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VERMICOMPOSTING USING THE EARTHWORM WITH VARIOUS ORGANIC MATERIALS

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ABSTRACT

Aim of the research is to learn more about vermicomposting process, which involves procedures like constructing a station for vermicomposting, importing an earthworm for compost (Eisenia), as well as generating vermicomposting from dry grass clippings, cow dung, as well as rice straw. The vermicomposting produced is of great value to ultimate user such as farmer, who may use it to replace chemical fertilisers and obtain highest price for organic products by using locally accessible composting materials. Eisenia is utilized for vermicomposting with three distinct treatments: grass, rice straw grass, and rice straw. During the procedure, the pH, humidity, and temperature are all recorded. After two (02) and four (04) months. Sigma Plot 12.0 is used to conduct statistical analysis on the findings. The temperature is in the range of 1–36 °C for all three treatments, the humidity is between 79.5 to 99.5 percent, as well as the pH varied between 5.5 and 7.5 until stabilising upon 59th day. Mixture of the rice straw as well as the grass generated the highest vermicomposting (105 kg/m^2), followed by grass (102.5 kg/m^2) and rice straw (87 kg/m^2).

KEYWORDS: *Cow Manure, Dry Grass Clippings, Earthworm Eisenia, Rice Straw, Vermicomposting***.**

1. INTRODUCTION

Vermicomposting is the technique of converting agricultural waste into high-quality compost using earthworms. Worm cast and decaying organic waste are the primary components of vermicomposting. Vermicomposting helps in the transformation of agricultural waste (trash, animal faeces, and domestic waste) into highly nitrogen fertilisers for plants and soil. Vermicomposting is a natural alternative to artificial fertilisers that is rich in micronutrients. It is also an exceptional development booster as well as defender for crop vegetation. Since it is simple to make, vermicomposting is becoming an important component of organic agricultural systems. Vermicomposting leads to organic enrichment tried to investigate vermicomposting, but discovered no significant results. Suriname hasn't done any research in this area since then. Vermicomposting and its impact on vegetable production require more study, especially since vermicomposting investigation would provide farmer with an ecologically sustainable fertiliser as well as assist in the agricultural sector's transition to a green future(1).

Application of technology is assist in cost management in agriculture, which has increased in recent year, adding to farmers' responsibilities in terms of pesticides as well as chemical fertilisers. As a consequence, cost of manufacturing has increased significantly. Usage of organic fertilisers such as vermicomposting is an essential resolution to the problem, as it substitutes chemical input in crop production as well as minimizes monetary expenses, while also resulting in organic food that demands a better selling price. If people's living standards improve throughout the globe, there is a growing demand for organic food, which is produced using only natural pesticides and fertilisers and is considered to be healthier for customers and better for the environment. The agricultural industry in Suriname is largely dependent on imported chemical inputs, such as chemical fertilisers and pesticides, which come at a considerable cost. Substituting organic inputs, such as vermicomposting, for chemical fertilisers will provide a boost to organic agricultural systems. As a consequence, the goal of this research is to develop besides enhance technologies for manufacturing high-quality(2).

The effects of liming and microorganism inoculation on total sulphur, certain heavy metal and calcium, (Cu, Zn, besides Pb) concentrations in different biological waste are studied. Vermicomposting is discovered to be an essential skill targeted at disposing of biological substrates such as MSW (municipal solid waste) that had an enhanced concentration of heavy metals. To the original biological substrates lime is added that enhanced the total calcium and total sulphur content of vermicomposting significantly (P 0.05). As microorganisms are infected, the heavy metal concentration of end products is marginally reduced (P 0.05) when compared to the control. Fungal strains are shown to be more effective than B strains in the detoxification of heavy metals(3).An overview of the worldwide state-of-the-art on vermicomposting is presented, along with the highlights of the authors' research. The impacts of vermicast on plant development are also addressed. The study investigates the potential of different earthworm species for 'bioprocessing' various types of organic waste. The article also reviews the results of research on the impact of vermicasts produced in reactors fed with aquatic weeds or agro-waste on plant development, which are very few and far between(4).For the earthworm Eiseniafoetida, regression equations are given. Every year, more than one million tonnes of coffee pulp is processed in Colombia(5).Nutrient, as well as quality availability is examined. The results showed that the depth of the bed had minimal impact on the C and N contents, but that time had an effect on both. During vermicomposting, low levels of humid-like chemicals and an increase in the fractionation ratio. There is an improvement in available Mg, Ca, and P after the earthworms ate the pulp, but a decrease in K(6).

2. LITERATURE REVIEW

A. A. Ansari et al. describe the goal of this study is to utilize bio dung and vermicomposting to treat organic left-over (grass, water hyacinth, water hyacinth + grass) on a large scale (grass, water hyacinth, water hyacinth + grass) in three distinct amalgamation. T3 had the most effective pre-digestion of organic left-over by aerobic as well as anaerobic rottenness, according to the results. The temperature of bio dung unit rose to a maximum of 37/51/5 °C before gradually dropping to a constant of 35/25/1.75 °C, resulting in a reduction of agricultural waste free of harmful microorganisms. 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 near to neutral. The C: N ratio is lowered down to the required level (12/41/3.71). Due to the preferred delectableness of earthworm Eisenia foetida towards mixed composting material, vermicomposting resulted in tall vermicomposting output. The results revealed that the vermicomposting is nutrient-dense, as well as that the quantities of these nutrients in the compost changed as the process proceeded until they reached their optimum absorptions for plant growth(7).

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 frequently used in vermicomposting: Dendrobaena veneta, Eisenia fetida, Eisenia andrei, plus to a lesser degree, Perionyx excavates, as well as Eudrilus Eugenia. This chapter covers the features and life cycles of eight common earthworm species(8).

Research Question:

1. Why Vermicomposting using the Earthworm?

3. METHODOLOGY

3.1 Design:

The research comprised many stages, including the building of, the composting from Guyana, the processing from, rice straw cow dung, as well as dry grass clippings. In a shaded field, a vermicomposting station of 3×10×8 m^3 (h×l×w) is erected. The vermitech Pattern is used to set up the vermicomposting units at the vermicomposting station. Containers for cultivating the earthworms is constructed out of concrete pieces of 150×100×60 cm^3. Drainage holes (2×2 cm^2) are bored into the concrete modules to assist improved water drainage. To preserve a pleasant environment, the station's roof is constructed of zinc sheets with isolation paper beneath. The vermicomposting station's walls are constructed of wired mesh to allow for air movement. The first sheet of the culture bed (Fig. 1) is prepared: To guarantee sufficient drainage, a vermi-bed layer of broken bricks is put down first, followed by a layer of sand 5.9–7.6 cm thick. Second layer: wet loamy soil up to a height of 14.5 cm. This stratum is infected with Eisenia earthworms. 3rd layer: Fresh/dry cow dung clumps are scattered over the soil 4th layer: soil is then blanketed with 10 cm of dry grass clippings/rice straw.

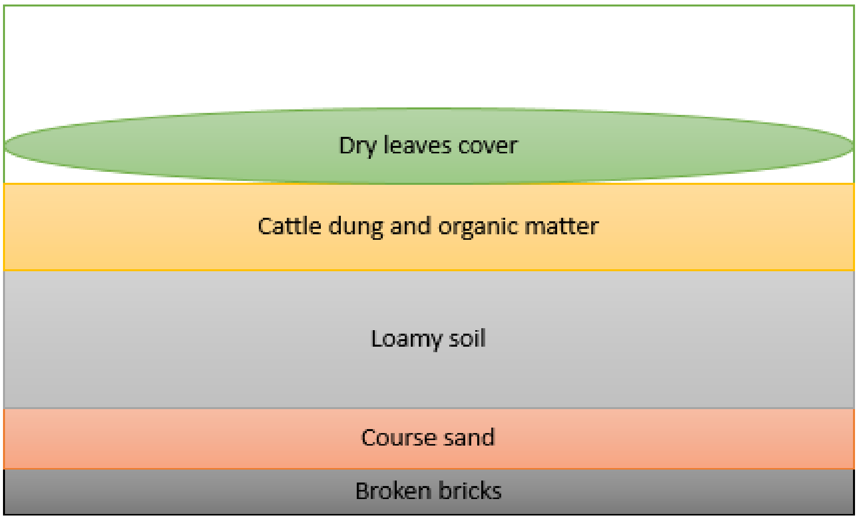

Fig. 1: In A Unit, Set Up A Culture Bed

3.2 Sample:

To protect the earthworms from sunlight and birds, the entire apparatus is covered with banana leaves. It is as well as turning once a week before the vermicomposting is collected. Two hundred (200) composting earthworms, Eisenia type, are imported from Guyana in the second phase. The earthworms are grown in one unit for 04 months and utilized to produce vermicomposting out of cow dung as well as dry grass clippings. After the lawn is mowed, the dried grass clippings are collected from the garden and put in bags. The dairy farm units supplied the cow manure. On a weekly basis, the organic waste comprised of 4.5 kilogram cow dung as well as 1.5 kg dry grass cutting. The following vermicomposting parameters are evaluated after four (04) day period: By physically removing the earthworm from vermicomposting, total population of earthworms may be estimated. The total volume of vermicomposting produced (weight in kg).

3.3 Instrument:

Analyses carried performed at a soil laboratory utilizing 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 vermicomposting as well as cow manure for the existence of E. coli bacteria as well as Salmonella. The modified semi-solid Rappaport-Vassiliadis media system is utilized to detect Salmonella in various matrices, while the pluripotency test is employed to evaluate the presence.

3.4 Data Collection:

On a cemented earth floor, the vermicomposting experiment is carried out. The size of each dry grass clippings, vermi-bed of cow manure, and rice straw waste in a 5:1 ratio is 1.5×1×0.1 m^3. 25 Eisenia earthworms are injected in each cell. Dry banana leaves are utilized to cover the entire unit, which is wet up to the sixth week (Fig. 2).

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

Vermicomposting using Perionyxceylanensis Mich. is produced with sugar industry-derived press mud and an equal amount of cow manure (1:1). (1:1). The resultant vermicomposting 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. Vermicomposting showed a 36.94 percent, 28.56 percent, and 20.82 percent increase in NPK above worm-free compost, respectively. In the presence of earthworms, the colonies of fungus, actinomycetes, as well as bacteria in the compost grew. The microbial populations in the worm gut are greatest in the midgut. At P>0.05, the connection between microbial population increase and vermicomposting time is statistically significant (r = 0.473, 0.49, and 0.493, respectively for bacteria, actinomycetes, as well as fungi). The duration of vermicomposting is positively related with increases in total bacterial, fungal, and actinomycetes species. When combined with cow dung in a 1:1 ratio, press mud is successfully transformed into - microorganism-rich vermicomposting as well as nutrition, according to the study(9).

3.5 Data Analysis:

pH, humidity, as well as temperature are monitored in every vermicomposting unit on a weekly basis throughout the vermicomposting period. A field compost thermometer is used to measure the temperature is used to determine the humidity. The humidity ranges are 09–41 percent (dry); 39–81 percent (wet); and 79–100 percent (very humid) (extremely humid). A soil pH metre is used to determine the pH. The entire vermicomposting yield as well as total earthworm population are calculated after 02 as well as 04 months, and chemical tests of the vermicomposting are conducted. A hand-sorting method is employed to estimate the overall number of earthworms. This is done using sample sizes of 20×20 cm^2 in four samples taken from each process to determine the total population per square metre (Fig. 3). There are three kinds of earthworms in the population: juveniles, non-clitellate earthworms, as well as clitellate earthworms (Fig. 4) produced is weighted in kilogrammes as well as collected in disposable trash bags. The % productivity of vermicomposting as well as calculated using 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 techniques previously stated, 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 vermicomposting (dry grass clippings, cow dung, as well as rice straw) are determined. The Sigma Plot 12.0 software is used to conduct statistical analysis on the findings. Differences between means are determined using an Analysis with Variance of Simple Classification (one-way ANOVA). The Indian hoc test is used to evaluate treatments that are substantially different. The significance threshold is set at 0.05.

4. RESULT & DISCUSSION

The temperature of the vermicomposting unit is measured in seven days as well as determined to be 26.5 degrees Celsius, which is in the range of 0.5 to 35 degrees Celsius. The humidity findings indicated that unit is moist (84.5 percent), which is in the 79–91 percent range for rapid development. For vermicomposting, pH varied from 6.40 to 7.60, which is in the 4–10 range. The passive approach estimated the total number of earthworms to be 300. (Adult and juvenile). The initial quantity of worm used in vermicomposting is 4999.5, which increased 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 produce 0.24 kg of vermicomposting/day (39–51 percent conversion rate). At least 8–19 kg of earthworm/m2 (1.9–3.9 lb ft-2) is required for a good population of earthworms. The objective of this study is to investigate if the epigeic earthworm Eudrilus Eugenia might convert waste leaf litter and waste cow dung into vermicomposting. Nitrogen is increased by 14.9 percent in leaf litter vermicomposting and 1.62 percent in cattle manure vermicomposting; potassium is increased by 1.69 percent in leaf litter vermicomposting and 0.56 percent in cattle manure vermicomposting; and phosphorus is increased by 1.46 percent and 1.11 percent in leaf litter vermicomposting and cattle manure compost, respectively. In leaf litter vermicomposting and cow manure vermicomposting, the carbon nitrogen ratio is decreased by 0.33 percent and 2.76 percent, respectively(10).

Table 1 shows the findings received. The pH of the vermicomposting is moderately acidic waste, gross organic carbon is 18.53 percent, 42.96 percent, and 21.02 percent, respectively. The vermicomposting contained 1.36 percent gross nitrogen, whereas the raw material contained 1.88 percent. The C/N ratio in cow dung and vermicomposting is the same (12.5:1), whereas the raw material had a considerably higher ratio (22.5:1). In the vermicomposting and cow waste, total phosphorus is 0.47 percent, 0.26 percent, and 0.78 percent, respectively. The average potassium level of the vermicomposting is 0.56 percent, 0.99 percent in raw material, as well as 0.75 percent in cow dung, indicating that the vermicomposting had less potassium than the raw material as well as cow manure. Complete manganese, zinc, iron, as well as copper concentrations in vermicomposting are greater than in raw material, indicating that have accumulated are smaller than in cow dung.

TABLE 1: RAW FEEDSTOCK AND VERMICOMPOSTING 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

Vermicomposting include essential micronutrient, as well as the nutritional status matches those of earlier research. As shown in Fig. 5, the temperature recorded 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 variation in °C is restricted to 0.25, 0.31, and 0.23. As indicated in Fig. 6, the temperature in rice straw is 27.65 °C, followed by 27.12 °C in grass + rice straw alongside 27.09 °C in grass during the second 8 weeks. The temperature variation in the second cycle is restricted to 0.51, 0.38, and 0.25 degrees Celsius. Temperatures varied from 0 to 35 degrees Celsius throughout both stages. 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 shown in Fig. 7. The humidity in rice straw is 92.50 percent during the second 8 weeks, followed by 94.99 percent in grass as well as 93 percent in rice straw grass. The humidity is 80–100 percent throughout each of these cycles, suggesting a moist environment, slightly greater than the range (80–90 percent) for fast Eisenia development during the vermicomposting phase.

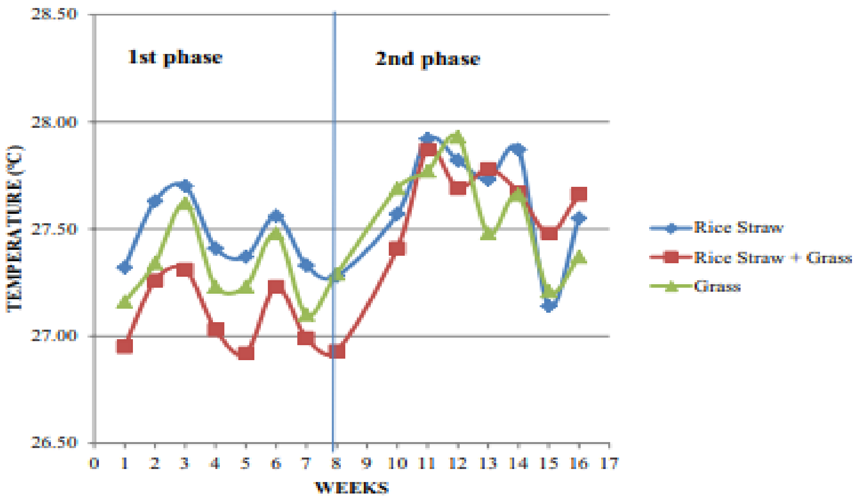

Fig. 5. The Temperature (°C) Fluctuated Throughout the Initial and Subsequent 8 Week of Vermicomposting.

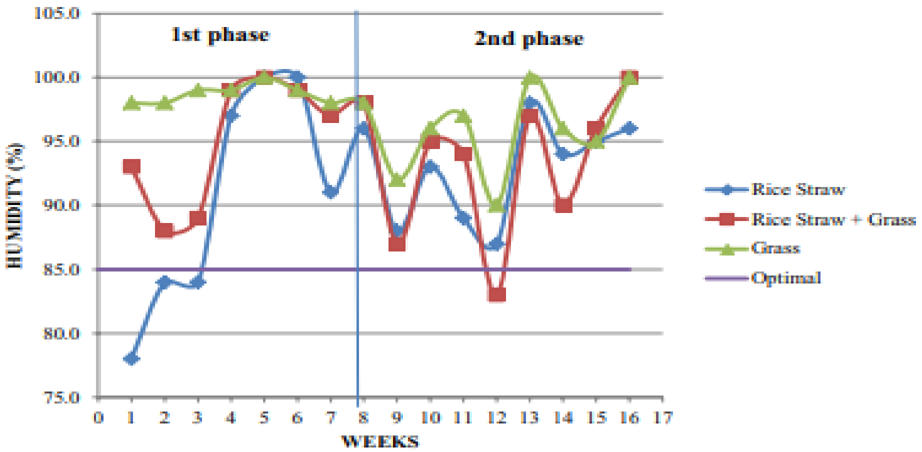

Fig. 6. The Humidity Levels Fluctuate Throughout the Initial and Subsequent 8 Week of Vermicomposting.

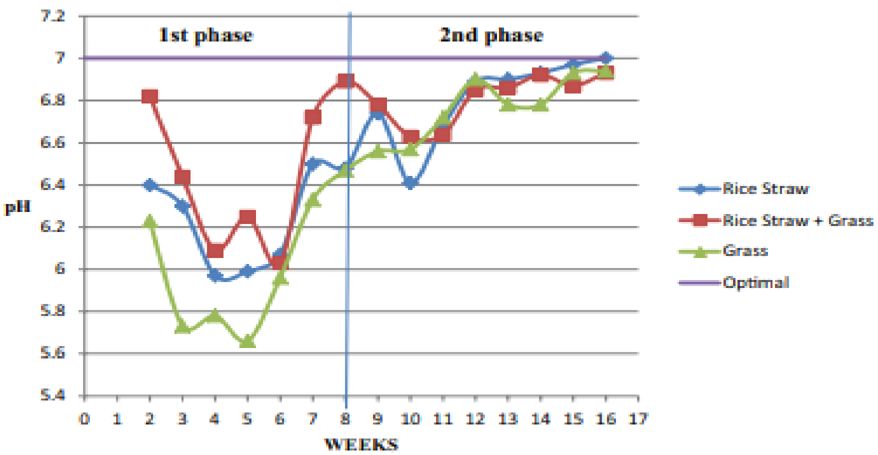

Fig 7. pHof the Soil Varies Throughout the Initial and Subsequent 8 Week of Vermicomposting.

5. CONCLUSION

Eisenia is utilized to effectively vermicomposting rice straw, animal dung as well as dry grass clippings. The resultant vermicomposting is black in colour, smelled mull-like soil, as well as is homogenous. It included all of the necessary macro- as well as micronutrients for plants, such as, P, N, Ca K, Mn, Mg, Zn, Cu, and Fe, indicating that an ecologically acceptable nutrient-rich fertiliser for agriculture had been developed. Future study should look at the potential of generating vermicomposting from various sources of waste materials and manure. The pH of entirely three transactions changed from 4.9 to 6.6 until the compost is possible to harvest on the final day, when it is almost neutral. This is consistent with a pH variation of 4–10 during the process, with value near neutrality after the vermicomposting is suitable to harvest. It may happen as a consequence of the CO_2 and organic acids produced by microbial metabolism. According to numerous research, most earthworm species prefer a pH of around 6.5.

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