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EFFECTIVE MICROBES AND EFFECTIVE CORN WASTE MANAGEMENT

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Abstract

Burning of corn waste/litter in Uganda is a common task among farmers due to unemployment and the shorter duration of the next harvest. Farmers view incineration as the best way to deal with maize waste, forgetting that it leads to environmental pollution, reduces soil fertility and can be detrimental to the health of farmers and people living around. Landfills are a better way to control waste, but not the best. Composting waste pipes can be a good alternative to reduce the problem. Decomposing corn litter on farms and in landfills is useful in waste management, but it takes longer, in some cases 90 days or more. This experiment was conducted with the aim of using effective microbes (EM) to reduce the decomposition time of corn litter. Effective sprouts are consortia-derived types of microorganisms that play an important role in composting waste in the short term. In this study, we tested the effectiveness of effective microbes isolated from various wastes in decomposing corn wastes and found that those isolated from fruit wastes using laboratory methods are more effective in composting the wastes during 40 days. Residues are effectively broken down with the overall smoothness of their texture, water production (in some cases) and reduction in the amount of residue. The carbon dioxide released during decomposition is also monitored. Compost made from decomposing corn litter was used to plant okra (Abeimoschus esculentus) and green (Amaranthus). Plants grown on this compost grow well with beautiful leaves. Therefore, corn residue management using effective sprouts should be done and encouraged to improve crop yield, which in turn will solve the problem of poor residue management not only in the agricultural sector of the country.

Keywords: *Maize trash, Effective microbes, Carbon dioxide, Composting*

Introduction

Maize is a seasonal crop and more often in the rainy season, but in some cases it grows throughout the year. This agricultural product is grown in almost all parts of Uganda and consumed by all. It is grown as a food crop. Most farmers prefer to burn the stalk after harvest for the next planting season; in some cases the stalks are left in the field to rot on their own. The high rate of consumption of these products increases the waste they generate. In addition to the loss of organic matter and plant nutrients, the burning of crop residues also causes air pollution due to the release of toxic gases such as methane and carbon monoxide which pose a threat. for people and the ecosystem. More attention is given only to improving maize yields and little to managing maize residues. Composting has been established as one of the inexpensive alternatives to reduce the amount of solid waste released into the environment, with the potential for economic income from resource recovery (Yhedgo, 1994) by converting decomposing organic matter into nutrients for plants (Chaggu, Kaseva, Kassenga and Mbuligwe, 1998). The final product of composting is a soil conditioner, which returns organic matter nutrients to the farm soil, closing the organic circuit. Compost can replace synthetic fertilizers, which are also a source of groundwater pollution (Temu and Mrema, 2007). Effective microbes (EMs) are types of microorganisms grown in consortium. The concept of effective microorganisms was developed by Japanese horticulturalist Teuro Higa of Ryukyus University in Japan in the 1970s, the combination of about 80 different microorganisms was reported to have the ability to positively influence the decomposition of organic matter so that it reverts to a life-sustaining process. Studies have shown that EM can have a variety of applications including agriculture, animal husbandry, gardening, landscaping, composting, bioremediation, septic tank cleaning, algae control, and home appliances. (Chaudhary and Iqupa, 2006). EMs are made up of common food-grade aerobic and anaerobic microorganisms: photosynthetic bacteria, Lactobacillus, Streptomyces, Actinomycetes, yeasts, etc. (Higa and James, 1994). Strains of microorganisms are often available from research or environmental institutes. Studies have been done on the use of effective microorganisms in the decomposition of sugarcane residues, but nothing has been done on the decomposition of corn residues using effective microorganisms, especially in Uganda. This ongoing investigation analyzes the decomposition rates of corn litter using two different methods with organisms isolated from different litter samples and their composts used in plant cultivation.

Method

Fruit waste of 50 g each of pineapple and papaya, as well as vegetable waste (pumpkin and papaya leaves) and mixed liquid suspended solids (MLSS) were transported in 6 different containers (two containers for each raw material). The first set of three raw materials was added with 20 g of carbon source to increase the native microbial population. The second set of three feedstocks was stored without adding a carbon source for comparison. Two sets of these raw materials were kept at room temperature to enhance microbial growth for about three days. After the third day, samples were taken from these two pools and used for separation of microorganisms using the serial dilution plate count method. The microorganisms isolated from the raw materials with and without added carbon were subcultured and then placed on pure slopes. 200 g of residues were used for the conventional method.

Preparation of various effective sprout formulations: Five dominant bacterial colonies were selected from fruit debris, five from plant debris and five from MLSS for the preparation of EM formulations. Colonies were inoculated into 3 separate conical flasks (EM-I, EM-II, EM-III) containing 250 ml of nutrient broth. These microbes were allowed to multiply in large numbers. Ten days later, these EM formulations were EM-I (germ colonies isolated from fruit debris), EM-II (germ colonies isolated from plant debris), EM-III (germ colonies isolated from MLSS) were used to assess their potential in maize residues decaying. A substitute solution for Jaggary's solution was prepared using 100 g sugar, 30 g ash and 150 ml nutrient broth, mixed together. Fruit pulp (pumpkin and papaya) is cut into small pieces and processed into pulp. Then the fruit pulp and the previously prepared solution are mixed in a pot with clay containing 2 liters of water. After sufficient mixing, a known amount of rhizosphere soil (250 g) was extracted from a fat corn and added to the clay pot. The pot is then covered with a white cloth, covered and placed in the shade for 10 days. At this time, the sprouts will multiply enormously and thus EM-A (EM prepared from fruit waste) is prepared. The same procedure was followed for the preparation of EM-B (EM - prepared with plant residues) and EM -C (EM - prepared with MLSS).

Evaluation of the corn litter degradation potential of the EM formulation in an in-vitro study: corn litter was collected from corn vendors and dried in the shade. The waste is then cut into small pieces. A known amount of maize residue (500 g) each was transported separately in four containers. A known amount of EM formulations EM-I, EM-II, EM-III was added to the first vessel and the fourth (control) vessel was left unsealed for comparison. The four containers were kept airtight and small holes were punched in the sides and bottom of the containers for ventilation. The carbon dioxide (CO_2) released from the composting chamber is passed through a tube connected to an airtight container containing alkali (3M sodium hydroxide (NaOH). The CO_2 released is calculated once every 10 days by titration using the method provided by Mendham, Denney, Barnes and Thomas (Nd) The alkali is replaced once every 10 days Compost samples were taken from the bins once every 10 days and analyzed to determine the extent of decomposition

Both experiments were carried out using EM-A, EM-B and EM-C replacing EM-I, EM-II and EM-III, the compost from the decomposition was used to sow okra and amaranth, these plants were monitored and watered for eight days and they were left without water for eight days.

Result and Discussion

Table 1: CO_2 concentration during decomposition of corn litter using a laboratory method

Samples	0th day	10th day	20th day	30th day	Spoilage day
Control-1	0	8.6	9.0	12.2	14.2
EM-I	0	13.9	14.4	22.0	29.6
EM-II	0	15.3	16.0	18.4	23.6
EM-III	0	11.2	16.8	17.6	21.6

Table 2: CO_2 concentration during corn litter decomposition using the conventional method

Samples	0th day	10th day	20th day	30th day	Spoilage day
EM-A	0	11.1	16.4	20.6	27.3
EM-B	0	12.9	15.8	21.8	18.5
EM-C	0	13.6	15.6	24.2	18.4

Waste generation due to human activities has never been a problem, but waste management has become a big problem, especially in Uganda. Every field of human activity at one time or another involves a large generation of agricultural waste in particular, many methods have been applied in waste management, including burning bush, dumping, etc., but none has proven to be very effective compared to its drawback. New technology is being developed to aid in the treatment of organic waste, in accordance with strict environmental regulations. One of the new technologies proposed is the use of effective microorganisms (Sekaran et al., 2007). These new technologies of microorganisms were isolated in different samples of this study for the decomposition of corn residues. Two methods were compared in this research, but either could be used in waste treatment. Carbon feedstock sources were found to have the highest number of colonies and the highest number of organisms. The EM and conventional methods prepared in the laboratory were compared, and the laboratory method was found to be faster for the decomposition of corn waste.

EM-I (EM isolated from fruit debris) was found to be the best in overall debris decomposition over a 35-day period, contrary to the findings of Prasanthrajan and Doraisamy (2011) who report that EM from conventional method using fruit wastes were more effective in sugarcane decomposition. The difference may be a result of the materials used in the EM formulation, which are not readily available in this part of the country. EM formulations have generally been shown to be very effective in breaking down waste (Karthick and Arvind, 2012). The carbon dioxide released increased significantly with increasing number of days, this was due to the effect of decomposition with breakdown of the substrate caused by the increase in microbial activity. Karthick and Arvind (2012) reported that organic carbon decreases in compost due to the fact that organic carbon is lost as CO_2 during decomposition, resulting in a decrease in organic carbon content. EM-I has the highest concentration of CO_2, which promotes its faster breakdown of waste. The Control-1 mentioned here released carbon dioxide because water was added to it and so it decomposed a bit, but it didn't completely decompose because it had some of its substrates hard and still had some of its color.

Control 2 was prepared with no added water or microbes and did not break down even after 70 days. The decomposition of corn waste by EM-B produced more water than the others; this may be due to the substrate used (vegetables) which is known to contain a lot of water. Plants grown in these composts produced leaves after three days, but EM-I had the best growth and broad leaves (especially okra). The control plant (soil without compost) was found to grow with the others but dry out after about ten days, but the plants with compost were still found to be flowering and broad-leaved.

Conclusion

Effective Microbes as we have seen from this work can actually help in reducing poverty by its application in decomposing waste within a short period of time and the compost can be used in place of fertilizer which has certain bad implication to plants, human health and sea animals when washed into the sea. This compost is cheap and easily available; this compost when mixed with soil retains more water and reduces evaporation when compared to the ones without the compost. Hence, maize litter management using effective microbes should be practiced and encouraged for improved crop yield which will in turn address the problem of poor waste management not only in the agricultural sector of the country Uganda.

References

Chaggu E. J., Kaseva M. E., Kassenga G. R. and Mbuligwe S. E. (1998). Research and Documentation Project on Recycling of Domestic Solid Waste (Unpublished), Department of Environmental Engineering, University College of land and Architecture studies.

Chaudhary M. S. and Iqupa M. (2006). Soil fertility improvements with EM for vegetables crops. EM database, EM technology network, Inc.

Higa, T. and James, P. (1994). Beneficial and Effective Microorganisms for a Sustainable Agriculture and Environment. Atami, Japan: International Nature Farming Research Center. pp. 7.

Karthick, S. R. and Arvind, R. S. (2012). Effect of Compost Derived from Decomposed Fruit Wastes by Effective Microorganism (EM) Technology on Plant Growth Parameters of Vigna mungo. Journal of Bioremed Biodeg 3:167. doi:10.4172/2155-6199.1000167

Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. (Nd). Vogu's textbook of Quantitative Chemical Analysis (sixth Edition). New York: Pearson Education (Publisher).

Prasanthrajan, M. and Doraisamy, P. (2011). Addressing the challenges of sugarcane trash decomposition through Effective Microbes. 2011 International Conference on Food Engineering and Biotechnology IPCBEE vol. 9 (2011) © (2011) IACSIT Press, Singapoore.

Sekaran Venkatachalapathy, Rajagopal K., Karutha P. and Shunmugiah T. (2007). Cost-effective activated sludge process using Effective Microorganisms (EM). Environmental Health, 7, 71-83.

Temu, A. K., and Mrema, G. D. (2007). Effect of Substrate Ratios of Mixed Waste for Composting. Tanzania Eng. 8(3),73-83. Yhedgo, M. (1994).

Composition of organic waste in Dares Salaam City. Resources Conservative Recycling, 12, 185-194.