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Short Communication

EFFECTIVENESS OF BLACK SOLDIER FLY LARVA (*HERMETIA ILLUCENS*) IN SOLID WASTE MANAGEMENT AND KITCHEN WASTE COMPOSTING

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INTRODUCTION

Solid Waste Management (SWM) is a fast growing urban environmental issue in Sri Lanka. There are several methods to produce compost such as Vermi composting, Cockroach composting, Bokashi, Compost tea etc. Composting with worms and grubs is a known method of organic waste management. Currently Black soldier fly larvae (BSFL) based composting become new approach in the world. *Hermetia illucens* is a common fly of the Stratiomyidae family who has complete life cycle with four stages. BSF do not have functional mouth parts; therefore they do not bite nor feed. Adult not be regarded as unsanitary or a vector of diseases (Leclercq, 1997). The female black soldier fly deposits a mass of about 500 eggs in decaying matter such as dung, carrion, garbage and other organic waste (Larde, 1990). Vastly BSFL are used to reduce manure accumulation and harvested pre-pupae can be used as an animal feed (Newton *et al.*, 1977).

BSFL composting system is more suited for urban households as it is capable of giving acceptable solutions to several problems that associated with conventional compost bins. They are controlling of house fly (*Musca domestica*) other than the bioconversion of organic waste material (Sheppard 1983; Bradley and Sheppard, 1984) and it is usually not a pest and not attract to human habitation or foods. Due to high efficiency, fresh material conversion is extremely fast and it reduces production of bad odour to a minimum. BSFL is able to consume diets with fat contents (Barry, 2004) and these benefits include reduced green house gas emissions from avoided landfill emissions, decreased commercial fertilizer usage, increased soil carbon storage and decreased soil erosion. This study was to investigate efficiency of BSFL in terms of waste reduction ability and quality of compost produced by them using commonly available solid waste.

MATERIALS AND METHODS

This study was carried out at the Regional Agriculture Research and Development Centre, Makandura, in 2015 *Yala* season. BSFL were collected from Makandura research field and multiplied. BSFL with average length of 1 cm were used to add 5 kg of selected waste materials as T1- vegetable stuff + BSFL, T2 - kitchen waste + BSFL, T3 - 'Pilisaru' material + BSFL, T4 - vegetable stuff and T- 5 cattle manure + plant materials as vermin composting with earth warms (*Easinia* sp.). The treatments were arranged in a Complete Randomized Design (CRD) with three replicates. Plastic containers of 18L volume were prepared providing drainage holes covered with a mesh at the bottom.

Collected data were weight of decomposing materials at weekly intervals during decomposing, temperature inside the bins, mean daily temperature, time taken for complete decomposing and the weight of decomposed material, final weight sieved by 4 mm mesh. Sensory evaluation was done with 20 people (No odour, Moderate odour, High odour). Completely decomposed samples were used for nutrient analysis as organic carbon content (Walky-black method), total Nitrogen (Kjeldahl method), available Phosphorus (using spectrophotometer), available Potassium (flame photometer), pH (1:1 soil: water according to McLean, 1982) and Electric Conductivity (1:5 water). A Pot experiment was conducted to assess the suitability different compost materials growing leafy vegetable "Mukuwenna" (*Alternanthera sessilis*) as a CRD design and selected treatments were T1 - only top soil, T2 - top soil: normal compost, T3- top soil : BSFL compost and T4 - Top soil : Virmy compost. Harvests were collected in one month intervals. The data were statistically analyzed by using SAS 9.2, (2009) statistical software and means were compared using DMRT.

RESULTS AND DISCUSSION

The highest weight reduction as 87.2% was obtained in kitchen waste + BSFL after four weeks and final weight was 638.3 g from initial weight. Pilisaru material + BSFL, obtained the lowest weight reduction 51.1% after ten weeks with final weight of 2.45 kg. The highest composting efficiency was obtained in vegetable stuff+ BSFL (57.66%) while lowest value was obtained in vegetable stuff only as 18.65. As BSFL chew down waste into uniform small particles T1, T2 and T3 showed higher composting efficiency than the control (T4).

BSFL with Vegetable stuff and BSFL and Kitchen waste gave high potential for avoidance of waste segregation through higher rate of weight reduction. As Pilisaru material + BSFL contained more dried leaves which were unable to break down due to high cellulose content. Sensory evaluation showed 85% - no odour in vermin compost,

80% - no odor in Pilisaru composting, 75% - no odour in vegetable stuff composting and 70% - moderately odor in kitchen waste composting with BSFL. According to Sheppard 1983; Bradley and Sheppard (1984), odour reduction may be due to ability of BSFL to suppress bacterial growth and control oviposition and development of house fly (*Musca domestica*) which is a critical issue of house hold compost bin.

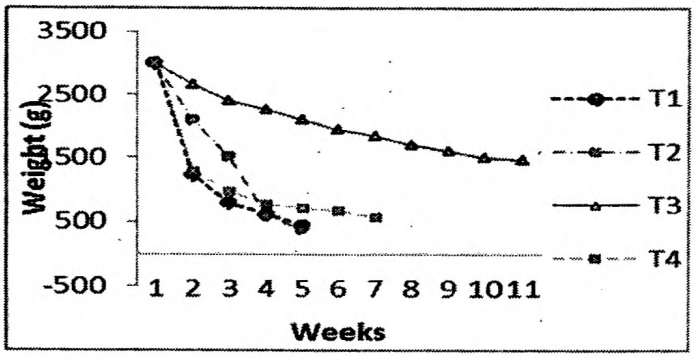

Figure 1. Weight loss of raw materials of compost with time
T1=Veg + BSFL; T2=Kitchen waste + BSFL; T3=Pilisaru material + BSFL; T4=Vegetable stuff only.

The highest N % in compost showed as 3.59 and 3.88% in Kitchen waste + BSFL and Vermi compost respectively which have exceeded the N % of SLS compost standard. Further veg. stuff + BSFL showed low total N than Veg. stuff only. Nitrogen content in dairy manure was reduced probably due to the reduction of larval biomass according to Myers *et al.* (2008). Among treatments where BSFL were used T2 showed the highest N content as 3.59%. Both in Vermi- compost and kitchen waste + BSFL compost can be recommended as nitrogen rich sources (Table 1).

Table 1. Nutrient analysis of compost (Dry weight basis).

Treatment	pH	EC (ms/cm)	N (%)	P_2O_5 (%)	K_2O (%)	Organic carbon (%)
T1 Vegetable stuff + BSFL	9.91^{a}	12.90^{a}	1.81^{b}	0.84^{bc}	1.38^{ab}	41.42^{c}
T2 Kitchen waste + BSFL	5.89^{e}	11.59^{a}	3.59^{a}	1.17^{ab}	0.88^{b}	59.43^{b}
T3 Pilisaru material + BSFL	7.09^{d}	5.80^{b}	2.09^{b}	0.62^{c}	1.90^{a}	32.12^{c}
T4 Vegetable stuff only	9.09^{b}	3.43^{c}	2.09^{b}	1.19^{ab}	0.92^{b}	38.24^{c}
T5 Vermi compost	8.03^{c}	1.03^{d}	3.88^{a}	1.39^{a}	0.42^{c}	154.06^{a}
SLS standards	**6.5-8.5**		**>1.0**	**> 0.5**	**> 1.0**	**20**
LSD	0.44	0.41	0.24	0.23	0.25	0.30

Means followed by the different letters in each column are significantly different.

Veg. stuff + BSFL compost showed significantly lower value for available P (0.84%) than decayed veg. stuff, but treatments were not significantly different from each

other. BSFL + kitchen waste and Veg stuff showed high percentages of P but not significantly different with the Vermi- compost. Pilisaru material + BSFL compost showed the highest percentage of potassium as 1.9%. There were significant differences in pH among all treatments and it proved that BSFL is capable of decreasing concentrations of organic alcohols and acids significantly while processing micro aerobic fermentation leachate (Green and Popa, 2012). As BSFL is capable of reducing acidity, they can be effectively used for compost production with high acidic substrates. When compared the yields of leafy vegetable "*mukunuwenna*", BSFL, vermi and normal compost gave more or less equal yields which were not significantly different.

CONCLUSIONS

Waste reduction within short period of time (1-1½ months) can be done by using BSFL for various sources of organic matter except rough plant structures that contain more cellulose. Though traditional composting works well with yard waste, BSFL can effectively convert kitchen waste into compost. Therefore BSFL can be an appropriate solution for solid waste management/ kitchen waste management due to its high rate of waste reduction, low time period for decomposing, limited space requirement and low level of odour generation.

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