

INTRODUCTION

One of the most eternal problems mankind faces is the dilemma of how to dispose the waste. The amount of solid waste generated in Coimbatore city has increased dramatically during the past several years. On an average, the city generates 800 MT per day of solid waste from households, industries and manufacturing processes. With global population expecting to climb into billions within the next century, our society must find ways not only to reduce our waste materials, but also to detoxify our water, soil, land and environment.

The concept of Effective Microorganisms (EM) was developed by Higa, (1991). EM is a liquid concentrate consisting of mixed cultures of beneficial and naturally occurring microorganisms that can be applied as inoculants to increase the microbial density of soils. The basic principle behind EM technology is that when introduced into an environment for biodegradation, it rapidly devours the methanogens and pollutants which are formed as a result of the chemical breakdown process. As a result, compost piles mixed with EM produce no harmful or offensive odours, and decompose very rapidly into pure, nutrient rich composts, which can be directly infused back into the process of organic farming with astonishing results.

Cow pea [*Vigna unguiculata* (L.) Walp] and lady's finger [*Abelmoschus esculentus* (L.) Monech] were the test plants selected for the present study.

Cow pea (*Vigna unguiculata* (L.) Walp.)

Cow pea is a leguminous plant and it plays an important nutritional role in developing countries of tropics and subtropics. Because of its high protein content (20 – 25 per cent), cow pea has been referred to as “poor man's meat”. Young leaves and pods of cow pea contain vitamins and minerals which have fuelled its usage for human consumption and animal feeding. It is a good supplement to staple foods. It has the ability to fix nitrogen in soil and it meets its own requirement. It is a rich source of lysine and tryptophan.

Lady's finger [*Abelmoschus esculentus* (L.) Monech]

Lady's finger is an economically important plant cultivated throughout India. It is a multiple use crop and is grown for its immature fruit, which is eaten as a cooked vegetable (Akanbi, 2002). Leaves, buds and flowers are also edible

Assessment of future solid waste management requires accurate knowledge of the quantity and quality of solid waste. The solid waste consists of paper, garden trimmings and yard waste, organic fractions (vegetable, fruit and food waste), jute, wood pieces, cloth, rubber etc. Easily degradable fractions can be segregated from and non-biodegradable fractions and converted into nutrient enriched organic manure by eco-friendly cost effective, EM technology. The successfulness of this study not only gives permanent solution for land filling problems but also to extent reduce the application of chemical fertilizers for crops to a certain extent.

With this background, the present investigation entitled, **“EFFICACY OF EFFECTIVE MICROORGANISMS (EM) ON BIODEGRADATION OF SOLID WASTE (SW) INTO ORGANIC MANURE AND ITS INFLUENCE ON TEST PLANTS”** was carried out with the following objectives.

OBJECTIVES

1. To evolve an appropriate technology for the decomposition of solid waste into a nutrient enriched organic manure by Effective Microorganisms.
2. To assess the compost maturity of EM-SW compost by analyzing cellulose, organic carbon, total nitrogen, total phenol, total soluble, reducing and non-reducing sugars and the enzymes like catalase, peroxidase and dehydrogenase in the degraded waste
3. To determine the leghaemoglobin content in root nodules of Cow pea (leguminous crop)
4. To analyze the biometric and yield parameters of test plants, Lady's finger and Cow pea, to assess the effect of EM-SW compost.

5. To estimate carbohydrates, chlorophyll, proteins, tocopherol, ascorbic acid and enzymes like catalase and peroxidase in the test plants
6. To determine the microbial biomass and urea level by analyzing dehydrogenase and urease in the soil.
7. To assess the impact of EM-SW compost by analyzing NPK levels during pre and post harvest days of the soil.

METHODOLOGY

Collection of Materials

Solid waste was collected from the campus of Avinashilingam University for women, Coimbatore.

Collection of Effective Microorganisms (EM)

EM was collected from Centre for Advanced Studies in Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore.

Activation of EM

EM is available in a dormant state and requires activation before application. Activation involves the addition of 20 litres of water and 2 kg of jaggery (pure cane sugar) to 1 litre of dormant EM. The mixture was poured into a clean air tight plastic container and stored at ambient temperatures away from direct sunlight for 8 to 10 days. During the period of activation, a white layer of Actinomycetes was formed on the top of the solution accompanied by a pleasant smell which indicates the activation of EM. The pH is also a determining factor. The pH of the EM should be below 4.0.

EM – SW Compost Preparation

Solid waste was collected every day from the campus of Avinashilingam University for women, Coimbatore. The SW collected consisted of paper, garden trimmings and yard waste, organic fraction (vegetable, fruit and food waste), jute, wood pieces, cloth, rubber, etc. Biodegradable fractions were segregated from non-biodegradable fraction.

About 20 cm thick solid waste was put in a clean 3 x 1 x 2 mts composting pit and activated EM was sprayed over this layer. A second layer of solid waste, about 30 cm. thick was spread over the previous and also sprayed with EM solution. This layering process was repeated to height of about 100 cm. The stack was completed with a final layer of 5 cm. of cow dung. The entire stack was kept moist by spraying it with activated EM solution at regular intervals. After about 25 to 30 days, the volume of bed dropped substantially and a sweet smelling white mold appeared on the biomass. At this point, the finished compost was collected and sieved. The compost was analysed for pH, cellulose, organic carbon content, total nitrogen (N), total phenol, total soluble sugars, reducing and non-reducing sugars and enzymes like catalase, peroxidase and dehydrogenase.

Pot Culture Experiment

A pot culture experiment was conducted with Lady's finger [*Abelmoschus esculentus* (L.) Molch] Cow pea [*Vigna unguiculata* (L.) walp.] as the test crops to evaluate the influence of EM – Solid Waste (SW) compost.

Design and Layout of the Experiment

The design followed for the experiment was a Randomized Block Design consisting of four treatments each replicated 3 times.

On the 30 and 60 DAS (Days After Sowing) and at harvest (90 DAS), various biometric, yield and biochemical parameters observed were evaluated.

Treatments

There were four treatments as detailed below and were compared with standard check, NPK and evaluated against the absolute control.

- T₁ - Absolute control
- T₂ - EM – solid waste compost (20t ha⁻¹)

T₃ - EM – solid waste compost (80t ha⁻¹)

T₄ - NPK (chemical fertilizer)

EM-SW Waste – Biochemical Analysis

The following biochemical parameters in EM-SW compost were analyzed at an interval of 15 days each for 60 days and were compared with raw SW.

- Cellulose (Updegraf, 1969)
- Organic carbon (Walkely and Black, 1934)
- Total nitrogen (Microkjeldhal method – Humphries, 1956)
- Total Phenol (Folin – Ciocalteu method – Bray and Thrope, 1954)
- Total soluble sugars (Dubois *et al.*, 1951)
- Reducing sugars (Dinitrosalicylic acid method – Miller, 1972)
- Catalase (Vir and Grewal, 1975)
- Peroxidase (Malik and Singh, 1980)
- Dehydrogenase (Kun and Abood, 1949).

Biometric Parameters of Test Plants at 30 and 60 DAS (Days After Sowing).

- Plant height (cm)
- Root volume (cu cm)
- Number of nodules/ plant
- Number of leaves/ plant
- Fresh and dry weight of plant (g)
- Number of flowers / plant

Yield Parameters of Test Plants at harvest (90 DAS)

- Plant height (cm)
- Root volume (cu.cm)
- Number of nodules/ plant
- Number of leaves/ plant
- Fresh and dry weight of plant (g)

- Number of Pods / plant
- Length of pods (cm)
- Weight of pods (g)
- Single seed and 100 seed weight (g)

Biochemical Analysis of Test Plants – the following biochemical parameters were carried out in Lady's finger and Cow pea.

- Estimation of protein (Lowry *et al.*, 1951)
- Estimation of chlorophyll content (Arnon, 1949)
- Estimation of carbohydrate (Anthrone method – Hedge and Hofreiter, 1962)
- Leghaemoglobin (Appleby and Bergersen, 1980)
- Estimation of catalase (Vir and Grewal, 1975)
- Estimate of peroxidase (Malik and Singh, 1980)
- Estimation ascorbic acid (Roe and Kuether, 1953)
- Estimation of tocopherol (Rosenburgh, 1992)

Soil Analysis of the Test Plants

- Estimation of urease (Nesslerization method – Sumner, 1955)
- Estimation of Dehydrogenase (Kun and Abood, 1949)
- Initial and experimental soil analysis like pH, EC and available NPK

Statistical Analysis (Panse and Sukhtame, 1978)

The data obtained from various experimental observations were subjected to the statistical analysis. Based on the results, inferences were drawn. Wherever necessary, the data were analyzed by applying techniques for analysis of variance for completely randomized block design. Treatments were compared using Duncan's Multiple range test.

FINDINGS OF THE STUDY

Biochemical Analysis of Raw and Composted EM-SW

The cellulose, organic carbon, total phenol, total soluble sugar, reducing and non-reducing sugars showed a decreasing trend and total nitrogen showed an increasing trend from 0.57 per cent to 1.26 per cent during 60 days decomposition of SW with activated EM..

The enzymes like catalase and peroxidase showed an increasing trend from 30 to 90 days where as in dehydrogenase, the values declined after 60 days.

Biometric and yield parameters of the Test Plants – Lady's finger and Cow pea

All the biometric and yield parameters showed a significant increase in T₃ (EM-SW compost 80 t ha⁻¹) treatments, in both the test plants, Lady's finger and Cow pea.

Biochemical analysis of the test plants

The total carbohydrate content in T₃ treatment (EM-SW 80 t ha⁻¹) attained a maximum increase of 0.080 to 0.98 mg g⁻¹ in Lady's finger and in Cow pea, the increase was from 10.04 to 19.87 mg g⁻¹

The chlorophyll content (a, b and total) and protein content registered a significant increase upto 60 DAS and declined at 90 DAS in Lady's finger and Cow pea plants. Here the T₃ treatment attained a maximum increase when compared to other treatments.

The leghaemoglobin content was analyzed in the root nodules of cow pea (leguminous plant) which strictly increased from 0.025 mol⁻¹ cm⁻¹ to 0.031 mol⁻¹ cm⁻¹ and declined to 0.026 mol⁻¹ cm⁻¹ at 90 DAS in T₃ treatment.

The non enzymatic antioxidants like ascorbic acid (vit-C) and tocopherol (vit-E).and enzymatic antioxidants like catalase and peroxidase recorded a significant increase in T₃ treatments from 30 to 90 DAS in Lady's finger and Cow pea.

Soil Analysis

The initial and experimental soil analysis of lady's finger and cow pea showed an increase in pH, EC and available NPK levels in T₃ treatments.

Dehydrogenase and urease activity were profoundly increased in T₃ treatments in both Lady's finger and Cow pea which attained a maximum level at 60 DAS and declined at 90 DAS.

CONCLUSION

The research findings in the present study revealed that, the solid waste can be converted into a value added, enriched organic manure, by an eco-friendly Effective Microorganisms (EM). The activated EM not only enhanced the biometric, biochemical and yield parameters of T₃ treatment (EM-SW 80 t ha⁻¹) of the test plants such as Lady's finger and Cow pea, but also increased the organic matter content of the soil. Thus, the Effective Microorganism (EM) technology helps in the decontamination of our environment.

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