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Biocomposting a Green Technique for Improvement of Soil fertility using Rice Husk

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Abstract - *Rice husk (RH) is an abundant agricultural solid waste which is generated during rice-milling process. The present study involves the conversion of RH and fruit waste into Bio compost through vermicomposting technique with two batches, one without molasses (B1) and another one with molasses (B2). After 10 weeks of vermicomposting, both the batches show better quality bio compost with higher nutritional status and encouraged the growth of earthworm. The compost was tested and the test result reveals that the percentage of Soil Organic Carbon (SOC) was about 2.3% and 2.44% for B1 and B2 respectively and also the Nitrogen, Phosphorus and Potassium content was sufficient in the compost for the growth of plants. The SOC of the compost helps in the improvement in the soil fertility also.*

Key Words: Rice husk, vermicompost, Bio compost, molasses, Soil organic carbon;

1.INTRODUCTION

1.1 General: Rice is being cultivated by almost more than 75 countries around the world and rice husk is the byproduct obtained during the de-husking process in the rice mills, which is an agricultural waste that causes serious environmental problem. Burning of rice husk in open piles is the most commonly practiced which has led to air pollution problems. Rice husk contains Carbon (C), Oxygen (O), Hydrogen (H), Nitrogen (N), Sulphur (S), Silicon (Si), Iron (Fe), Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), and Phosphorus (P) which makes it a good source of many nutrients for crops.

1.2 Composting: The organic materials are subjected to bacterial decomposition, the end product remaining after bacterial activity is called as humus. The entire process involving both the seperation and bacterial conversion of the organic solid wastes is known as Composting. Decomposition of the organic solid wastes may be accomplished either aerobically or anaerobically, depending on the availability of oxygen.

1.2.1 Types of Composting: There are two types of composting depends on the availability of the oxygen content,

i. Aerobic Composting.

ii. Anaerobic Composting.

i) Aerobic Composting: It is defined as the process in which under suitable conditions, facultative aerobic organisms principally, thermophilic, utilize considerable amounts of oxygen in de-composting organic matter to a fairly stable humus called compost.

ii) Anaerobic Composting: It is the breakdown or putrefaction of the organic matter to the production of methane and carbon di oxide by reduction in the absence of oxygen.

1.3 Principles of Composting:

i) To transform the biodegradable organic materials into a biologically stable material and in the process reduce the original volume of waste.

ii) To destroy pathogens, insect eggs and other unwanted organisms and weed seeds that may be present in wastes.

iii) To retain the maximum nutrient content.

iv) To produce a product that can be used to support plant growth and as a soil amendment.

1.4 Factors affecting Composting: The most important factors affecting the composting are given below –

1. Segregation of refuse
2. Grinding or shredding of refuse.
3. C/N ratio.
4. Proportion or blending of wastes.
5. Moisture content.
6.Placement of materials for composting.
7. Temperature.
8. Aeration.
9. Organisms in composting.
10. Use of inoculum.
11. Reaction (pH control).
12. Climatic conditions.
13. Destruction of pathogenic organisms.
14. Fly control.

1.5 Objectives of Composting

i) To improve the soil fertility.
ii) To enhance sustainability technique for solid waste management.
iii) To improve environmental and public health. It can be utilized as fertilizer for organic farming.
iv) To compare the Compost with and without molasses.

1.6 Composting Techniques

i) Windrow Composting: It is one of the oldest methods of composting and can be constructed on ground in form of piles of 0.6 to 1 m height. The width and length of piles are kept as 1 to 2 m and 6m respectively. The moisture content is maintained at 50% to 60% and temperature at 55^0C. Turning of windrows is often accompanied by the release of offensive odors.

ii)Mechanical composting: The composting by open windrow composting method requires very large area. The process of mechanical composting is adopted which is very fast and mechanical device are employed in turning the solid waste undergoing composting. The stabilization of the waste takes only about 3 to 6 days. A mechanical composting plant is a combination of various units which perform specific functions.

iii) Vermicomposting: Vermicomposting involves the stabilization of organic waste through earthworms. Vermicompost is the result of combined activity of micro-organisms and earth worms. Vermicomposting includes 2 steps of decomposition
a) Primary decomposition.
b) Secondary decomposition.
The moisture level of 50% - 55% heap is maintained and the temperature in a range of 28 – 45^0C. The harvesting of vermicomposting starts from the 28th day of the introduction of the earthworms.

2. LITERATURE REVIEW

[1]Pardeep Kaur (April 2019) "Enhanced bio composting of rice straw using agricultural residues: an alternate to burning"
Rice straw which predominantly contains cellulose, hemicellulose and lignin, can be converted into value-added product such as bio-compost. The present study was planned to carry out rice straw degradation, added with agricultural residues like rice bran and fruit waste in different combinations, with standard fungal culture of Tricho-dermaharzianum MTCC 8230. Methods Rice straw added with fruit waste and rice bran was moistened with sterilized water in five different proportions. The experimental trays were inoculated with spore suspension (1 × 108 spores/ml) of T.harzanium. The trays were observed for change in pH, appearance and chemical fibres (acid detergent fibre, neutral detergent fibre, and acid detergent lignin).

[2] "Manual of Soil Fertility Improvement Technologies in Lowland Rice Ecologies of GHANA" Mr. Richard Twumasi-Ankrah (March 2014)
Soil improvement technologies applicable to the Northern Savanna and Southern Zones have been tested and documented. For the Savanna Zone, indigenous materials like rice straw, cow dung, and human excreta have been emphasized, whereas in the Southern Sector, materials used include rice straw, sawdust, and poultry manure. In all cases, the use of phosphate rocks applies. The use of these materials as composts was also tested and documented. Other technologies include the charring of rice husk and sawdust, which is applied to improve the carbon - nitrogen ratio in the soil. In addition, the practice of improving rice seedling growth using small quantities of inorganic fertilizer was also tested and found to be very effective.

[3] Dr. Satoshi Tobita (January 2011) "Soil Testing in India"
Soil Testing is well recognized as a sound scientific tool to assess inherent power of soil to supply plant nutrients. The benefits of soil testing have been established through scientific research, extensive field demonstrations, and on the basis of actual fertilizer use by the farmers on soil test-based fertilizer use recommendations. Soil testing was initiated in the country in the beginning of planning era by setting up of 16 soil testing laboratories during 1955. Government of India has been supporting this programmer during different plan periods to increase the soil analyzing capacity in the country.

3. METHODS AND METHODOLOGY

3.1 Materials required for composting:

i) Rice husk - Rice husk is the by-product obtained from the rice mill industry. The rice husk is generally not recommended as cattle feed since its cellulose and other sugar contents are low, which means that there is a limited source of energy for the cattle.

ii) Cow dung and Fruit waste: The cow dung helps to degrade the agricultural wastes and also the worms will feed on the cow dung. The cow dung increases the nitrogen content of the vermicompost.

iii) Molasses: Molasses was collected from the sugar factory and it is sprayed on one of the batches (B2).

3.2 Procedure:

3.2.1 Batch 1

1. Dig a trench for composting, the compost trench should be about 70 cm length 90 cm wide 25cm deep. The area of the trench would be determined by the amount of organic matter to compost. The rice husk was mixed with water and kept for fermentation for 5 days. After fermentation, the mix was then placed in alternate layers.

2. The composting area, is the base area (pile's length and width) A family can allocate an area of 0.36 m^2 of the yard to composting. Usually, a 15% of the area is left for contingencies since some material rolls down pile (due to wind, rain, small animals) to the pile side.

   If the maximum height is 0.25m, then: Volume m^3 = (0.7*0.9*0.25) => 0.157m^3, corresponds to about 40Kg parent material to compost.

3. The rice husk should be piled in the first layer and third layer with a layer of either cow dung and vegetable matter in the second and fourth in an alternating arrangement with rice husk and the top of the pile is covered with soil layer.

4. The heap is watered to maintain the moisture content between 50% to 60%. The heap is turned 15 days once to regulate the offensive odor from the heap and also to maintain the temperature of about 55^0C.

3.2.2 Batch 2

The above steps are repeated for batch 2 with one more trench which includes molasses. The molasses was applied as sources of microbial decomposers and energy for microbes respectively to promote composting processes. Molasses (4.5L) were diluted in water. This solution was then added to rice husk and evenly mixed to bring water content up to 50% (moist-weight basis), resulting in the final weight of composting materials.

Fig.1 Rice-husk mixing with molasses

3.3 Soil testing: After 90 days the compost was tested. The sample was collected in a plastic bag and sent it to a laboratory to determine the p^H, N, P, K, Sulphur, zinc, boron, iron, manganese, copper, in order to determine the nutrients and SOC of soil to check the fertility of the soil after composting of rice husk.

4. Results and Discussions

4.1. Soil fertility: Soil has become one of the world's most vulnerable resources in the face of climate change, land degradation, biodiversity loss and increased demand for food production. Soil organic carbon (SOC) is a major component which refers to the carbon associated with soil organic matter (SOM). Some of the organic fraction of the soil and is made up of decomposed plant and animal materials as well as microbial organisms.

According to the present study experiment was carried out in two batches one batch without molasses and another one batch with molasses. The results showed that there is an increase in the SOC content of about 2.37% and 2.44% respectively. As the SOC content in the compost is sufficient according to the results. Since the SOC content is sufficient there is an improvement in the soil fertility.

Table.1 Shows the test results for p^H, EC and SOC.

SL NO	Parameters	Batch 1	Batch 2
1	PH	7.6	7.4
2	Electrical conductivity	0.46	0.41
3	Organic Carbon (%)	2.37	2.44

4.2 Vermicompost is a sustainable technique: It is a low-cost technology, environmentally friendly process. The resulting component has been shown to have several positive impacts on plant growth and health. As the present solid waste management technique is effective in improvement in soil fertility with less cost this technique attains suitable technique by managing the soil waste which is originated from the agricultural waste.

Also, the present study reveals that there is an increase in the soil nutrients which is very helpful in plant growth and better yield.

Fig.2 Compost with worms.

4.3 Bio compost/organic fertilizer: The bio-compost obtained from the present study can be used as organic fertilizer which is increasingly considered in agriculture as an alternative to inorganic fertilizers which imparts effects on plant growth, crop yield and the soil fertility. the silica in rice husk and straw is very beneficial for plants by increasing their phosphorus contents, leaf size and chlorophyll content and effect of silica and the physical strength of plants such as in cell walls. These organic fertilizers show improvement in crop, such as improved tolerance of stresses and higher yields. The nutrients like N, P, K, S, Zn, Mn, Cu were sufficient for the plant growth which is present in both the compost batches.

Fig.3 Final Bio-compost after 90 days.

4.4 Comparision of the compost with and without molasses:

i. The present study was carried out in two batches, one batch without molasses and another one with molasses.

ii. The molasses was added as a source of microbial decomposers and energy for microbes to promote rice husk composting which improves the decomposition rate as they are cellulosic in nature and require more time for decomposition.

iii. The comparison was done between the two batches which shows that there is an increase in nutrient concentration in both the batches. The obtained results conveyed that the nutrients are sufficient for plant growth and crop yield.

iv. The p^H value in the compost also increased in both the batches which shows better oxygen content in the soil with 7.6 and 7.4 respectively, this helps in decomposition of organic matter in the presence of oxygen. The table below shows the nutrient values of the compost.

Table.2 Nutrient values of the Bio-compost

NUTRIENT CONCENTRATION IN COMPOST			
SL NO	Parameters	Batch 1	Batch 2
1	Nitrogen	2042	2103
2	Phosphorus	181	165
3	Potassium	417	378
4	Sulphur	8	1
5	Zinc	0.68	0.64
6	Boron	0.8	0.8
7	Iron	6.37	10.37
8	Manganese	1.15	1.09
9	Copper	0.3	0.31

Conclusions

- The bio compost or the vermicompost of rice husk will improve the soil fertility by increasing the nutrients content in the soil such as potassium, phosphorus and total nitrogen. The bio compost also increases the water holding capacity of the soil.
- To enhance Sustainability technique for solid waste management the present study will reveal that vermicomposting is a feasible technology for bio transforming of rice husk into value added bio compost.
- Rice husk fertilizers will show the improvement in crops such as improved tolerance of stresses and higher yields. The effect of silicon on plants will impart physical strength to their cell walls.
- India being the largest agriculture-based economy which generates crop residue which are burnt and causes a major environmental problem. Composting being an effective sustainable technique helps in minimizing the air pollution.

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