HOMEMADE ORGANIC FERTILIZER

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ABSTRACT

This project is about making organic fertilizer in house using degradable waste materials. These wastes creates nuisance to environment. The study consist of a literature review on composting, compost application to agricultural soil, important ingredients for composting, process of composting and phases of composting. The purpose of composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility. The composting process has received much attention in recent years because of pollution concerns and environmentally sound methods for treating waste. Waste volumes continue to rise, which leads to loss of resources and increased environmental risks. Composting aims to stabilization of waste for land filling , volume and mass reduction of solid waste and return of organic substances to the natural cycle .This paper review information on the composting and preparation of compost in the house for treating waste as a means of addressing the environmental pollution concerns. A pot experiment evaluating the influence of compost, performance was conducted in the house.

Keywords: fertilizer, composting, degradable waste

I. INTRODUCTION

Food wastes could be regarded as pure streams of waste and they constitute a major burden to the environment such as odour emanation, vermin attraction, toxic gas emission, groundwater contamination, high energy content and to achieve dual benefits of energy production and waste stabilization(Sun-Kee et al, 2004) . The primary factor in treating food waste is the physico-chemical characteristics of substrate, including particle size and composition. According to Sun-Kee et al (2004), degradation of each component of food waste is affected by environmental conditions. Carbohydrate, cellulose, and protein have their own optimum pH and retention times for degradation (Sridhar and Arinola 1991). Food wastes are commonly generated in homes, institutions and these wastes must be removed to provide a clean and healthy environment. These can be achieved to use in field crop production.

An Organic fertilizer refers to a soil amendment derived from natural sources that guarantees, atleast, the minimum percentages of nitrogen, phosphate, and potash. Virtually any organic material can be used as a fertilizer; materials vary considerably in the concentrated of plant nutrients they contain and the rate which these nutrients are released for the plants use. Of the sixteen essential plant nutrients, the macronutrients nitrogen, phosphorus, and potassium are used in the greatest quantity by plants. The term "complete fertilizer" refers to a material that contains these three nutrients. In organic gardening, low phosphate content in the soil is the most difficult imbalance to correct. A common source of phosphate in organic gardening is rock phosphate, but this is relatively insoluble in soils above a pH of 6.0.

Review of literatures

From the study of literatures, the composting food waste has been used as a means of recycling organic matter back into the soil to improve soil structure and organic fertilizer. Food waste has high energy content, and the primary factor in treating food waste is the physico-chemical characteristics of substrate, including particle size and composition. Composting converts organic waste stream generated into very rich organic fertilizer that is useful for crops growth.

Objectives of this study

The main objective of this work was to reduce the self weight of concrete and to study the behavior of concrete with the percentage variation of vermiculite as fine aggregate from 0% to 40% at 10% intervals. The Workability and Compressive strength Properties have studied for each mixes.

II. EXPERIMENTAL PROGRAM

A. Introduction

The concept of recycling waste nutrients and organic matter back to agricultural land is feasible and desirable. Land application represents a cost effective outlet for the producers of compostable wastes and a potential cheap source of organic matter and fertilizer elements for landowners. Composting is one of the

most promising technologies to treat wastes in a more economical way, for many centuries composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility.

B. **Composting**

At the simplest level, the process of composting requires making a heap of wet organic matter known as green waste (leaves, food waste) and waiting for the materials to break down into humus after a period of weeks or months. Modern, methodical composting is a multi-step, closely monitored process with measured inputs of water, air, and carbon- and nitrogen-rich materials. The decomposition process is aided by shredding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture. Worms and fungi further break up the material. Bacteria requiring oxygen to function (aerobic bacteria) and fungi manage the chemical process by converting the inputs into heat, carbon dioxide and ammonium. The ammonium ($NH+4$) is the form of nitrogen used by plants. When available ammonium is not used by plants it is further converted by bacteria into nitrates ($NO-3$) through the process of nitrification.

Composting of waste is an aerobic (in the presence of air) method of decomposing solid wastes. The process involves decomposition of organic waste into humus known as compost which is a good fertilizer for plants. However, the term "composting" is used worldwide with differing meanings. Some composting textbooks narrowly define composting as being an aerobic form of decomposition, primarily by aerobic or facultative microbes. An alternative form of organic decomposition to composting is "anaerobic digestion".

C. **Important ingredient for composting**

The following are the important ingredients for composting:

- ***Carbon***
- ***Nitrogen***
- ***Oxygen***
- ***Water***

Certain ratios of these materials will provide beneficial bacteria with the nutrients to work at a rate that will heat up the pile. In that process much water will be released as vapor ("steam"), and the oxygen will be quickly depleted, explaining the need to actively manage the pile. The hotter the pile gets, the more often added air and water is necessary; the air/water balance is critical to maintaining high temperatures (135°-160° Fahrenheit / 50° - 70° Celsius) until the materials are broken down. At the same time, too much air or water also slows the process, as does too much carbon (or too little nitrogen). Hot container composting focuses on retaining the heat to increase decomposition rate and produce compost more quickly.

The most efficient composting occurs with an optimal carbon: nitrogen ratio of about 10:1 to 20:1.Rapid composting is favored by having a C/N ratio of ~30 or less. Theoretical analysis is confirmed by field tests that above 30 the substrate is nitrogen starved, below 15 it is likely to outgas a portion of nitrogen as ammonia.

Nearly all plant materials have both carbon and nitrogen, but amounts vary widely, with characteristics noted above (dry/wet, brown/green).Fresh grass clippings have an average ratio of about 15:1 and dry autumn leaves about 50:1 depending on species. Mixing equal parts by volume approximates the ideal C:N range. Few individual situations will provide the ideal mix of materials at any point. Observation of amounts, and consideration of different materials as a pile is built over time, can quickly achieve a workable technique for the individual situation.

D. **Suitable materials for composting**

Can be Composted	**Cannot be composted**
Sewage sludges	Coal ash
Industrial wastes (e.g. food, pulp & paper).	Metal, glass and plastic.
Yard and garden wastes.	Nappies.
Municipal solid wastes (up to 70% organic matter by weight).	The roots of persistent weeds, like bindweed and couch Grass.

Soft prunings, clippings and leaves	Leaves with persistent disease such as black spot
Kitchen waste like fruit, peelings, teabag sand eggshell.	Meat and fish bones
Paper shredded, mixed with grass cuttings and used sparingly.	Cooked food, especially meat, as this attracts vermin

E. **Microorganisms**

The proper mixture of water, oxygen, carbon, and nitrogen, micro-organisms are able to break down organic matter to produce compost. The composting process is dependent on micro-organisms to break down organic matter into compost. There are many types of microorganisms found in active compost of which the most common are:

Bacteria- The most numerous of all the microorganisms found in compost. Depending on the phase of composting, mesophilic or thermophilic bacteria may predominate.

Actinobacteria- Necessary for breaking down paper products such as newspaper, bark, etc.

Fungi- molds and yeast help break down materials that bacteria cannot, especially lignin in woody material.

Protozoa- Help consume bacteria, fungi and micro organic particulates.

Rotifers- Rotifers help control populations of bacteria and small protozoans.

F. **Phases of composting**

Under ideal conditions, composting proceeds through three major phases:

1. Mesophilic phase (I)
2. Thermophilic phase (II).
3. Maturing phase (III).

1. Mesophilic phase (I):

An initial, mesophilic phase, in which the decomposition is carried out under moderate temperatures by mesophilic microorganisms.

2. Thermophilic phase (II):

As the temperature rises, a second, thermophilic phase starts, in which the decomposition is carried out by various thermophilic bacteria under high temperatures.

3. Maturing phase (III):

As the supply of high-energy compounds dwindles, the temperature starts to decrease, and the mesophiles once again predominate in the maturation phase.

G. **The composting process**

Composting of agricultural waste and municipal solid waste has a long history and is commonly employed to recycle organic matter back into the soil to maintain soil fertility. The recent increased interest in composting however has arisen because of the need for environmentally sound waste treatment technologies. Composting is seen as an environmentally acceptable method of waste treatment (Yvette B etal, 2000). It is an aerobic biological process which uses naturally occurring microorganisms to convert biodegradable organic matter into a humus like product. The process destroys pathogens, converts N from unstable ammonia to stable organic forms, reduces the volume of waste and improves the nature of the waste. It also makes waste easier to handle and transport and often allows for higher application rates because of the more stable, slow release, nature of the N in compost (Fauziah etal, 2009). The effectiveness of the composting process is influenced by factors such as temperature, oxygen supply (i.e. aeration) and moisture content. There are two fundamental types of composting aerobic and anaerobic:

Aerobic:

Composting is the decomposition of organic wastes in the presence of oxygen (air); products from this process include CO2, NH3, water and heat. This can be used to treat any type of organic waste but, effective composting requires the right blend of ingredients and conditions. These include moisture contents of around 60-70% and carbon to nitrogen ratios (C/N) of 30/1. Any significant variation inhibits the degradation process. Generally wood and paper provide a significant source of carbon while sewage sludge and food waste provide nitrogen. To ensure an adequate supply of oxygen throughout, ventilation of the waste, either forced or passive is essential. (Yvette B etal, 2000).

Anaerobic:

Composting is the decomposition of organic wastes in the absence of O2, the products being methane (CH4), CO2, NH3 and trace amounts of other gases and organic acids. Anaerobic composting was traditionally used to compost animal manure and human sewage sludge, but recently is has become more common for some municipal solid waste (MSW) and green waste to be treated in this way (Yvette B etal,2000).

H. **Slow and rapid composting:**

There are many modern proponents of rapid composting that attempt to correct some of the perceived problems associated with traditional, slow composting. Many advocate that compost can be made in 2 to 3 weeks. Many such short processes involve a few changes to traditional methods, including smaller, more homogenized pieces in the compost, controlling carbon-to-nitrogen ratio (C:N) at 30 to 1 or less, and monitoring the moisture level more carefully. However, none of these parameters differ significantly from the early writings of compost researchers, suggesting that in fact modern composting has not made significant advances over the traditional methods that take a few months to work. For this reason and others, many modern scientists who deal with carbon transformations are sceptical that there is a "super-charged" way to get nature to make compost rapidly.

Both sides may be right to some extent. The bacterial activity in rapid high heat methods breaks down the material to the extent that pathogens and seeds are destroyed, and the original feedstock is unrecognizable. At this stage, the compost can be used to prepare fields or other planting areas. However, most professionals recommend that the compost be given time to cure before using in a nursery for starting seeds or growing young plants. The curing time allows fungi to continue the decomposition process and eliminating phytotoxic substances.

I. **Pathogen removal**

Composting can destroy pathogens or unwanted seeds. Unwanted living plants (or weeds) can be discouraged by covering with mulch/compost. The "microbial pesticides" in compost may include thermophiles and mesophiles, however certain composting detritivores such as black soldier fly larvae and redworms, also reduce many pathogens. The first stage of bokashi preserves the ingredients in a lactic acid fermentation. The acid is a natural disinfectant, used as such in household cleaning products, so that what enters the second (digestion) stage is essentially free of microbial pathogens. Thermophilic (high-temperature) composting is well known to destroy many seeds and nearly all types of pathogens (exceptions may include prions). The sanitizing qualities of (thermophilic) composting are desirable where there is a high likelihood of pathogens, such as with manure.

J. **Trouble shooting guide**

Problem	**Possible cause**	**Solution**
Foul odor.	Compaction.	Turn or decrease its size.
	Excess moisture.	Turn organic waste or add dry material such as straw.
Ammonia odor.	Too much nitrogen.	Add high-carbon (brown) items
Low temp.	Too little moisture.	Add water and turn
	Poor aeration.	Turn
	Site composting too small.	Enlarge site
High temp.	Too much nitrogen.	Add high-carbon

		(brown) items
	Site composting too large.	Reduce site size or turn more frequently
Pests such as rats, raccoons and insects.	Presence of meat scraps or fatty food wastes.	Pest free area

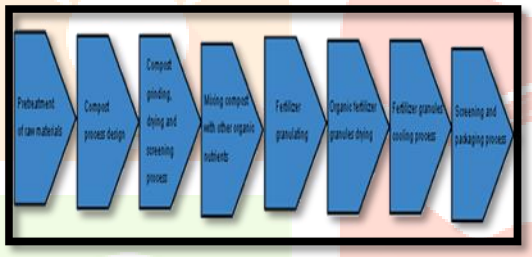
K. **Compost Quality**

Compost quality is measured by several criteria, including the following:

1.Moisture Content.
2.Nutrient Content.
3.Heavy Metal.
4.Particle Size Distribution.
5.Stability.
6.Pathogen Levels.
7.Product Consistency over Time.

III. MANUFACTURING PROCESS

Organic Fertilizer Manufacturing Process



1. Pretreatment of raw materials

Raw materials:

Raw materials of organic fertilizer are adequate and multiple.

1. Agricultural Waste: straws, cottonseed meals, mushroom residues, bio-gas residues etc.
2. Industrial Waste: vinegar residues, sugar residues, lees etc.
3. Household Garbage: kitchen waste, food waste, restaurant garbage etc.

Figure.1 Materials in a collection bin

Figure.2 Various food scraps collected from different areas

Selection and store of organic raw materials:

Almost all organic wastes, except those containing high toxins, can be used as composting materials, but, to increase the soil organic matter or make a growth media, materials with a high C:N ratio, such as straw and husk of grains/cereals (e.g., rice and wheat), corn stalk, bagasse, sawdust, and other materials (e.g., tree trunks and branches), will be the main ingredient. They should be dried and stored in a nearby place.To shorten the compost time, the waste is shredded to a uniform size and then mixed in a controlled way to ensure desired properties of the composting mixture (C/N ratio, moisture content, etc.) The straws

and green manure should be cut into lengths of 5-10 cm. The wood and shoots of fruit trees and vines should be cut with shredders, grinders, or chippers.

Raw Materials Mixing: All kinds of materials should be evenly mixed in fertilizer mixer before granulation. In this process, no chemical additives are added which decrease quality of the organic fertilizer.

2. **Composting process**

Take any used pot with holes at the bottom for drainage and aeration. The pot selected for composting as shown figure.4. Put a layer of coconut husk or other material like cork(as shown in figure.3) that decomposes more slowly at the bottom to prevent too much moisture coming out of the pot. Cover with a layer of soil about 5 cm thick.

Figure.3 A pot with first layer coconut husk and soil.

Figure.4 A pot selected for composting

Put all your kitchen waste for the day over this soil as shown in figure.5 and figure.6.

Figure.5, this shows a layer of waste over the soil

Figure.6, this shows that the layering of waste

Cover the waste well with soil and coconut husk as shown in the figure.7.

Figure 7

You can start all over again with another layer of waste day by day as shown in figure.8.

Figure 8

And repeat by completely covering with another layer of soil. This will ensure there are minimal flies and smell. As you keep layering waste and soil alternately, you will have to stir the contents once or twice a week to ensure proper aeration.

Always keep the pot covered with a metal lid or thick cardboard or old rags of carpet. We tend to use metal because it is waterproof and that can control the amount of moisture in the pot better when it's exposed to sun and rain. A tap is attached with the pot to get the liquid fertilizer separately from the solid fertilizer. We will get the liquid fertilizer as shown in figure.9.

Temperate climates may delay composting to about 1-2 months. Check the compost that is being made in the pots and remember to stir regularly once or twice a week.

Keep a dish under the pot to collect the excess moisture that will be released. This water is precious and can be used as fertilizer for plants. If you're keeping the pot outdoors directly on the grass, the water will directly go to the soil and fertilize it.

Those with larger garden space can dig a hole and do the same process. Keeping the compost pit covered is a good idea to keep away pests and flies.

Composting at home is the most affordable and comfortable composting method used due to its suitability for a small range of feed stocks and facility capacities. Regular checking of the pot assists with mixing of the materials and more importantly supply the oxygen to the bacteria, and also ensures that all parts of the inside the pot reach the required essential for pathogen destruction. Turning is required every two to three days in the first two weeks. After this period frequent turning of the compost is not required as less heat is generated and less oxygen is required while the compost undergoes maturation. The complete process takes 1-3 months.

Liquid Fertilizer

In our preparation of homemade organic fertilizer a different kind of method is involved. Here, we prepare a fertilizer in a pot with tap for aeration process. Compost is formed naturally without any chemical ingredients. After several weeks the water content in the compost increases tremendously. The liquid content in the compost is taken separately after 3 months. The liquid obtained during the composting process has all properties of fertilizer. This liquid is known as liquid fertilizer.

Figure.9, liquid fertilizer obtained from these process

3. **Compost Grinding and Drying Process**

Finished compost are too wet and coarse to be granulated directly without further conditioning. Therefore, preparing the compost for granulation, there are 3 steps needing to do first:

Grinding:

Grinding to produce a finer material (finely ground compost will allow almost all the compost to undergo the granulation process). For grinding the local household grinding machine and mixer are used.

Screening:

Screening to remove larger particles (e.g. fractions >10mm will be screened out and discarded. There is no fixed rule) rocks and unwanted debris. The screening is done manually using a hand siever.

Drying:

Removing the moisture by natural method of drying.

4. **Mixing compost with other organic nutrients**

It is necessary to boost the nutrient content of composts when targeting the granulated fertilizer market by the addition of other organic nutrients (e.g. humic acid) and mineral fertilizers.

Humic acid is useful to improve soil fertility. It is an ideal additive to boost bio-activity and improve the performance of compost or composted fertilizers, an effective agent to use as a complement to organic fertilizers. The addition of other nutrients to the compost reduce the nuisance odour develope from the fertilizer as shown in figure.10

The addition of these organic N sources and the mineral fertilizers, such as rock phosphate and sulphate of potash, have a significant impact on improving the particle size distribution of the mix and the ease with which the resulting mix could be granulated.

Figure.10, mixing the compost with organic nutrients

5. Fertilizer granulating process

Granulation refers to the act or process in which primary powder particles are made to adhere to form larger, multi-particles entities called granules. It is the process of collecting particles together by creating bonds between them. But in this preparation process we have eliminated the granulating process because this is a homemade preparation of fertilizer. Granulating machineries not available at home. Since, this stage was neglected.

6. **Organic Fertilizer drying Process**

For drying the fertilizer, a clean plastic sheet is placed in the terrace where the sunlight is available. Then the organic fertilizers were spread on the plastic sheet and check that the sunlight is falling on them. Leave it asuch and do not disturb them till it gets completely dry.

Organic fertilizers in granular form must have a certain percentage of moisture, and water retention in fertilizer has a significant impact not only on the quality of the final product but also its effectiveness, therefore the drying process is an important step in the processing of organic fertilizer.

Figure.11, drying the compost in the sunlight

7. Organic fertilizer cooling process

The fertilizer drying process is over. Then, the fertilizer is to kept inside the room free from the sunlight. The fertilizer is allowed to be in room temperature for certain days.

Following the drying process, organic fertilizers are also cooled to remove the heat with a rotary cooler (in case of large quantities). The cooler machine slopes slightly so that the discharge end is lower than the material feed end in order to convey the fertilizer through the cooler under gravity. Organic fertilizers to be dried enter the cooler, and as the rotary cooler rotates, fertilizer is lifted up by a series of internal fins lining the inner wall of the cooler. When the fertilizer gets high enough to roll back off the fins, it falls back down to the bottom of the cooler, passing through the cold air stream as it falls.

8. **Screening and Packaging Process**

The organic fertilizer granules should be screened to obtain the desired particle sizes. In this process, fertilizers are separated by screening into same size ranges. Here, we use household siever for screening.

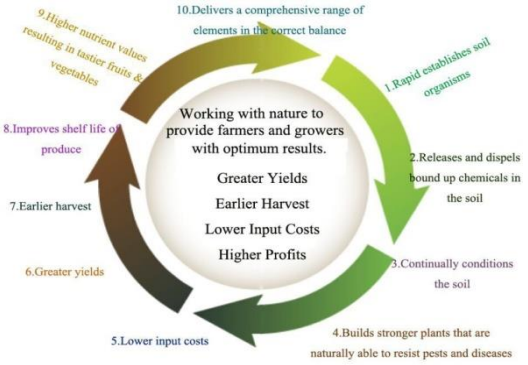
Organic fertilizers with uniform size are obtained. We had stored our organic fertilizer in a glass bottle so that it can free from fungus. After six month gap the fertilizer might kept in sunlight to avoid bacteria, fungi, etc. If required pack the fertilizer using the plastic paper.

9. **Final Product**

Now, this organic fertilizer is ready and can fed them into the soil. Organic fertilizer with uniform size are obtained. Organic fertilizer are great option for plants. But these fertilizers are good enough to treat the plant-eating insects, mold and diseases. The plants that suffering from any of these issues can be recovered. The figure.12 shows the homemade organic fertilizer.

Figure12, the obtained organic fertilizer.

10. **The Purpose of Organic fertilizer**



IV. RESULT

S. NO	General Test	Range	Analyzed Result	Remark
1.	Moisture, percent by weight	15.0-25.0	15.0	Low
2.	Colour	-	-	Dark brown to black
3.	Odour	-	-	Absence of foul odour
4.	Bulk density (g/cm3)	0.1-1.5	1.0	sufficient
5.	pH	5.5-7.5	6.0	Sufficient
6.	Conductivity (dsm-1)	3.0-5.0	4.0	Sufficient
7.	Pathogens	-	-	Nil
8.	Organic Carbon (C) %	8.0-15.0	12.0	Sufficient
9.	Nitrogen (N) %	1.5-4.0	2.0	Sufficient
10.	C:N ratio	10- 20	20	High
11.	Phosphorous (P) %	0.15-8.0	0.25	Marginal
12.	Potassium (K) %	1.0-5.0	4.0	High
13.	Sulfur(S)	0.1-	0.2	Marginal

	%	0.8		
14.	Calcium (Ca) %	0.1-1.5	0.15	Low
15.	Magnesium (Mg) %	0.1-1.0	0.1	Low
16.	Zinc (Zn) ppm	10-150	70	Sufficient
17.	Iron (Fe) ppm	250-500	400	High
18.	Manganese (Mn) ppm	10- 15	10	Marginal
19.	Boron (B) ppm	3.0-5.0	5.0	High
20.	Cadmium (Cd) ppm	3.0-15.0	5.0	Low
21.	Copper (Cu) ppm	300-450	300	Low
22.	Chromium (Cr) ppm	50-150	50	Marginal
23.	Lead (Pb) ppm	100-150	100	Marginal
24.	Nickel (Ni) ppm	10-150	50	Sufficient
25.	Mercury (Hg) ppm	0.15-0.2	0.15	Marginal
26.	Arsenic (As) ppm	10-15	11.0	Low

V. CONCLUSION

To check the quality of our homemade organic fertilizer we plan to grow a plant. We chose a two small size curry plants for our experiment. One plant is planted without any fertilizer and the other plant is planted using the homemade organic fertilizer. The two curry plants are planted at same time. The plants are placed nearer to each other so that there is no soil variation. After 9 months the result of the two curry plants growth were shown below: We had grown a curry plant using our organic fertilizer. The result of our organic fertilizer on this plant gives healthy plant with all sufficient nutrients. Thus the below figure.13 shows. The plant grown without the fertilizer had not given a healthy growth. It is also attacked by insects and affected by fungal disease due to insufficient nutrients.

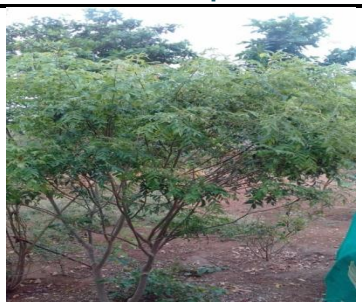


Figure.13, the growth of the plant using the organic fertilizer.

Figure.14, the growth of the plant without using a fertilizer.

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