Vermicompost: A Source of soil fertility management in organic farming

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Abstract: *Use of vermicompost in crop field can reduce the cost of cultivation by replacing chemical fertilizer and it maintains sustaimentnable agriculture by improving soil texture and its enrichment. Vermicompost can convert waste in to money, so, it is rapidly becoming a growth business with an overall mandate of organic farming. Most of the farmers of India in general and Arunachal Pradesh in particular are marginal and poor. For them it is sometimes not possible for construct a cemented vermicomposting tank for producing vermicompost due to lack of Government subsidy. A low-cost bamboo beam vermicomposting unit was prepared and productivity was analyzed. The economics of bamboo beam vermicomposting unit was worked out and compared with that of the cemented tank vermicomposting unit as collected from different sources. In bamboo beam vermicomposting unit, the cost of production of one quintal vermicompost for first year was Rs. 79. For second year it was Rs. 6 and for the third year it was Rs. 14.40. In cemented tank vermicomposting unit the cost of production of one quintal vermicompost for first year was Rs. 632 and for second year onwards it was Rs. 10. Thus it is concluded that low-cost vermicomposting technology can be used as a source of income generation for the rural people by recycling and utilizing the locally available biodegradable wastes.*

Key words: Vermicomposting technology, biodegradable waste, Arunachal Pradesh.

Introduction

Arunachal Pradesh is a 'biodiversity rich hot spot' in the Indian Eastern Himalayas. The agro climatic condition and variation in elevation and latitude caused the occurrence of different and distinct vegetation types of this region. Huge amount of agricultural crop residues, weed biomass from both cropped and non-cropped areas are also available annually, which are usually burned for crop cultivation in the subsequent years. The estimated amount of agricultural crop waste in Arunachal Pradesh was 261865 tonne (t) per year which could be harvested from the cereals and legumes cultivated. In addition, a substantial

amount of wastes are also arising from livestock. For instance, about 2221440 t of wet dung per annum, and 1382520 t of urine per annum were arising from total number of livestock available (Bordoloi et al., 2007). In all, these agro-wastes could be utilized successfully for compost preparation and recycled for integrated nutrient management for enhancing production and maintaining productivity.

While using organic materials as manures for crop production, the farmers are faced with the problems of organic materials being bulky, with a low nutrient content in relation to their volume, and being often messy and has bad odour. Therefore there is a need to develop an eco-friendly and appropriate technology to maximize economic value of nutrients of agro-waste for sustainable utilization. Decomposition reduces much of organic substances due to physical breakdown of substrate, leaching of soluble materials, and catabolism or oxidation (Seastedt, 1984). Conventional methods of composting takes relatively higher time and produce low quality manure. Use of earthworm for degradation of organic waste and production of vermicompost is becoming popular and is being commercialized. Use of vermicasting as biofertilizer can be one of the measure to overcome productivity crisis in agriculture and play a multifaceted role in the improvement of soil texture through its influence in soil pH, as agent of physical decomposition by promoting humus formation by improving soil texture and its enrichment (Venkateshwarlu, 1995). Desai (1993) reported that by using vermiculture the cost of production could be substantially reduced by way of replacing chemical fertilizers.

In totality, vermicompost can convert waste in to money, so, it is rapidly becoming a growth business with an overall mandate of organic farming. Most of the farmers of India in general and Arunachal Pradesh in particular are marginal and poor and may not afford to construct cemented vermicomposting tank. So, it is envisaged to have a low- cost unit for the resource poor farmers of this region. By considering all these views, for maintaining sustainable crop production as well as to reduce the cost of fertilizer application an attempt was made to prepare a non-tank vermicomposting unit (bamboo beam) by utilizing locally available materials and resources. It can also be viably used as a source of income generation for the rural people by utilizing locally available biodegradable waste materials.

Material and Methods

An experiment was conducted to evaluate a low-cost bamboo beam structure for vermicompost preparation. The specific objective of the study being to test the efficiency of some plant waste material as a source of compost as well as to test the efficiency of methods of compost preparation and also to develop a low-cost, eco-friendly bio-composting technique.

Three types of compost namely simple compost, enriched compost and vermicompost were prepared from easily available agricultural waste i.e. rice straw, weeds from rice field and kitchen waste. Cow dung was mixed for all the compost in the ratio of 1:1 (by weight). Bamboo beam of size 1m×1m×0.5 m were prepared. The beam was covered with polyethylene sheet to check the nutrient loss and to provide proper temperature for quick decomposition. In vermicomposting, after 25 days of decay the partial decomposed materials were transferred to the vermicomposting bed of size 2m×1m×0.3 m for inoculation of earthworms. The identified suitable strain of earthworm i.e. *Eisenia foetida* (Sav.) was collected from Multi-Disciplinary Training Centre (MTDC), Khadi Village Industries Commission (KVIC), Midpu, Arunachal Pradesh. A total of 1500 earthworms (750 earthworms; size < 0.7 g, 750 earthworms size > 0.7 g) was inoculated for each bed and the bed was covered by a gunny cloth. Moisture was maintained at 40-50%. Each of the treatments was replicated three times to reduce the error of measurement of particular parameters. Among all, vermicompost was found more nutritious, less time consuming and more productive. The structure of bamboo beam unit and different stages of vermicomposting are presented in Figure 1.

The economics of bamboo beam vermicomposting unit was worked out and compared with that of the cemented tank vermicomposting unit as collected from different sources. The cost of cemented tank vermicomposting unit was calculated by personal observation and by having interviews with different farmers which have their own vermicomposting units prevailing in Papum Pare district and from the Department of Agriculture, Govt. of Arunachal Pradesh. The net cost of production per kilogram per year was calculated.

Results and Discussion

For construction of low cost bamboo beam vermicomposting unit of 1 tonne capacity per harvesting a total of 60 piece bamboos was needed for construction of shed and bamboo beam, which was cost around Rs. 600. The total cost of thatch and polythene sheet comes around Rs. 600. Labour cost for construction of the unit was Rs. 350. The initial cost of earthworm was Rs. 2000. The total cost including maintenance and packaging for first year was Rs. 3950. For second year it was Rs. 300 and for third year it was Rs. 720. In one year 5 harvesting was done, so total of 50 q of compost was harvested from the unit. Net profit for first year was Rs. 31,050, for second year it was Rs. 34,700 and for third year it was estimated Rs. 34,280. In the first year, the cost of production of one quintal vermicompost was Rs. 79, for second year it was Rs. 6 and for the third year it was Rs. 14.40 (Tables 1 and 2).

The construction cost of one tonne capacity per harvesting cemented tank type of vermicomposting unit was Rs. 31,600. An expenditure of Rs. 500 was required for maintenance and packaging from the second year onwards. Thus the production cost for one quintal vermicompost was Rs. 632 in the first year. And from second year onwards it was Rs. 10 only (Tables 3 and 4).

From the data it is seen that non-tank bamboo beam vermicomposting unit, takes very low-cost compared to a concrete tank. The cost of production of one tonne vermicompost can be reduced by 87.5 % in the first year. For second year cost of production could reduce to 40%. Third year it needs some what more that is 44% more cost of production due to repairing of bamboo beam and bamboo shed for production of vermicompost for subsequent years. On an average, the production cost of one quintal vermicompost in bamboo beam was Rs. 33.13 and in cemented tank it was Rs. 217 in first three years.

Low cost vermicomposting technology can help the marginal and resource poor farmers of the North East India. The cost of cultivation of crops can also be reduce by popularizing vermicomposting technology by replacing the need of chemical fertilizers. Most of the peoples of North East India depend on Agriculture. Vermicompost not only helps to increase the productivity of crops but also helps as income generation for the youth of North East India. By utilizing locally available resources and waste material available by their own, the farmers can construct a small vermicomposting unit and can utilize it as a source of income generation. Now a days, it is a great concern to popularize the organic farming. The demands of organic

products are increasing not only in the local market but also in global market.

Figure 1: (a) Bamboo beam structure (partial decomposition tank), (b) Placing of agricultural waste material in partial decomposition tank, (c) Earth worm collection from rearing bed, (d) Vermicomposting bed after inoculation of earthworm.

Table 1. Cost of production of non tank vermicomposting unit (bamboo beam)

Parameters	**Cost**		
	1st year	**2nd year**	**3rd year**
Construction of shed (Bamboo 20 pieces @Rs. 10 per culm), (Size of shed 14m×16 m)	200.00	-	40.00
Bamboo beam 12 numbers (size 1 m ×1m×0.5 m), and bed 6 numbers (size 2 m × 1 m × 0.3 m), (Bamboo 40 pieces @Rs. 10 per culm)	400.00		40.00
Thatch	400.00	-	100.00
Polyethylene sheet	200.00	-	100.00
Man days for construction (@ Rs. 70)	350.00	-	140.00
Miscellaneous	100.00	100.00	100.00
Cost of earthworm	2000.00	-	-
Packaging cost	200.00	200.00	200.00
Sieve	100.00	-	-
Total cost	3950.00	300.00	720.00
Cost of production of 1 q vermicompost	Rs. 79.00	Rs. 6.00	Rs. 14.40

(Production capacity per harvesting 10 quintal)

Table 2. Production of vermicompost in non-tank vermicomposting unit (bamboo beam)

	1st year	**2nd year**	**3rd year**
Production in one harvesting	10q	10q	10q
5 harvesting in one year	50 q	50 q	50 q
Market price for 1 kg vermicompost	Rs. 5.00	Rs. 5.00	Rs. 5.00
Gross income after 1 year	Rs.25,000.00	Rs.25,000.00	Rs.25,000.00
Sale of earthworm	Rs. 10,000.00	Rs. 10,000.00	Rs. 10,000.00
Gross income after 1 year	Rs. 35,000.00	Rs. 35,000.00	Rs. 35,000.00
Net profit	**Rs. 31050.00**	**Rs. 34700.00**	**Rs. 34280.00**

Table 3. Cost of production of tank type vermicomposting unit (cemented type)

Parameters	**Cost**		
	1st year	**2nd year**	**3rd year**
Construction of shed (11m ×3m)	14,000	-	-
Construction of tank of size (3m× 1m ×1m) total 3 numbers of tank	15,000	-	-
Miscellaneous	300.00	300.00	300.00
Cost of earthworm	2000.00	-	-
Packaging cost	200.00	200.00	200.00
Sieve	100.00	-	-
Total cost	31,600.00	500.00	500.00
Cost of production of 1 q vermicompost	Rs. 632.00	Rs. 10.00	Rs. 10.00

(Production capacity per harvesting 10 quintal)

Table 4. Production of vermicompost in tank type vermicomposting unit (cemented type)

	1st year	**2nd year**	**3rd year**
Production in one harvesting	10q	10q	10q
5 harvesting in one year	50q	50q	50q
Market price for 1 kg vermicompost	Rs. 5.00	Rs. 5.00	Rs. 5.00
Gross income after 1 year	Rs. 25,000.00	Rs. 25,000.00	Rs. 25,000.00
Sale of earthworm	Rs. 10,000.00	Rs. 10,000.00	Rs. 10,000.00
Gross income after 1 year	Rs. 35,000.00	Rs. 35,000.00	Rs. 35,000.00
Net profit	**Rs. 3,400.00**	**Rs. 34,500.00**	**Rs. 34,500.00**

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