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JUVENILE HOME: A NOVEL TECHNIQUE IN VERMICOMPOSTING

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Abstract— In vermicomposting process, where the migration of worms is allowed from chamber to chamber or layer to layer, the adult worms move towards the new compost pile where the food is available. Large number of juvenile worms with eggs is left behind. The vermi cast left is toxic for the worms; hence the young worm dies out. Further, segregation of the eggs and the compost are done by sieving, but very thin silk thread like baby worms and eggs are also passes through the sieve. Sieving often causes injury to young worms and eggs. Therefore, to rescue the juvenile worms before they are finally send off for sieving and packing, a novel technique "Juvenile home" for the young worms has been introduced here.

Key Words- Juvenile worm, Perforated aeration pipe, MSW, Earthworms

I. INTRODUCTION

As we know that the basic criteria for healthy growth of the worms are obtained by regulating Temperature, Moisture, ventilation and the food supply. Here after the mother worms had migrated towards the new waste, the juvenile home is inserted into the heap of the compost before it is sieve and pack. The juvenile home is nothing, but packed of waste suitable for the worms to stay. The home is placed at a distance of maximum 30 cm-40cm gap and kept for the period of two to three days in the compost. The juvenile worms automatically got accumulated in the home and the home is taken out and put into the new pile /chamber or layer. Due care is taken for optimum moisture and ventilation. It is done by immersing perforated pipe into the pile or by burying home inside the pile of Compost.

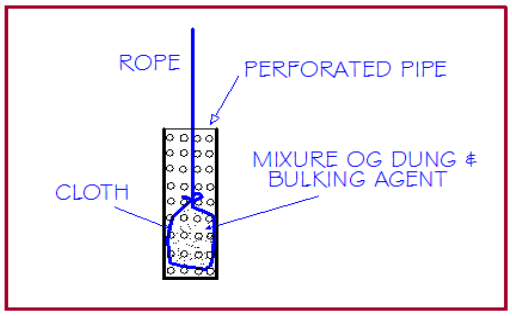

FIG. 1 THE JUVENILE HOME

II. LITERATURE REVIEW

2.1 Municipal Solid Waste

Solid waste – All the wastes other then liquid and excreta from garbage, trash, rubbish, or junk. It's the stuff thrown from our homes, schools, offices, factories, malls, hospitals, among other things. This includes construction debris, bulky items such as appliances and furniture, waste from the market and farms, and special or hazardous waste from hospitals and factories.

MSW- The MSWs are the waste generated from the municipal residential colony, market area, medical area, distribution centre etc. The MSW can create significant health problems and very unpleasant living environment problems. The waste provides breeding sites for flies, insects, snakes, rats etc. The waste also pollutes waters, air and lands.

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2.1.1 Categories of MSW:

Organic Waste	Vegetable, fruits and other foods wastes
Combustible	Paper, wood, dry leaves etc.
Non-combustible	Metal, stones, bottle etc.
Ashes/Dust	Residue from fires.
Dead Animals	From slaughter and dead of animals
Hazardous Waste	e-waste, acids, battery and medical waste

2.1.2 Factors Affecting MSW Generation

The types and quantities of solid waste vary from place to place and social status and types of people. The factors affecting quantities and type of waste are:

a) Geographical region.

b) Socio cultural practices.

c) Seasonal variation.

d) The stage of emergency.

e) The packaging of food.

2.1.3 Waste Generation

The materials which are identified as no longer being of value and are either thrown away or gathered together for disposal are the initial stage of waste generation. The various source of waste are as follows:

a) Residential:- Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires, and household hazardous wastes.).

b) Industrial: Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.

c) Commercial: Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.

d) Institutional: Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.

e) Construction & Demolition: Wood, steel, concrete, dirt, etc.

f) Municipal Service: Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.

g) Manufacturing: Industrial process wastes, scrap materials, off-specification products, slay, tailings.

h) Agriculture: Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).

2.2 Composting

Composting is a biological process in which micro-organisms, mainly fungi and bacteria, convert degradable organic waste into humus like substance. This finished product, which looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants. The process of composting ensures the waste that is produced in the kitchens is not carelessly thrown and left to rot. It recycles the nutrients and returns them to the soil as nutrients. Apart from being clean, cheap, and safe, composting can significantly reduce the amount of disposable garbage. The organic fertilizer can be used instead of chemical fertilizers and is better specially when used for vegetables. It increases the soil's ability to hold water and makes the soil easier to cultivate. It helped the soil retain more of the plant nutrients.

2.1.4 Type of Composting:

- Anaerobic Composting
  The composting in absence of oxygen in which methane gas, organic acids, hydrogen sulphide and other substances are produced
- Aerobic Composting
  The composting in presence of oxygen in which Carbon dioxide (CO_2), ammonia, water, heat and humus, the relatively stable organic end product are evolved.

2.3 Vermicomposting of MSW

Vermicomposting is a composting technique which uses Earth worms to accelerate the composting process. In

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this method, worms are added to the compost to break the waste. The end product that is, the excreta of the worms makes the compost very rich in nutrients.In other words the Vermicompost, or Vcompost, is the heterogenous mixture of decomposing vegetable or food waste, bedding materials, and pure vermicast produced during the course of normal vermiculture operations. Vermicast, similarly known as worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by some species of earthworm.

2.3.1 How Vermicomposting Works

The decayed organic waste is the best food for the earthworm. The organic waste is naturally decomposed by the bacteria & fungi. When the earthworm is added to partially decomposed waste, the worms consume partially decomposed organic matter and the excreta of the worms enhanced the nutrient value of the compost. The percentage carbon in waste is also reduced and final end product is environmentally safe and generates financial benefit. Therefore, basic requirement of the vermicomposting is to create good home for the proper growth of worms in substrata or in waste pile. The characteristics and requirements for healthy growth of the worms should be given emphasis in vermicomposting to obtain best result.

2.3.2 Basic Requirements for Good Vermicomposting

Air: Like us, the air is also necessary for the worms. Arrangement is made for sufficient air circulation in the pile or vermicompost bin for the aerobic microbes and fungi to flourish.

Water: There should be optimum moisture content for proper growth of the worm. The water is sprinkle at certain intervals to maintain optimum moisture.

Food: All bio-degradable organic matters are the best food for the worms. The harmful waste like e-waste, medicine, chemicals, light, bulb, fluorescent tubes, spray cans, fertilizer, pesticide, batteries and shoe polish shall not be put into compost pit.

Temperature: The worms desires the temperature between 15^0C and 25^0C. However, some worms can survive up to 30^0C. Bacterial decomposition takes place at varying temperature, depending upon the type of bacteria. Based on temperature, there are mainly three phases of bacterial decomposition. They are psychrophilic stage (less than 25^0C), mesophilic stage (25^0C to 45^0C), and thermophilic stage (more than 45^0C). Therefore, temperature should be monitored to maintain within the range of 15^0C to 25^0C.

Darkness: The worms desire darkness. Therefore, the bin or compost pit is made of opaque materials. The sunlight is not directly allowed to reach worms. There are about 40,000 kinds of worms in the world as per the past study.

2.4 Earthworms for Vermicomposting

As per the past study, the Worms are found in the ground on every continent of the world, except Antarctica. Over 3,000 individual species of earthworms have been recorded throughout the World, but few species are found in India. There are mainly three broad categories of worms depending on habitat and 'lifestyle'. The litter dwelling species are normally used for vermicomposting.

2.4.1: Litter Dwelling Earthworms (Epigeic species)

There are several worms that normally live in the rotting litter or organic matter on the surface of soils. They grow and reproduce very fast compared with true soil dwelling earthworms. The three species most commonly used in vermicomposting are- Dendrobaena veneta (blue nosed worm), Red Wigler/Eisenia fotida (tiger or brandling worm), Eisenia andrei (red tiger worm). In warmer countries other tropical species such as Eudrilus eugeniae have been farmed.

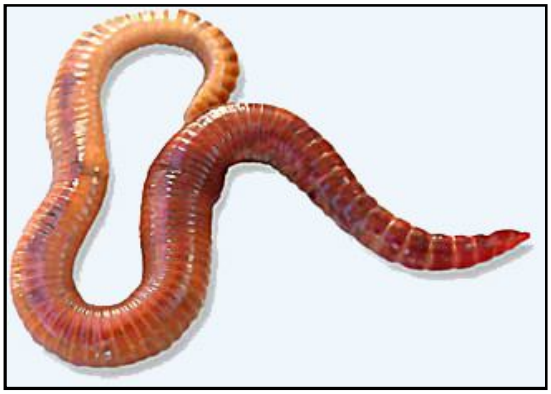

FIG-2 EISENIA FOTIDA

2.4.2 Topsoil Dwelling Earthworms (Endogeic species)

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Just below the surface live another group of small earthworms, in the first few centimetres of topsoil. They improve soil structure in the root zone of plants and recycle dead organic matter. One notable species is the 'green worm', Allolobophora chlorotica.

2.4.3 Deep Burrowing Earthworms (Anemic species)

Some of the most important species live deeper down in the soil profile in permanent vertical burrows that can be up to two metres long. They help create topsoil by dragging dead organic material from the soil surface down into their burrows, ingesting it along with soil and then egesting the mixture back on the surface as nutrient-rich earthworm casts. Species in this category are highly valued and have been successfully bred for land restoration projects. Two of the more beneficial species are Lumbricus terrestris (the lob worm or 'common earthworm') and Aporrectodea longa (black headed worm).

2.5 Method in Vermicomposting

a) Open Windrows

b) Worm through rows

c) Vermi Trench

d) Home Bin Compost.

2.5.1 Open Windrows

Mostly used method of vermicomposting is wind-rows. Cow manure/ partially Compost Waste is piled about 90 cm across and 90 cm high. It is then seeded with worms. As the worms work their way through it, fresh manure is added to the end of the row, and the worms move forward. The rows are covered with fronds or palm leaves to keep them shaded and cool. Some of these rows have a drip system a hose running alongside the row with holes in it, but most are watered by hand. Some of these rows are tens of metres in length. The compost is gathered from the opposite end once the worms have moved forward. It is then bagged and sold. Fresh manure, seeded with worms, begins the row and the process again. Some of the wind-rows have bricks running along their sides, but most are simply piles of manure without sides or protection. Manure is static composted for 30 days, then transferred to rows for worms to be added. After 90 days, the piles reach a height of about 90 cm. Wind-rows are also used to compost rice hulls and sugar cake , but this too is mixed with animal manure. Food scraps are sometimes added to worm beds.(Washington State University)

2.5.2 Worm Trough Rows

In this method a cement trough (60 cm × 180 cm) is made to raise worms and create worm compost. Because of the climate, they are watered by hand every day. In these beds, the only feedstock for the worms is manure. This manure is aged for about one week before being added to the trough. First, a layer of 7.5-10 cm of manure is placed in the empty trough, and then worms are added. As the worms consume the manure, more manure is layered on top, about every ten days, until the worm compost reaches to within about 5 cm of the top of the trough (about two months). Then the worms are separated from the compost and transferred to another trough.

2.5.3 Vermi Trench

The actual trench is dug as required but should not be too deep. Deeper you make it the more anaerobic it will be down below. There after add a lot of coarsely shredded corrugated cardboard. This help to absorb excess moisture from the rotting waste materials and helping to balance the C: N ratio of the mix. This pre-composted material should create a good 'habitat' for the composting worms. Add another layer of shredded cardboard/ egg flats. Above this layer add Bio-degradable waste. After this plenty of worms along with compost are layered. Finally the trench is cover with straw/rice hay. Containers, Enclosed Aerated Static Piles, Horizontal Agitated Beds, Aerated Piles, Rotating Drums, and Vertical

2.5.4 The Worm Bin

The Worm Bin is portable and small Vermicomposting technique for single family. There are many different ways to make a worm bin, but all worm bins should meet certain criteria in order to ensure the bin can process food scraps and keep your worms comfortable. To handle food scraps from two people, the bin should be at least 3 cu ft (0.08m^3) in size. The dimensions of this size bin are 30cm x 45cm x 60cm. The size can be design at will as per the requirement.

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In Worm Bin, firstly bedding for worm is prepared and then worm is inoculated. Thereafter the feeding is started. The basic criteria for good worm bin are as under:-

Troubleshooting in Vermicomposting

As per the first experienced and study there are several problems face during the vermin composting.

a) Escaping of the Worms from the bin.
b) Compost finished is toxic to worms.
c) The Juvenile Worms are left un-noticed and dies out.
d) Excessive moisture/high pH. and drippings
e) Over feeding & fruit flies.
f) Difficult to obtain huge number of Worms for Municipal Waste.
g) Intrusion of ants.
h) Juvenile home is the mixtures of partially decomposed dung and any bulking agent at optimum moisture contents of 45-60%. We have used partially decomposed cow dung as main food and shredded & moistened hay as bulking agent. 20% of bulking agent by weight is sufficient for the worm to flourish.
i) The mixture is wrapped with loosely woven smooth cloth, wet and bind with rope. One end of the rope is kept sufficiently long to pull out. The Juvenile Home is put inside the perforated pipe that is kept immersed at suitable
j) Distance for aeration. The home can also be directly buried inside the compost at shallow dept as shown in figure-2. The entire home is pulling out with the help of rope after two-three days.
k) Juvenile home is the mixtures of partially decomposed dung and any bulking agent at optimum moisture contents of 45-60%. We have used partially decomposed cow dung as main food and shredded & moistened hay as bulking agent. 20% of bulking agent by weight is sufficient for the worm to flourish.
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III. MATERIALS

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IV. CONSTRUCTION

A mixture of partially decomposed cow dung and shredded & moistened hay are wrapped in a smooth and loosely woven cloth serves as the juvenile home (FIG. 3).

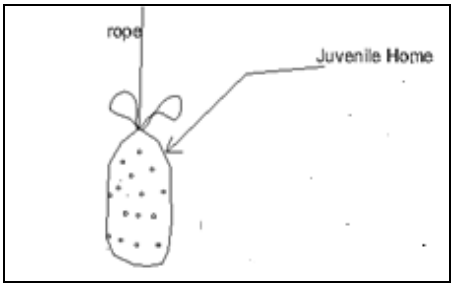

FIG. 3 JUVENILE HOME

The assembled called “Juvenile Home” is put into the strata of compost not below 10cm. If the Juvenile Home is to be put into deeper dept then perforated aeration pipe is used to put the “Home inside”, as shown in FIG. 3. Rope is used to pull out the home at several intervals.

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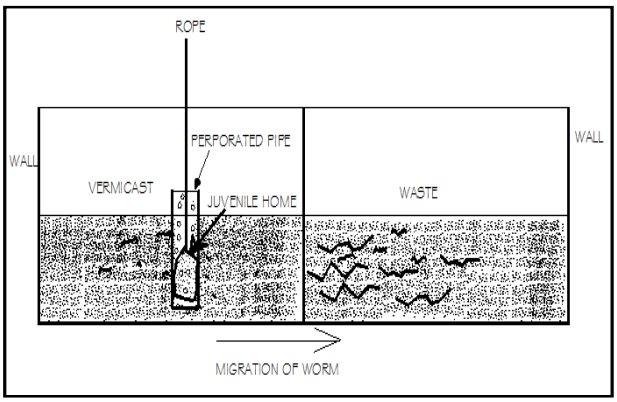

FIG. 4 APPLICATION OF JUVENILE HOME.

The home can also be directly buried inside the compost at shallow dept as shown in figure-5. The entire home is pulling out with the help of rope at the interval of 24 Hrs.

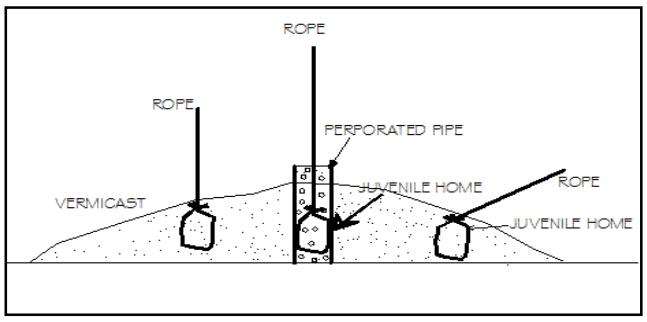

FIG. 5 JUVENILE HOME WITHOUT PAP

V. EXPERIMENTATION

As an attempt, we have tried to rescue baby worm with the help of dustbin kept at a distance of 1-2 ft. But it was difficult to insert in a perforated aerated pipe. In this experiment 800 gms of partially compost cow dung were collected from the street.

FIG. 6 DUSTBIN AS HOME

200 gm of hey were shredded and soaked into water for 24 hrs. Both were mixed together and wrapped in wet cloth. The assembled were put in the PAP and taken out after 24 hrs (FIG. 7).

FIG. 7 EXPERIMENT

The worms were counted and inoculated into the main compost box along with mother worm. Again another home were put into same PAP and taken out after next 24 Hrs and counted. The optimum moisture contents and required temperature were regulated.

VI. RESULTS & DISCUSSIONS

The home inserted into compost strata for the first time gave 68 nos of Juvenile worms after 24 hrs of immersion into the Compost. For the 2nd time in the same place we obtained 26 nos of worms and for the 3rd time we got only 6 nos of worm. The numbers of worms rescued depends upon the number of eggs left and consecutive

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hatching. The number of baby worms left to orphan depends from season to season.

VII. BENEFITS

- Mortality rate of the worm will decrease thereby enhancing population of the worm.
- Young worms of same age group can be inoculated in same pile and hence juvenile home need not be put in unless the maturity time is achieved.
- Construction and working is simple need no technical expert.

VIII. RECOMMENDATIONS

1. Owing to growing quantities of bio-waste, more population of the worm is requiring. The present technique to rescue juvenile worm before it is sent for harvesting is simple and practicable, hence recommended for implementation by the Vermicomposting unit.
2. Further experiment is required in every month of the year to assess best season for preparation of JH.

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