Addressing the Problem of Maize Trash Management using Effective Microbes

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ABSTRACT

Farmers consider burning as the best way to treat maize trash, and forgetting that it results to environmental pollution, decrease in soil fertility and could be detrimental to health of the farmers and people living around. Landfills are also better ways of controlling waste but not the best. Maize trash decomposition in fields and waste bins are helpful in waste management but takes a longer time, in some cases it takes a period of 90 days or more. This experiment was conducted with the aim of using Effective Microbes (EM) to reduce the time taken for maize trash decomposition. Effective Microbes are varieties of microorganisms grown as consortium which plays a great role in converting wastes into compost in short span of time. In this study, we tested efficiency of effective microbes isolated from different wastes in decomposing maize trash, it was found that those isolated from fruit wastes using laboratory method was most effective in converting the trash to compost within 40 days. The wastes were effectively decomposed with the complete softness of its texture, water production (in some cases) and reduction of the volume of the waste. Carbon dioxide released during the decomposition was monitored as well. Compost produced from the maize trash decomposition was used in growing okra (Abeimoschus esculentus) and green (Amaranthus). It was discovered that the plants grown with these compost grew well with good leaves. Hence, maize trash 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 Nigeria.

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

INTRODUCTION

Maize is a seasonal crop in Nigeria; it is more prevalent during raining season but in some cases grows throughout the year. This farm produce is cultivated in almost all parts of Nigeria and being consumed by all, it is grown as a food crop. Most farmers

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would prefer to burn up the stalk after harvest against next planting season, in some cases the stalks are left in the farm to decay all by itself. After harvesting, the maize is eaten cooked or roasted or used for further production (for example, “Akamu”, corn starch, flour {for baking}, sweet corn, corn methanol etc). The high rate of consumption of this produce has actually increased the waste generated there in. Besides the loss of organic matter and plant nutrients, burning of crop residues also causes atmospheric pollution due to the emission of toxic gases like methane and carbon monoxide that poses threat to human and ecosystem. Composting has been established as one of the low cost alternatives for minimizing the volume of solid waste disposed off to the environment, with a potential for economic gain from resource recovery (Yhedgo, 1994) by converting putrescible organic matter into plant nutrients (Chaggu, Kaseva, Kassenga and Mbuligwe, 1998). The final product of composting is a soil conditioner, which returns nutrients of organic matter to farm soil thus closing the organic loop.

The compost can potentially replace synthetic fertilizers, which are also a source of groundwater pollution (Temu and Mrema, 2007). Effective Microbes (EM) are varieties of microorganisms grown as consortium. The concept of Effective Microorganisms was developed by Japanese horticulturist Teuro Higa from the University of Ryukyus in Japan. He reported in the 1970s that a combination of approximately 80 different microorganisms is capable of positively influencing decomposing organic matter such that it reverts into a life promoting process. The studies have shown that EM may have a number of applications, including agriculture, livestock, gardening, landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses (Chaudhary and Iqupa, 2006). EM consists of common and food-grade aerobic and anaerobic micro-organisms: photosynthetic bacteria, Lactobacillus, Streptomyces, Actinomycetes, yeast, etc. (Higa and James, 1994). The strains of the micro-organisms are commonly available in research institutes or from the environment. Studies have been conducted on the use of Effective Microorganisms in the decomposition of sugarcane trash but none have been done on the decomposition of maize trash using Effective Microorganisms especially in Nigeria. This present research studies the decomposition rates of the maize trash using two different methods with organisms isolated from different waste samples and their composts used in growing plants.

METHOD

Fruit wastes of 50g each from pineapple and pawpaw, as well as vegetable wastes (pumpkin and pawpaw leaves) and Mixed Liquid Suspended Solids (MLSS) were taken in 6 different containers (two containers for each raw material). The first set of three raw materials was added with 20g of carbon source in order to increase the native microbial population. The second set of three raw materials was stored without the addition of carbon source for comparison. These two sets of raw materials were kept under room temperature for enhancing the microbial growth for about three days. After the third day, the samples were taken from these two sets and used for isolation

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of microorganisms using serial dilution-plate count method. The microorganisms isolated from the raw materials with and without the addition of carbon were sub cultured then placed in pure culture slants. 200g of the wastes were used for the conventional method.

Preparation of Different Effective Microbe's Formulation: Five predominant bacterial colonies from fruit wastes, five from vegetable wastes and five from MLSS were selected for the preparation of EM formulations. These colonies were inoculated in 3 separate conical flasks (EM1, EM2, EM3) containing nutrient broth of 250ml. Then these microbes were allowed to mass multiply. Ten days later these EM formulations EM1 (microbial colonies isolated from fruit wastes), EM2 (microbial colonies isolated from vegetable wastes), EM3 (microbial colonies isolated from MLSS) were used for assessing their potential in maize trash decomposition.

A solution in replacement for Jaggary solution was prepared using 100gm of sugar, 30gm of ash and 150ml of nutrient broth, these were mixed together. The fruit wastes (pumpkin and papaya) were cut into small pieces and made to pulp. Then the fruit pulp and the solution prepared above were mixed in an earthen pot containing 2 litres of water. After proper mixing a known quantity of rhizosphere soil (250gm) were taken from fertile maize crop field and added into the earthen pot. Then the pot was covered with white cloth, lid and was placed in shade for 10 days. By this time the microbes would multiply in enormous number and thus the EM – F (EM prepared using Fruit wastes) was prepared. The same procedure was followed for preparing EM - V (EM - prepared using vegetable wastes) and EM - S (EM - prepared using MLSS).

Assessing maize trash degradable potential of EM formulation under in-vitro study: Maize trashes were collected from corn sellers and were shaded dry. Then the trashes were chopped into small pieces. A known quantity of maize trash (500g) each was taken separately into four containers. A known quantity of EM formulations EM1, EM2, EM3 were added to first the containers and the fourth container (control) was left uninoculated for comparison. All the four containers were kept air tight and small holes were made by the side and under the containers for aeration. The evolved carbondioxide (CO_2) from the compost chamber were passed through a tube connected to an air tight container containing alkali (3M sodium hydroxide (NaOH). The liberated CO_2 was calculated once in 10 days by titration using the method stated by Mendham, Denney, Barnes and Thomas (Nd). The alkali was changed once in 10days. The compost samples were taken from the containers once in 10 days and were checked for the extent the decay had gone. The same experiments were conducted with EM-F, EM-V, and EM-S by replacing EM1, EM2, and EM3. Compost gotten from the decay was used for planting okra and Amaranthus, these plants were monitored and watered for eight days and left un-watered for another eight days.

RESULTS AND DISCUSSION

Waste generation due to activities of man is never a problem, but waste management has been a huge problem especially in Nigeria. Every sphere of human endeavour at one point or another involves huge waste generation in agriculture in particular, many methods have been applied to waste management which include bush burning, landfills and so on but none have proven so effective when compared of its disadvantages. New technology is being produced to assist the organic waste treatment, conforming to strict environmental regulations. One of those new technologies being proposed is the use of effective microorganisms (Sekaran *et al.*, 2007). These new technology microorganisms have been isolated from different samples in this study for maize trash decomposition. Two methods were being compared in this research but any one can be used for waste treatment. The raw materials with carbon source were found to have the highest number of colonies and number of organisms. The EM prepared through laboratory and conventional methods were compared, and it was found that the laboratory method was faster in the decomposition of the maize trash. EM-1 (EM isolated from fruit wastes) was found to be the best in the overall decomposition of the waste within a period of 35 days, this is in contrast 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 disparity could be as a result of the materials used in the EM formulation which was not readily available in this part of the country. Generally it has been proven that EM formulations are very effective in waste decomposition (Karthick and Arvind, 2012). The carbon dioxide released increased considerably with increase in days, this is as a result of the decomposition effect with breakdown of the substrate caused by increase in microbial activity.

Karthick and Arvind (2012) has it that organic carbon was decreased in compost due to the fact that organic carbon is lost as CO_2 during decomposition which thus results in lower organic carbon content. EM-1 had the highest CO_2 concentration, which supports its fastest decomposition of the waste. The control-1 mentioned here had some carbon dioxide released because of some amount of water added to it and therefore had little decomposition, but not fully decomposed as it had some of its substrates hard and still retained part of its colour as shown in the figures below. Control-2 was set up without any addition of water or microbes and was not decomposed even after 70 days. The decomposition of the maize trash by EM-V produced more water when compared to the others; this could be as a result of the substrate used (vegetable) which is known to contain lots of water. Plants grown with these composts brought out leaves after three days, but EM-1 had the best growth and broad leaves (especially okra). It was discovered that the control plant (soil without compost) grew alongside with others but withered after ten days but still plants with compost were found flourishing and with broad leaves.

Table 1: CO_2 concentration evolved during maize trash decomposition using laboratory method

Samples	Day 0	Day 10	Day 20	Day 30	At spoilage
EM-1	0	18.9	19.4	27.0	34.6
EM-2	0	20.3	21.0	23.4	28.6
EM-3	0	16.2	21.8	22.6	26.6
Control-1	0	13.6	14.0	17.2	19.2

Source: Laboratory Experiment, 2013

Table 2: CO_2 concentration evolved during maize trash decomposition using conventional method

Samples	Initial	Day 10	Day 20	Day 30	At spoilage
EM-F	0	16.1	21.4	25.6	32.3
EM-V	0	17.9	20.8	26.8	23.5
EM-S	0	18.6	20.6	29.2	23.4

Source: Laboratory Experiment, 2013

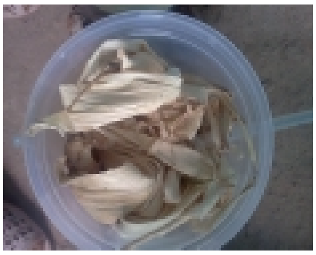

Fig 1: Control-2

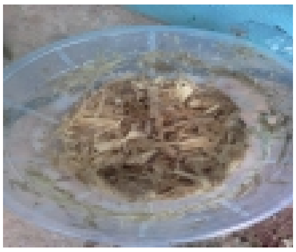

Fig 2: Control-1 after ten days

Fig 3: Control-1 at spoilage

Fig 4: EM-1 after ten days

Fig 5: EM-1 at spoilage

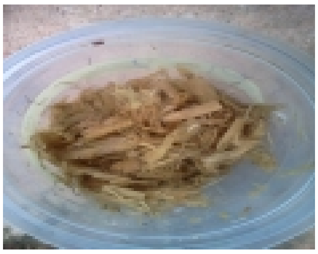

Fig 6: EM-2 after ten days

Fig 7: EM-2 at spoilage

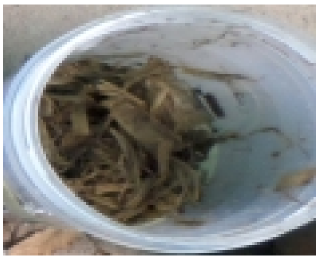

Fig 8: EM-3 after ten days

Fig 9: EM-3 at spoilage

Fig 10: EM-F after 10 days

Fig 11: EM-F at spoilage

Fig 12: EM-S after ten days

Fig 13: EM-S at spoilage

Fig 14: EM-V after ten days

Fig 15: EM-V at spoilage

Fig 16: Set up for the collection of CO_2

Fig 17: Amaranthus Nursery

Fig 18: Withering Okra plant (control)

Fig 19: Okra Nursery

CONCLUDING REMARKS

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 trash 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 Nigeria.

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