistened loamy soil up to a height of 14.5 cm. This layer is inoculated with Eisenia earthworms. 3rd layer: Fresh/dry cattle dung clumps are strewn across the soil 4th layer: soil is then coated with 10 cm of dry grass clippings/rice straw.

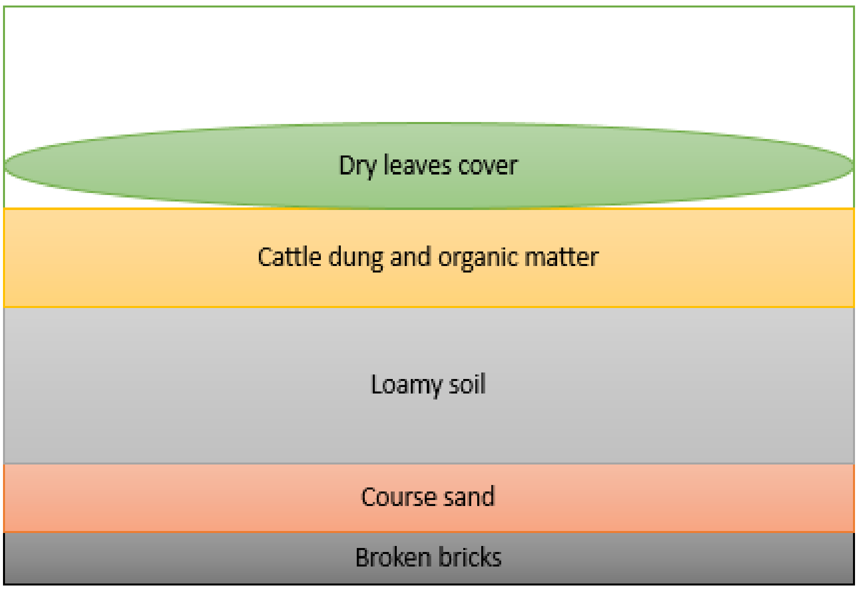

Fig. 1: In A Unit, Set Up A Culture Bed

Sample

To shield the earthworms from sunshine and birds, the whole device is coated in banana leaves. It is as well as turning once a week before the vermicompost is harvested. Two hundred (200) composting earthworms, Eisenia type, are introduced from Guyana in the second process. The earthworms are cultured in one unit for 04 months and used to make vermicompost out of cow manure as well as dry grass clippings. After the lawn is mowed, the dry grass clippings are gathered from the garden and placed in sacks. The dairy farm units provided the cow manure. On a weekly basis, the organic waste consisted of 4.5 kg cow manure as well as 1.5 kg dried grass clipping. The following vermicompost parameters are examined after four (04) day period: By physically separating the earthworm from vermicompost, overall population of earthworms can be determined. The total volume of vermicompost generated (weight in kg).

Instrument

Analyses carried out in a soil laboratory using the following methods: pH-H_2O is measured with a pH metre, and EC measured with metre; TOC (titrimetric percent) utilizing is measured using a spectrophotometer's colorimetric process; as well as is determined utilizing method ensure tested vermicompost as well as cow manure for the existence of E. coli bacteria as well as Salmonella. The adapted semi-solid Rappaport-Vassiliadis medium system is used to detect Salmonella in different matrices, while the pluripotency test is used to assess the existence.

Data Collection

On a cemented earth floor, the vermicomposting experiment is carried out. The scale of each dry grass clippings, vermi-bed of cow manure, and rice straw waste in a 5:1 ratio is 1.50x1.00x0.10 m^3. 25 Eisenia earthworms are inoculated in each cell. Dry banana leaves are used to cover the whole unit, which is moistened up to the sixth week.

Fig. 2: The Experimental Architecture for Vermicomposting Is Depicted in This Diagram

Vermicompost with Perionyx ceylanensis Mich. is made with sugar industry-derived press mud and an equivalent volume of cow dung (1:1). The resulting vermicompost had a pH of 6.83, an electrical conductivity of 1.82 dS/m, a nitrogen, potassium content, as well as phosphorus of 1.13 percent, 2.38 percent, and 3.13 percent, respectively, as well as a 29 percent organic carbon content as well as a C/N ratio of 17.39. Vermicompost had a 36.94 percent, 28.56 percent, and 20.82 percent rise in NPK over worm-free compost, respectively. In the presence of earthworms, the colonies of fungi, actinomycetes, as well as bacteria in the compost increased. The microbial communities in the worm gut are largest in the midgut. At $P > 0.05$, the relationship between microbial population growth and vermicomposting time is statistically important ($r = 0.473$, 0.49, and 0.493, respectively for bacteria, actinomycetes, as well as fungi). The length of vermicomposting is positively associated with increases in overall bacterial, fungal, and actinomycetes species. When mixed with cow dung in a 1:1 ratio, press mud is effectively converted into - microorganism-rich vermicompost as well as nutrient, according to the report [10].

Data analysis

pH, humidity, as well as temperature are measured in every vermicompost unit on a weekly basis during the vermicomposting period. A field compost thermometer is used to determine the temperature is used to determine the humidity. The humidity levels are 09–41 percent (dry); 39–81 percent (moist); and 79–100 percent (extremely humid) (wet). A soil pH metre is used to determine the pH. The total vermicompost yield as well as total earthworm population are estimated after 02 as well as 04 months, and chemical analyses of the vermicompost are performed. A hand-sorting system is used to approximate the total population of earthworms. This is performed using sample sizes of 20×20 cm^2 in four samples collected from each procedure to estimate the overall population per square metre (Fig. 3). There are three types of earthworms in the population: juveniles, non-clitellate earthworms, as well as clitellate earthworms (Fig. 4) generated is weighted in kilogrammes as well as collected in plastic waste bags. The percentage productivity of vermicompost as well as determined utilizing the formula:

$$\text{Productivity of vermicompost} = \frac{\text{Harvested vermicompost (kg)}}{\text{Total mass feed (kg)}} \times 100\%$$

Fig. 3: Type of Sorting by Hand

Fig. 4: Different Age Classes of Earthworms

Using the methods previously mentioned, the Fe, C/N ratio, C, K, Cu, Mn, N, P, EC, pH-H_2O, as well as Zn levels of feeding material as well as vermicompost (dry grass clippings, cow manure, as well as rice straw) are determined. The Sigma Plot 12.0 programme is used to perform statistical analysis on the results. Differences between means are calculated utilizing an Analysis with Variance of Simple Classification (one-way ANOVA). The Indian hoc test is used to examine treatments that are significantly different. The significance level is set at 0.05.

Result & Discussion

The temperature of the vermicompost unit is measured in seven days as well as found to be 26.5 degrees Celsius, which is in the range of 0.5 to 35 degrees Celsius. The humidity results showed that unit is damp (84.5 percent), which is in the 79–91 percent series for hasty development. For vermicomposting, pH ranged from 6.40 to 7.60, which is in the 4–10 range. The passive method calculated the total population of earthworms to be 300. (adult and juvenile). The initial amount of worm utilized in vermicompost is 4999.5, which rose to 13,000 after 90 days. 0.9 1 pound of earthworm processes 0.9 pound of organic matter (74–86 percent moisture) as well as yield 0.24 kg of vermicompost/day (39–51% conversion rate). At least 8–19 kg of earthworm/m^2 (1.9–3.9 lb ft^{-2}) is needed for a satisfactory population of earthworms.

The aim of this research is to see whether the epigeic earthworm Eudrilus Eugenia could convert waste leaf litter and waste cattle manure into vermicompost. Nitrogen is increased by 14.9 percent in leaf litter vermicompost and 1.62 percent in cattle manure vermicompost; potassium is increased by 1.69 percent in leaf litter vermicompost and 0.56 percent in cattle manure vermicompost; and phosphorus is increased by 1.46 percent and 1.11 percent in leaf litter vermicompost and cattle manure compost, respectively. In leaf litter vermicompost and cattle manure vermicompost, the carbon nitrogen ratio is reduced by 0.33 percent and 2.76 percent, respectively [8].

Table 1 displays the results obtained. The pH of the vermicompost is mildly acidic waste, gross organic carbon is 18.53 percent, 42.96 percent, and 21.02 percent, respectively. The vermicompost contained 1.36 percent gross nitrogen, while the raw material contained 1.88 percent. The C/N ratio in cow manure and vermicompost is the same (12.5:1), but the raw material had a much higher ratio (22.5:1). In the vermicompost and cow waste, total phosphorus is 0.47 percent, 0.26 percent, and 0.78 percent, respectively. The average potassium content of the vermicompost is 0.56 percent, 0.99 percent in raw material, as well as 0.75 percent in cow manure, meaning that the vermicompost had less potassium than the raw material as well as cow manure. Complete manganese, zinc, iron, as well as copper concentrations in vermicompost are higher than in raw material, suggesting that have accumulated are smaller than in cow manure.

Table 1: Raw Feedstock and Vermicompost Chemical Properties

Parameter	Cow manure	Dry grass clippings	Vermicompost
pH-H_2O	6.2	6.5	6.5
EC (mS/cm)	5.7	3.0	3.7
TOC in percent	21.0	43.0	18.5
Total N in percent	1.6	1.9	1.4
C:N ratio	13:1	23:1	13:1
Total P in percent	0.8	0.3	0.6
Total K in percent	0.9	1.2	0.6
Total Mn in ppm	633	235	544
Total Cu in ppm	34.8	6.8	26.9
Total Zn in ppm	921	118	611
Total Fe in percent	1.6	0.2	1.6

Vermicompost contain important micronutrient, as well as the nutrient status matches that of previous studies. As seen in Fig. 5, the temperature measured during the vermicomposting period in the twelve-vermicomposting unit during the first eight week is 27.45 °C in rice straw, 26.58 °C in rice straw + grass, as well as 26.81 °C in Grass. The temperature fluctuation in °C is limited to 0.25, 0.31, and 0.23. As shown in Fig. 6, the temperature in rice straw is 27.65 °C, trailed by 27.12 °C in grass + rice straw besides 27.09 °C in grass during the second 8 weeks. The temperature fluctuation in the second cycle is limited to 0.51, 0.38, and 0.25 degrees Celsius. Temperatures ranged from 0 to 35 degrees Celsius during both phases. During the first eight weeks, the humidity in the twelve-vermicomposting unit is 91.30 percent in Rice straw, 94.90 percent in rice straw + grass, as well as 98.10 percent in Grass, as seen in Fig. 7. The humidity in rice straw is 92.50 percent during the second 8 weeks, trailed by 94.99 percent in grass as well as 93 percent in rice straw grass. The humidity is 80–100% during each of these cycles, indicating a moist atmosphere, marginally higher than the range (80–90%) for rapid Eisenia growth during the vermicomposting phase.

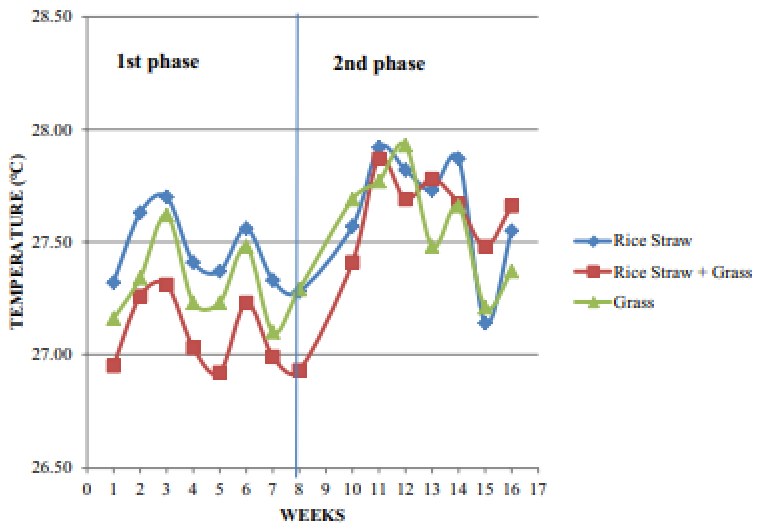

Fig. 5. The Temperature (°C) Fluctuated Throughout the Initial and Subsequent 8 Week of Vermicomposting

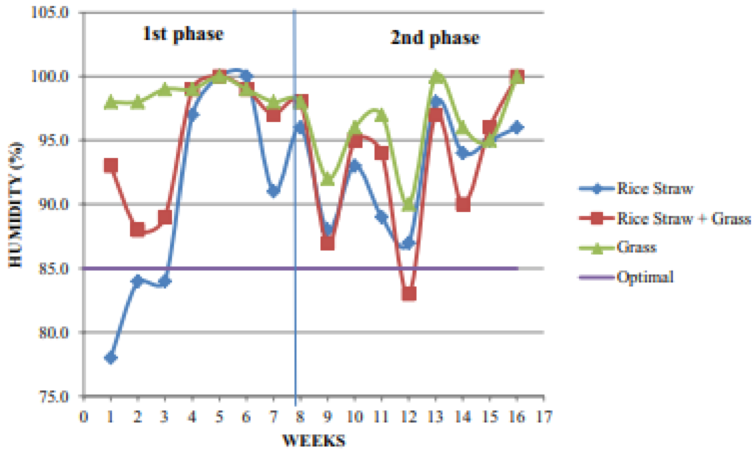

Fig. 6. The Humidity Levels Fluctuate Throughout the Initial and Subsequent 8 Week of Vermicomposting

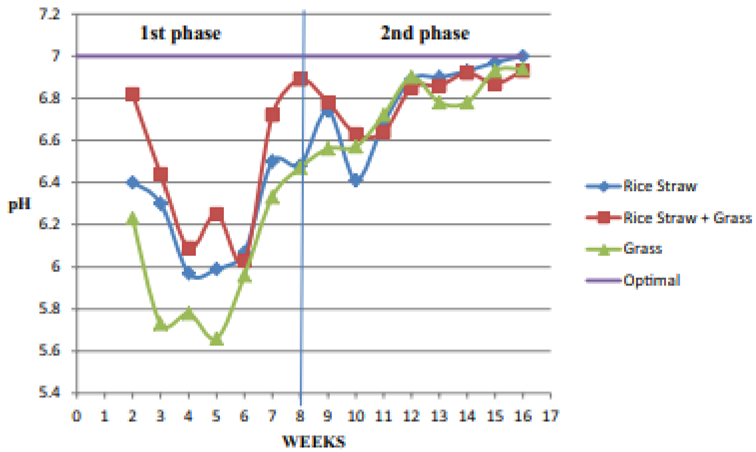

Fig. 7. pH of the Soil Varies Throughout the Initial and Subsequent 8 Week of Vermicomposting

Conclusion

Eisenia is used to successfully vermicompost rice straw, cow manure as well as dry grass clippings. The resulting vermicompost is dark in colour, smelled mull-like dirt, as well as is homogeneous. It contained all of the essential macro- as well as micronutrients for plants, such as, P, N, Ca K, Mn, Mg, Zn, Cu, and Fe, signalling that an environmentally friendly nutrient-rich fertiliser for agriculture had been created. Future research should look at the possibility of producing vermicompost from other sources of waste materials and manure. The pH of altogether three dealings varied from 4.9 to 6.6 till the compost is able to harvest on the last day, when it is nearly neutral. This is consistent registering a pH variety of 4–10 throughout the course, with value adjacent neutrality once the vermicompost is prepared to harvest. It could happen as a result of the CO_2 and organic acids released by microbial metabolism. According to many studies, most earthworm species favour a pH of about 6.5.

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