Bio-waste processing and Development of Bio manure using black soldier flies

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Abstract- Most of the food waste and organic waste produced is currently decomposed by use of micro-organisms. Microbial decomposition or organic matter emits substantial amount of greenhouse gases each year, primarily in the form of carbon dioxide (CO2) and methane (CH4). Potential advantage of using Black Soldier Fly larvae (BSFL) is the insect's ability to recycle large amounts of carbon into edible insect proteins and oils rather than simply breaking it down into CO2 and CH4. Here we try to find out the difference between the two systems with respect to carbon lost to the atmosphere was statistically significant.

Index Terms- Black soldier fly larvae, *Hermetia illucens*, bio-compost, **Mortiz gold,** Hatching shower

I. INTRODUCTION

Cities of low and middle income countries face tremendous challenges with solid waste management services to ensure public health and avoid environment pollution. Most of the food waste and manure produced currently is by the use of aerobic or anaerobic microbial decomposition. Microbial decomposition emits substantial amount of greenhouse gasses primarily in the form of carbon dioxide (CO2) and methane (CH4). For higher volumes of CO2 and CH4 are returned to atmosphere each year by microbial decomposition. Therefore it would be useful to develop methods with lower emission measures. It is possible to reduce considerable amount of methane emissions.Recycling organic waste material (biowaste) is still fairly limited, especially in low- and middle-income settings, although this is by far the largest fraction of all generated municipal waste. It mainly deals with urban organic municipal waste from households, commercial activities, and institutions. It describes the fairly novel approach of biowaste conversion by insect larvae, using the example of the Black Soldier Fly (BSF*)*, *Hermetia illucens*, an approach that has obtained much attention in the past decade.

Th Black Soldier Fly *(Hermetia illucens)* is a non- pest insect that is known to be a useful means of converting food waste, animal manure, and other organic substrates into manure, and other organic substrates into protein, edible oils, and chitin. Black Soldier Fly larvae (BSFL) are voracious eaters, and can consume more than twice their own body weight. BSFL digest feed material quickly dried Black

Soldier Fly prepupae contain 42% protein and 35% fat, and have been shown to be an excellent feed source for swine, poultry, and fish. Black Soldier Fly- mediated recycling has other benefits as well, including reducing the order of decaying organic material, BSFL fed manure have reduced counts of E. coli and Salmonella species in the residual material. There are several ways in which BSFL could have a favorable impact on the environment, carbon emission in particular.

Methodology

Figure 1.process flow chart

BSF treatment facility BSF rearing unit

This ensures that a reliable and consistent amount of small larvae (called 5-DOL) is always available to inoculate the daily amount of bio-waste that is received for processing at the treatment facility. A certain number of larvae hatchlings are, however, kept in the rearing unit to ensure a stable breeding population.

Waste receiving and pre-processing unit

It is critical that the waste received at the facility is suitable for feeding to the larvae. A first step involves a control of the waste to ensure it contains no hazardous materials and no inorganic substances. Further steps then involve a reduction of the waste particle size, a dewatering of the waste if it has too high moisture and/or a blending of different organic waste types to create a suitable balanced diet and moisture (70-80%) for the larvae

BSF waste treatment unit

This is where the 5-DOL from the rearing units are fed with bio-waste in containers called “larveros”. Here, the young larvae feed on the bio-waste, grow into large larvae and, thus, process and reduce the waste.

Product harvesting unit

Shortly before turning into prepupae, the larvae are harvested from the larveros. The waste residue itself is also a product of value.

Post-treatment unit

Both products, larvae and residue, can be further processed if required by the local market demand. We call this “product refining”. Typically, a first step will be to kill the larvae. Other steps of larvae refinement can be to freeze or dry the larvae, or to separate larvae oil from larvae protein. A typical step for residue refinement is composting or feeding the residue into a biogas digester for fuel production

Result and Discussion:

coming to result and discussion part, as of our statistics, 1gm of BSF eggs require 1.5 kg of waste per day which means 1 kg of BSF eggs feed on 15 kg of waste.1 gm of egg approximately be 8-10 thousand 5days old larvae. Collected eggs from hatching shower are weighted around a gram and kept separately for hatching.After 5 days hatched larvae are fed with grinded organic waste for around 25days. In these days 5 DOL were fed on waste to increase its biomass. After harvesting we received two products, one is pupa and the other one is

compost first one pupae or grown up larvae after feeding on the waste the larva will increase its biomass. Which are called as pupa. These grown up larvae are rich in nutritional value like protein, fat so used as a feed for poultry and fisheries. The biomass of pupae is known to contain approximately, 42% of protein, 25% of fat, 10% carbohydrate and 4% of fiber left is water content. Second is organic compost a main product, obtained after 25-30 days. We got of compost at the end for around 1gm of egg. After sun drying the compost is tested for N,P and K concentration along with macro and micronutrient concentrations at 'Sri laxminarayana laboratories, Dharwad.'Compost obtained is best suitable for fields as organic fertilizer.The test report of dried compost includes several parameters with minimum range for any compost to apply for fields.

Table 1: Physic-Chemical characteristics of compost samples

PARAMETERS	RANGES	RESULTS
Moisture (% by wt)	15–20	15.2
Color	Dark brown to black	Dark brown to black
Bulk ensity (g/cm)	0.7-0.9	0.76
Total organic carbon (Percent by wt.(min))	18.00	15.05
Total Nitrogen (% by wt.(min))	1.00	1.629
Total Phosphate (% by wt.(min))	0.8	0.654
Total Potash (% by wt.(min)	0.8	0.846
Odor	Absence of foul odor	Absence of foul odor
C:N ratio	10:1	9.23:1
pH	5.0	7.8
Conductivity	50.00	3.83

Discussion on test report: N**:** P**:**K concentration plays a major role in plant growth. When checked for earthworm compost which is a well known vermin-compost it is 1.2**:**0.86**:** 1.0 where as in BSFL compost it is 1.63**:** 0.65**:** 0.85.Odor: In the process of vermin-composting the absence of foul odor indicates that the compost is ready. Once the foul odor reduced then only we should separate pre-pupa so that the compost will be ready. Electrical conductivity: it reflects the degree of salinity in the composting product, which indicates its possible phytotoxic/phyto-inhibitory effects on the growth of plants.C**:**N ratio: the narrow C:N ratio with range 10**:**1 is good as it will start supplying N and other nutrients to the plants. BSFL compost has 9.23**:** 1 which is almost equal to the standard range.pH: initially ammonia releases due to ammonification and mineralization of organic nitrogen so pH will be around 6.6 to 7.6 after shifted to acidic and at the end the neutral pH that is 7.3 is obtained this might be due to volatilization of ammonia. Neutral pH is est suitable for field apply.

Conclusion: We conclude that the use of Black soldier fly larvae has a great potential in organic waste management, be it the treatment of market waste, municipal organic waste. However BSFL is capable of dealing with demanding environmental conditions such as global warming. The study also revealed that the concentration of NPK are good in manure hence can be used for fields as an organic fertilizer.Under the circumstances of this experiment, the BSFL organic waste treatment technology can contribute to reducing the burden of organic fertilizers in farm market and provide new way for entrepreneurs. However, the compost have standard quality in agricultural fields because BSFL compost is nutritionally on par with

earthworm compost and other important point is narrow C: N ratio which is very much optimum for soil application. The larva may be cultured for different applications such as replacement of soybean in poultry, fish meal in formulated diets, suitable replacement for conventional protein and fat sources, feed for chicks as protein supplement.

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