ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume 3, Special Issue 1, February 2014

International Conference on Engineering Technology and Science-(ICETS'14)

On 10th & 11th February Organized by

Department of CIVIL, CSE, ECE, EEE, MECHNICAL Engg. and S&H of Muthayammal College of Engineering, Rasipuram, Tamilnadu, India

Vermicomposting: A Superlative For Soil, Plant, And Environment

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ABSTRACT – Application of chemical fertilizers reduces land productivity and crops become dependent on periodic inputs of the chemical fertilizers. Land, need to be prevented from degradations. Green manures are effective alternatives to chemical fertilizers in the management and preservation of soil fertility and productivity, adding organic matter and nutrients to the soil. Soil fertility can be improved and maintained initially through use of organic inputs like well decomposed organic manure/Vermicompost. The best alternative of the present day's environmental degradation is to make proper use of the available unutilized organic biodegradable wastes in order to convert them into compost within a short period. Vermicompost could be used as an excellent soil amendment for main fields. The waste is often left unattended at the disposal sites, creating a health hazard. The slogan worth recollection is "Don't waste, waste, waste is precious". Improper solid waste disposal contribute to local episodes of disease, regional water resource pollution, and global greenhouse gases. Solid Waste Management (SWM) is one of the most pressing environmental challenges globally as well as locally. The implementation of SWM practices benefits both public health and environmental quality directly and substantially. This can be solved by combination of effective technologies like Bio dung composting and Vermitech. The waste generated from the city consists of biodegradable organics can be converted into valuable bio-compost by applying Vermicomposting technology.

Keywords: Chemical fertilizer;Solid waste; Earthworm; Compost

I. INTRODUCTION

It is important nowadays to improve soil health by providing the much needed organic matter, least soil become impecunious. The scope and potential for recycling variety of resources in agriculture is vat by any standards. Agriculture wastes recycling can bring tremendous benefits to agriculture and land management in long run. In addition there are the benefits of a cleaner environment, a healthier habitat and an intelligent use of all available recyclable resources without condemning them as wastes. Towards this end agriculture solid waste compost could serve as a valuable organic matter source given the shortage of organic nutrient source (Sinha, et al., 2011). Vermicompost is 100% pure eco-friendly organic fertilizer. This organic fertilizer has nitrogen phosphorus, potassium, organic carbon, sulphur, hormones, vitamins, enzymes and antibiotics which help to improve the quality and quantity of yield. It is observed that due to continuous misuse of chemical fertilizer soil losses its fertility and gets salty day by day. To overcome such problems natural farming is the only remedy and Vermicompost is the best solution. Vermicompost can be processed from most organic wastes such as animal manures, agricultural waste etc,through interactions between earthworms and microorganisms, in a mesophilic process (up to 35˚ C), to produce fully-stabilized materials with low carbon to nitrogen ratios. They have high and diverse enzymatic and microbial activities and contents, a fine particulate structure, good moisture-holding capacity and contain nutrients such as nitrogen, potassium, and calcium in forms readily taken up by plants. Vermicompost can have dramatic effects upon the germination, growth, flowering, fruiting and yields of most crops, particularly rice, fruit and vegetables, which are high value crops.

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II. CHEMICAL FERTILIZER AND THEIR IMPACT

In current practices we are using the chemical fertilizer to fulfill the plant nutrients requirement which have a serious impact on the soil and water bodies. The salinity of soil is one of the major threats by utilizing excessive chemical fertilizer. The chemical fertilizers have a serious impact on as follows.

- Loss of soil fertility (reducing food production)
- Plants can utilize only 20 - 30% nutrients; the balance either evaporates or is washed into water bodies (i.e. ground water, surface waters, etc.),
- Ground water and surface water pollution.
- Destruction of marine life (declining fish populations, reducing a major source of protein for human Consumption).
- Loss of biodiversity on land and in water

A. ORGANIC FARMING

With the introduction of green revolution technologies, the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs. Intensive agriculture with the use of chemical fertilizers in large amount has, no doubt, resulted in manifold increase in the productivity of farm commodities but the adverse effect of these chemicals are clearly visible on soil structure, micro flora, quality of water, food and fodder. At this critical juncture, organic fertilizers (Manure) are useful supplement to chemical fertilizers. Organic farming has emerged as the only answer to bring sustainability to agriculture and environment. An organic fertilizer is also an ideal for practicing organic farming.

III. MATERIALS AND METHODS

A. Methods of Waste Collection

The Waste samples (Agricultural waste and Nursery wastes) were collected separately in random manner from Vriddachalam Taluk, Cuddalore District, Tamil Nadu.The Solid Waste, both fresh and decomposed, was collected from the various sources. These wastes were characterized by segregating and discarding the non-biodegradable fraction, and the biodegradable component was used for the experiment (composting).

B. Why is Vermiculture important?

The environment benefits by the reduction of waste in an area, essentially reducing the ecological footprint of the community present. Usable waste is "recycled" back into the ecosystem instead of being sent to a landfill or incinerated.

C. Earthworms & Vermicompost Improve Natural Fertility & Water Holding Capacity of Soils

Use of chemical fertilizers over the years have destroyed the natural properties of soil and made it more 'compact' and 'biologically dry' (depleted in beneficial soil microbes). Earthworms make the soil 'soft & porous' by its burrowing actions & excretions containing nutrients & beneficial soil microbes to improve its natural fertility and productivity. Vermicompost works as a 'soil conditioner' and its continued application over the years lead to total improvement in the physical, chemical and biological quality of all soils even the 'sodic soils'. It has very 'high porosity', 'aeration', 'drainage' and 'water holding capacity' thus reducing the demand of water for irrigation. Vermicomposting technology using earthworms as versatile natural bioreactors for effective recycling of organic wastes to the soil is an environmentally acceptable means of converting waste into nutritious composts for crop production.

D. Methods of preparation

The processes of vermicomposting and composting were carried out for a period of 60 days. Waste should be segregated before being put for composting. Composting can be done either in pits or concrete tanks or well rings or in wooden or plastic crates appropriate in a given situation. It is preferable to select a composting site under shade, in an elevated level, to prevent water stagnation in pits during rains. Make small holes on the side of pits or tanks. Put big size of gravels on the bottom of pits to enable aerobic condition. Followed by a layer of coarse sand to a total thickness of 6-7 cms. Pits was filled by organic waste (4-5 cm length) .cattle dung (fresh or dry) are then scattered over the soil and covered with a 10cm layer of hay. Introduce red earthworms (10 to 20 numbers) and cover the pits with jute cloth cover and wire mesh to protect earthworm from birds, moles, and shrews. Water is sprayed till the entire set up is moist but not wet. Less water kills the worms and too much water chases them away. Provide a shed over the compost to prevent entry of rainwater and exposure to direct sunshine. Sprinkling of water should be stopped when 90 % bio-wastes are decomposed. Maturity could be judged visually by

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observing the formation of granular structure of the compost at the surface of the tank. Normally after 60 days, organic refuse changes into a soft, spongy, sweet smelling; dark brown compost will be ready for collection. Harvest the vermicompost by scrapping layer wise from the top of the tank and heap under shed. This will help in separation of earthworms from the compost. Sieving may also be done to separate the earthworms and cocoons. The temperature and moisture content were maintained by sprinkling adequate quantity of water at frequent intervals.

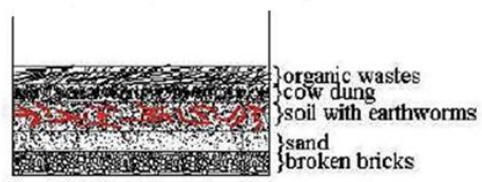

Fig .1. Vermicomposting Technology

E. Results and Discussion

The process of Vermicomposting activity significantly modified the physical and chemical properties of waste material that can be an important tool for organic farming. Vermicompost samples were collected at 0, 15, 30, 45and60 days. Which were processed for analysis of major nutrients nitrogen (N), available phosphorus (P), exchangeable potassium (K), calcium (Ca), and magnesium (Mg).The temperature (°C), moisture (%), pH, and electrical conductivity (EC) were recorded. Temperature was noted daily using a thermometer, and moisture content was measured gravimetrically. The OC of the samples was measured by Walkey-Black method; pH and EC of samples were recorded by a digital pH meter and conductivity meter, respectively. The N was estimated by the Kjeldahl method and the P and K contents of the samples were analyzed by calorimetric method and flame photometric method respectively. The Ca and Mg contents of the samples were also analyzed using atomic absorption spectrophotometer.

TABLE 1 - NUTRIENTS ANALYSIS

S. No	Nutrients	Measurements (%)
1	Organic Carbon	9.15 to 17.88
2	Nitrogen	0.5 to 0.9
3	Phosphorus	0.1 to 0.26
4	Potash	0.15 to 0.256
5	Sodium	0.55 to 0.3
6	Calcium and Magnesium (Meq/100 g)	22.67 to 47.6
7	Copper, mg L^{-1}	2.0 to9.5
8	Iron , mg L^{-1}	2.0 to 9.3
9	Zinc , mg L^{-1}	5.7 to 9.3
10	Sulphur ,mg L^{-1}	128.0 to 548.0
11	P^H	6-8

F. Vermicompost for Chemical Free Vegetables

Vermicompost is made from bio-degradable wastes that are easily available. It grows crops without the help of insecticides and medicines. It is affordable and helps to retain the fertility of the soil. However, not a lot of people are aware of its advantages. If this technology can be spread more widely, the farmers can enjoy more profit and we can enjoy chemical free vegetables. The vermicompost is rich in humic acids and can improve the structure of the soil. Small-Scale farmers are Growing More Vegetables and fruits with the application of Vermicompost (Organic fertilizer) in various Districts in Tamil Nadu.

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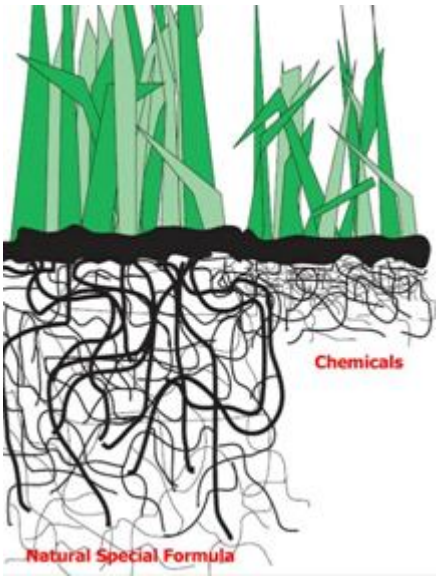

Fig .2.Comparison Between Chemical Fertilizer and Organic Mnaure

Criteria For Comparison	Chemical Fertilizers	Vermicompost
Macro nutrient contents	Mostly contains only one (n in urea) or at the most two (n & p in dap) nutrients in any one type of chemical fertilizer	Contains all i.e. nitrogen (n), phosphorus (p) & potassium (k) in sufficient quantities
Secondary nutrient contents	Not available	Calcium (ca), Magnesium (mg) & sulphur (s) is available in required quantities
Micro nutrient contents	Not available	zinc (zn), boron (b), Manganese (Mn), iron (Fe), copper (cu), molybdenum (Mo) and chlorine (Cl) also present
pH balancing	Disturb soil ph to create salinity and alkalinity conditions	Helps in the control of soil ph and checks the salinity and alkalinity in soil
Ec correction	Creates imbalance in soil ec affecting nutrients assimilation	Helps in balancing the Ec to improve plant nutrient adsorption
Organic carbon	Not available	Very high organic carbon and humus contents improves soil characteristics
Moisture retention capacity	Reduces moisture retention capacity of the soil	Increases moistures retention capacity of the soil
Soil texture	Damages soil texture to reduce aeration	Improves soil texture for better aeration
Beneficial bacteria & fungi	Reduces biological activities and thus the fertility is impaired	Very high biological life improves the soil fertility and productivity on sustainable basis
Plant growth hormones	Not available	sufficient quantity helps in better growth and production

Table 2. Comparision between Chemical Fertilizer and Vermicompost

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G .Vermicompost in field Lady's Finger plant

Fig.3.Plant Growth in Bucket

H.Vermicompost in Field of Potato

Fig.4.Potato Seed Germination in Bucket

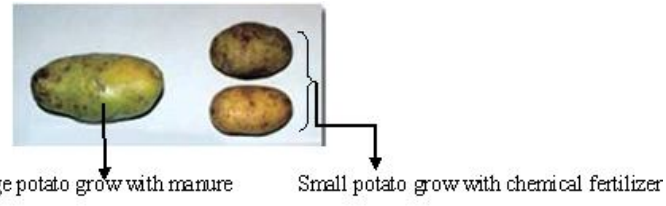

Fig.5.Growth of Potato using organic Manure

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Fig.6.Comparison of Growth of Cabbage between Chemical Fertilizer and Organic Fertilizer

IV. FARMER'S OPINION ON THE USE OF VERMICOMPOST ON VARIOUS CROPS

A. 'English vegetables' do the trick for Perambalur farmer

English vegetables like cauliflower, cabbage, carrot and beetroot are normally grown in the hills, especially the Nilgiris where the maximum temperature during summer rarely crosses 25 degree Celsius. Similarly, Hosur is another region in Tamil Nadu known to be climatically conducive for English vegetables.Mr.Ramkumar, has been brave enough to try these vegetables in Perambalur district where 35 degrees Celsius is considered a normal temperature. While Perambalur is known for maize, small onions, sunflower and so on, Mr. Ramkumar decided to chart a different course by growing English vegetables with the application of organic fertilizer. A native of Perambalur district, he started trying various crops on four acres of land. I attempted to raise "super Ponni" (deluxe) tomato, carrot, beetroot and also groundnut. I didn't get much profit for all the strain that I have undertaken. The only option I could think of was some vegetables like cabbage, turmeric, Maize, each on a plot of six cents to eight cents. I have harvested 2,100 kg of cabbage.

Fig.7.Cabbage grown using organic manure in Perambalur

B.Farmer amidst the Turmeric Plants He Raised Using Organic Farming

Kumaresan another agriculturist in Anthiyur explained the comparative advantages of vermicompost is that it improves soil aeration, texture and tilths, which helps to reduce soil compaction, it improves water retention capacity of soil because of its high organic matter content and it improves nutrient status of soil, both macro-nutrients and micro-nutrients.

Fig.8. Raised beds were prepared using a tractor.

C.Weeding

Due to continuous rains, weeds have grown and manual weeding is being performed.

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D.After weeding

Fig.9. Growth of Turmeric in Various Stages

V. ENVIRONMENTAL BENEFITS OF ORGANIC AGRICULTURE

A.Air and climate change

Organic agriculture reduces non-renewable energy use by decreasing agrochemical needs (these require high quantities of fossil fuel to be produced). Organic agriculture contributes to moderating the greenhouse effect and global warming through its ability to sequester carbon in the soil. Many management practices used by organic agriculture (e.g. minimum tillage, returning crop residues to the soil, the use of cover crops and rotations, and the greater integration of nitrogen-fixing legumes), increase the return of carbon to the soil, raising productivity and favoring carbon storage. A number of studies revealed that soil organic carbon contents under organic farming are considerably higher. The more organic carbon is retained in the soil, the more the extenuation potential of agriculture against climate change is higher.

B.Biodiversity

Organic farmers are both protectors and users of biodiversity at all levels. At the gene level, traditional and

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adapted seeds and breeds are preferred for their greater resistance to diseases and their resilience to climatic stress. At the species level, diverse combinations of plants and animals optimize nutrient and energy cycling for agricultural production. At the ecosystem level, the maintenance of natural areas within and around organic fields and absence of chemical inputs create suitable habitats for wildlife. The frequent use of under-utilized species (often as rotation crops to build soil fertility) reduces erosion of agro-biodiversity, creating a healthier gene pool - the basis for future adaptation. The provision of structures providing food and shelter, and the lack of pesticide use, attract new or re-colonizing species to the organic area (both permanent and migratory), including wild flora and fauna (e.g. birds) and organisms beneficial to the organic system such as pollinators and pest slayers.

C.Environmental Facilities

The impact of organic agriculture on natural resources favors interactions within the agro-ecosystem that is vital for both agricultural production and nature conservation. Ecological services derived include soil forming and conditioning, soil stabilization, waste recycling, carbon sequestration, nutrients cycling, predation, pollination and habitats. By opting for organic products, the consumer through his/her purchasing power promotes a less polluting agricultural system. The hidden costs of agriculture to the environment in terms of natural resource degradation are reduced.

D.Economic value of Vermicompost

The studies on Vermicompost for crop production show that use of chemical fertilizers can be reduced up to l00% for vegetables and corn, and 50% for rice and sugarcane. Farmers producing their own Vermicompost using available farm wastes can reduce their production costs for chemical fertilizers, prices of which have soared while minimizing environmental pollution and promoting soil/water conservation. More detailed and comprehensive studies, however, are needed to determine the commercial feasibility and profitability of Vermicompost application on various crops like lowland rice, fruit trees, coconut, banana, etc., in different locations.

VI. CONCLUSIONS

Vermicomposting appears to be the most promising as high value organic fertilizer which not only increases the plant growth and productivity by nutrient supply but is also cost effective and pollution free. Use of vermicompost promotes soil aggregation and stabilizes soil structure. This improves the air- water relationship of soil, thus increasing the water retention capacity and encourages extensive development of root system of plants. The mineralization of nutrients is observed to be enhanced, therefore results into boosting up of crop productivity. Vermicompost produced from the farm wastes is not only having beneficial effects on soil health and growth, quality and yield of crop but also playing vital role in eradication of pollution hazards.Vermicompost can be used for all crops agricultural, horticultural, and ornamental and vegetables at any stage of the crop. It will reduce the requirement of more land for disposal of fruits and vegetable wastes in near future. It helps to create better environments, thus reduce ecological risk.

ACKNOWLEDGMENT

The authors thank the Mrs. Dr.A.Jeeva (HORTICULTURSIT, Regional Research Station, and Tamil Nadu Agriculture University Branch) for her valuable suggestions. Mr. C.Rajesh Asst.Engineer, Agricultural Engineering Department for providing help during analysis work and suggestion during the statistical analysis of study.

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