Evaluation of Different Vermisystem for Recycling Fruit and Vegetable Waste in Bharatpur, Chitwan.

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ABSTRACT

This study was investigated to develop the effective vermi system for recycling fruit and vegetable waste collected from wholesale market. Three vermicomposting system Bed, Cement ring and Bin system was used to produce vermicompost by using in CRD with six replication of each system at Bharatpur, Chitwan, Nepal. Impact of different vermicomposting system on nutrient content of vermicompost, number of earthworm per m^3 and vermicompost produced per 100 kg of waste were also investigated. The earthworm species i.e.Eiseniafetida was inoculated for vermicomposting in all the experimental units. The nitrogen content of the vermicompost produced in the Bin system was significantly higher (2.50%) as compared to rest two. However, the content of Phosphorous and potassium content was found to be significantly higher in the vermicompost produced in Cement ring system (1.90% and 1.80%). The multiplication of earthworm in Bin system was found faster and better as compared to cement ring and bed system. In Bin system, earthworm incidence per m^3 was found to be significantly higher (5845). Similarly, vermicompost produced per 100 kg of waste in the Bin system was found to be superior (11.55 kg). Thus, bin system was found superior in terms of production of superior quality and quantity of vermicompost.

Key words:

Vermi system, Vermicompost, *Eiseniafetida.*

INTRODUCTION

In Nepal, mainly fruits and vegetables wastage contribute the major share in biodegradable waste and the waste occurs in collection and distribution centre and in different wholesale and retail markets. The estimated postharvest loss of fruit and vegetable has been estimated to lie in the range of 20% – 50% (Gautam and Bhattarai, 2006). Along the different stages from harvesting to marketing of horticultural products 15- 30 percent loss was reported earlier (Kaini, 2000). It is reported that 83% of the total waste that was dumped in filling site in Kathmandu valley is municipal wastage, 11 percent agricultural wastage and 6 percent industrial wastage (Pant and Yami 2008).

Vermicomposting is the process of recycling organic wastes through use of earthworms. Casting of earthworms contribute major nutrient i.e. nitrogen, phosphorous and potassium than adjacent soil and essential micronutrients like Mo, B, Cu, Mn, Fe, and Zn as well as growth regulating substances like gibberellin and auxin along with useful microorganisms like

Actinomyces,Azospirillum and *Phosphobacillus* (Edward, 1995). Different vermicomposting system has been practised in Nepal and abroad for production of organic fertilizer. Out of which bed system is considered to be the low technology and traditional method for large scale vermicomposting (Edward, 1998). Bed system is considered inefficient due its requirement for larger area, low process of compost formation and labour intensive in terms of feeding worms and harvesting compost (Edward, 1995) and nutrient is lost in that through volatilization and leaching (Edward, 1999).Vermicomposting on bin method is usually practiced indoors which can be easily performed and is efficient to avoid harsh environmental conditions (Sherman, 2003).

Vermicomposting of organic waste assists in meeting the requirements of legislation and institutional obligations, as well as social responsibility. Moreover decreasing use of chemical fertilizers and increasing use of organic one rejuvenates our soil, rehabilitates it and ensure its sustainability. Similarly chemical free organic products are produced providing an opportunity to increase socio economic and health condition of producer. These are ecofriendly and sustainable practice which can be used as powerful means to reverse the declining global productivity (Aveyard, 1988; Wani and Lee, 1992).

MATERIALS AND METHODS

The research was conducted during July 2012 to February 2013 in shade house at Bharatpur, Chitwan. The research consists of three vermicomposting systems with six replications in complete randomized design. The treatments used were Bed system, Cement ring system and Bin system. In Bed system, beds of dimensions 3×1.4×0.5 m^3 were made using brick and cement at 3 % slope for maintaining drainage. Small pebbles were kept at base for aeration and rice straw and maize stovers were used as bedding material. Cow dung at the rate of 8 kg per bed was used. 6000 earthworm per bed was used and 50 kg organic waste per bed for 20 times was used.In Cement ring system, cement ring of dimensions 0.96m diameter and 0.23m height was used and established at 3 % slope for maintaining drainage. Small pebbles were kept at base for aeration and rice straw and maize stovers were used as bedding material. Cow dung at the rate of 2 kg per ring was used. 1000 earthworm per ring was used and 8 kg organic waste per ring for 20 times was used.In Bin system, bins of dimensions 0.4×0.4×0.8 m^3 were used. Rice straw and maize stovers were used as bedding material. Cow dung at the rate of 0.5 kg per bin was used. 400 earthworms per binwere used and 4 kg organic waste per bed for 20 times was used.

The parameters were recorded and analyzed by using the ANOVA procedure described by Gomez and Gomez (1984). When the F-test indicated statistical significance at the P = 0.01 and P = 0.05 level, the Duncan's Multiple Range Test was used to compare the difference of the means.

RESULT AND DISCUSSION

1. **Effect of different vermisystem on nutrient content of vermicompost**

Three vermisystem of different scales were assessed for nutrient content in the vermicompost. The analysis emerged with the fact that the nitrogen content of the vermicompost produced in the Bin system was significantly higher (2.50%) as compared to that in Cement ring system (2.39%) and Bed System (2.18%) (Table 1).

(However, the content of Phosphorous and potassium content were found to be significantly higher in the vermicompost produced in Cement ring system (1.90% and 1.80%) and followed by Bed System (1.20% and 1.32%) and Bin system (0.80% and 0.80%) respectively (Table 2).

Table 1. NPK content of vermicompost produced in different vermicomposting system at Bharatpur, Chitwan, Nepal, 2013

Treatments	Nutrient content (%)		
Vermisystems	Nitrogen	Phosphorous	Potassium
Bed system	2.18[c]	1.20[b]	1.32[b]
Cement Ring system	2.39[b]	1.90[a]	1.8[a]
Bin system	2.50[a]	0.80[c]	0.8[c]
LSD	0.07**	0.25**	0.21**
SEM (±)	0.02	0.08	0.067
CV (%)	19.00	15.96	12.93
Grand mean	2.35	1.25	1.28

Means followed by common letter (s) within column are non – significantly different based on DMRT at P = 0.05. NS: Non significant. SEm: Standard Error of Mean. CV: Coefficient of Variation

The multiplication of earthworm in Bin system was found faster and better as compared to Cement ring and Bed system (Table 3). As a result higher activity of earthworm significantly influence on nitrogen content of the vermicompost. In bin system, there is minimum volatilization and leaching loss due to closed structure of the bin as compared to rest two systems.

The phosphorous and potassium content of vermicompost produced in Cement ring system and Bed system were significantly higher as compared to Bin system. It might be due to use of gravel and pebbles as a bedding material to maintain the aeration in these two systems. The content of phosphorous and potassium is higher in gravels and weathering of these materials might have contributed to phosphorous and potassium content of vermicompost.

The findings of present studies are more or less similar to the findings of other workers. Rosset and Benjamin (1993) also reported that Cuban earthworm vermicompost contained 1.5 to 2.2 % N, 1.8 to 2.2 % P 2O5, 1.0 to 1.5 % K2O, 3.5 to 4 % humic acid and 65 – 70 % organic matter.

2. **Effect of different vermisystem on earthworm density and vermicompost harvested**

Earthworm presence per m^3 and the amount of vermicompost produced per 100 kg of waste at different vermicomposting systems showed significant difference (Appendix 5 and 6). In Bin system, earthworm density per $m^3$was found to be significantly higher (5845) which was followed by Bed system (3947) and least was observed in Cement Ring System (2972) (Table 3).

Table 2. Effect of different vermicomposting systems on the earthworm density and vermicompost production per m^3 at Bharatpur, Chitwan, Nepal, 2013

Treatments	Earthworm per m^3	Vermicompost produced per 100kg of waste (kg)
Bed system	3947^b	9.90^b
Cement Ring system	2972^c	7.90^c
Bin system	5845^a	11.55^a
LSD	412.00	0.267**
SEM (±)	130.70	0.09
CV (%)	7.96	2.20
Grand mean	4021.83	9.45

Means followed by common letter (s) within column are non – significantly different based on DMRT at P = 0.05. NS-Non significant.SEm-Standard Error of Mean.CV-Coefficient of Variation

Similarly, vermicompost produced per 100 kg of waste in the Bin system was also higher (11.55 kg) than that of the Bed system (9.90kg) and the Cement ring system (7.90kg) (Table 3).

The structure of Cement ring system used for this research was 0.23 meter height with 0.96 meter diameter. So, after keeping the fruit and vegetable waste, the temperature inside the system reached up to 41^0c in summer and 32^0c in winter. Also the drainage system in Cement ring was poor and resulted in higher moisture retention rate. As a result the survival and activities of the earthworm was minimum. In case of Bin system, temperature reached only up to 35^0c in summer and 27^0c in winter due to provision made for better aeration and temperature control in the system. As a result higher activity of earthworm signifies to higher earthworm per m^3.

Vermicompost produced in Bin system was significantly higher due to greater number of earthworm per m^3 (Table 3). Higher the population of earthworm faster the composting of fruit and vegetable waste which signifies maximum vermicompost production as compared to rest.

Relationship between average maximum temperature (^{0}C), earthworm density per m3 and vermicompost produced per 100 kg of waste (kg).

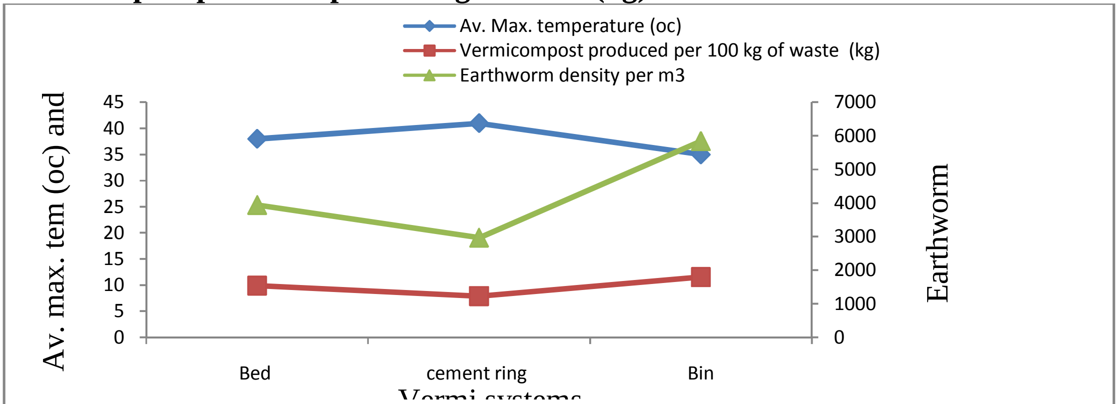

Figure 6: Relationship between average maximum temperature (0C), earthworm

The above figure states that the increase in temperature lowers the earthworm density which results in lower vermicompost production. The higher temperature at cement ring system i.e. 41^{o}c resulted in lower earthworm density (2972) and vermicompost production (7.9 kg). The lower temperature (35^{o}C) at bin system resulted in higher earthworm density (5845) and vermicompost production (11.55kg).

CONCLUSIONS

Thus, based on the present research, it can be concluded that process of recycling organic waste into vermicompost and quality of vermicompost depend upon rate of multiplication of earthworm. Higher the multiplication rate, faster the recycling process. Multiplications of earthworms are much affected by the temperature and aeration in the feeding material. The temperature and aeration are again determined by the structures used for recycling and quantity of organic waste fed to the earthworm. Bin system looks ideal for vermicomposting because of its design and size which helps in maintaining suitable range of temperature and aeration for earthworms.

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