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RESEARCH ARTICLE

MILLICOMPOST: AN ALTERNATE BIOCOMPOST FOR FOREST NURSERIES

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ABSTRACT

Soil macrofauna is known to play a significant role in the disintegration and decomposition of organic material added to the soil. Millipedes are the major macrofauna involved in litter decomposition in tropical, subtropical and temperate regions of the world. Millicompost is the process in which millipedes are employed for composting plant wastes. Like vermicomposting, millicompost is an ecofriendly technique involving no pollution. Hence an attempt has been made to compost invasive weed, *Parthenium hysterophorus* Linn. using two millipede species viz., *Harpaphe haydeniana* Wood, 1984 and *Spinotarsus colosseus* Attems, 1928. Among the composting species chosen for the present study, millipede species, *H. haydeniana* is highly efficient in composting the *P. histerophorus* leaf litter into useful organic manure than *S. colosseus* and ordinary compost. Physicochemical characters were significantly higher in millicompost than the ordinary compost. Increase in concentration of N, P, K, Ca and Mg was observed in compost produced with the help of millipede than ordinary compost. The narrow C/N ratio was also observed in millicompost than ordinary compost. It was observed that millicompost is superior and has positive effect on seed germination and growth of five tree species viz., *Tectona grandis*, *Casuarina equisetifolia*, *Eucalyptus tereticornis*, *Gmelina arborea*, and *Ailanthus excelsa* over ordinary compost. Hence, millicompost may be considered as alternate compost for the production of quality planting stock.

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INTRODUCTION

Inadequate raw materials and stringent forest policies have forced the wood based industries to become self-reliant in terms of acquiring their own raw materials. It is very encouraging that wood based industries are now working with farmers and local communities to encourage farm forestry and plantation forestry to achieve their wood demand. Today, 50 percent of wood supply in the country comes from non-forestry source and the rest of the industrial wood consumption is through imports and from plantations. Plantation forestry has tremendous scope for rural livelihood improvement and improvement of activities of wood based industries in the country. However, supply of quality planting stock to the farmers is the major bottle neck due to lack of micro and macro nutrients, insect pests, and diseases management. Various nursery practices are available using various biofertilizers for nutrient management, vermicompost in particular.

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However, use of millicompost as biocompost/biofertilizer for nutrient management is lacking. Like earthworms, millipedes are known to be macroinvertebrates / macrodetrivores terrestrial arthropods feeding on decaying matter such as dead wood, leaf letters and mineral soil. Millipedes play very important role in the ecosystem. They perform many functions such as soil turnover, aeration and conversion of nitrogen and phosphorous and incorporation of organic matter into the soil. They create a type of humus on the topsoil. The health and survival of deciduous forest depends on them since they are one of the primary mechanical decomposers of dead wood and leaf litter-detrivorus. These arthropods inhabits forest floor and it is also found to have established in plains, cultivated lands and gardens. They are seen on the soil surface during monsoon in singles or small numbers and also found in large aggregates. They are also found lying spirally coiled under litter, dead wood and inside the rotten trunks. They are more important than worms as agents of soil and nutrient turnover. Millipedes do not bite or pose any danger to humans since they don't have poison claws as centipedes. Reports revealed that millipedes are important members of the detritus food web and use manure as food source.

Microorganisms plays crucial role in the digestion of millipede by breaking down the cellulose into simple sugar. Further it is reported that the degradation of organic matter and recycling of detritus energy are favoured by the gut microbes of millipedes. Eventhough millipedes are the major saprophagous fauna, so far no sufficient information is available on using millipedes for compost production. Hence the present study aims to explore the efficiency of millipedes in converting the lignocellulosic biomass into useful biocompost as fertilizers for forest nurseries.

MATERIALS AND METHODS

Collection and maintenance of experimental animal (millipedes): Experimental animals were collected from forest campus, Coimbatore and their identity was confirmed as *Harpaphe haydeniana* (Wood, 1984) and *Spinotarsus colosseus* (Attems, 1928). Before employing the millipedes for compost production, they were domesticated and cultured in pots having a diameter of 20 cms. At the bottom of the pot, 5cm thick layer of soil was spread (this soil was also collected from the forest floor where the millipedes were found). The second layer of the culture media contained small wood pieces, dead and decaying leaf litters and paddy straw. Water was sprinkled as per need to maintain 50-60% moisture content of the culture medium. The activity of millipedes was examined in the morning as well as in the evening and the dead organisms (if any) was removed from the pot. Only after domestication for one month, the millipedes were used for composting.

Procurement of raw materials: Raw material, leaf litter of invasive weed, *Parthenium hysterophorus* was collected in the forest campus, Coimbatore.

Production of millicompost: Experiment was conducted in Institute of Forest Genetics and Tree Breeding, Forest Campus, Coimbatore. Moveable wooden boxes of dimension 90x110x105 cm^3, with lids on their tops, were used for composting. The compost boxes consist of identical interlocking sections, which is stacked on top of each other. About 7.5cm thick ordinary soil was spread at the bottom of the wooden boxes. The second layer contained some wood chips, 10kg of shredded raw material, leaf litter of *Parthenium hysterophorus* and 5kg of shredded paddy straw. Before placing the *Parthenium hysterophorus* in the compost box, the biomass of *P. hysterophorus* was put in a water tank containing 300 litre of water and 10ml of TBME (Tertiary Butyl Methyl Ether). After 12 hours of leaching in water, biomass was taken out and was subjected to photo-irradiation in the Sun. After 10-12 hours, when the moisture content of this biomass is reduced to 50%, it was mixed with 5kg of shredded paddy straw and placed over the wood chips of the compost box. The third layer of the compost pile of boxes contained cow dung slurry. The process of layering in these compost piles was repeated in the same sequence till a minimum of 90 cm height could be attained. The heaps were covered with soil and kept under semi-aerobic condition. The moisture content was kept between 50-60% by sprinkling water. After one month of composting, the piles in each box were turned upside down and side-to-side so as to mix the piles thoroughly. Thereafter, about 100 adult of millipede were introduced into each box, while no millipede was introduced in the control boxes. After 30 days the compost was ready to use.

Evaluation Milli-Compost (MC): To evaluate the efficiency of millicompost, germination percentage of seeds such as *Tectona grandis* (teak), *Casuarina equisetifolia* (casuarinas), *Eucalyptus tereticornis* (eucalyptus), *Gmelina arborea* (Gmelina), and *Ailanthus excelsa* (Ailanthus) were tested and the growth promoting efficiency was also tested using millicompsot under nursery conditions. Seed germination tests were conducted on seed bed. After one month seedlings were transferred to polybags containing millicompost. Growth parameters such as shoot length and collar diameter at initial stage, after one month and two months were taken and data was analysed statistically.

Physico-chemical Parameters of millicompost was also analysed using standard procedure.

Organic Carbon: O.C. may be determined by the titration method.

Nitrogen (N): Available Nitrogen of the samples would be determined by Potassium permanganate (KMnO4) Method.

Phosphorus (P): Phosphorus can be determined with the help of 0.5 M Sodium Bicarbonate as extranatent and Ammonium Molybdate for determination with the help of Spectrophotometer.

Potassium (K): Determination of Potassium of the organic samples can be done with 1 N Ammonium Acetate solution using Flame Photometer.

Calcium and Magnesium: Determination of Calcium and Magnesium will be done collectively using Complexometric Titration Method using ethylene diamine tetra – acetic acid (EDTA). Other parameters such as Cu, Zn, Mn and Fe were also analysed using standard laboratory procedure.

RESULTS AND DISCUSSION

In present scenario, adverse effects of inorganic fertilizers on soil health have resulted in practice of organic farming using biofertilisers and biocomposts. Attempts are made to reduce the use of chemical fertilizer through vermicompost and other biostimulants. Composting is a biological process in which organic biodegradable biomass is converted into humus rich product (compost) for use as a soil conditioner and an organic fertilizer. To restore the soil health, encouraging the activities of soil invertebrates in forestry is an essential step. The principal economic values of the soil macro invertebrates include soil turn over, incorporation of organic matter into the mineral horizons, improvement of soil aeration by creating cavities, conversion of organic nitrogen and phosphorous into plant assimilable forms, stimulation of soil respiratory enzymes, dispersion of microbial probacules and preservation of soil structure through humification. Only few works have been so far reported about compost derived from millipedes. Hence, the present study is attempted. Nitrogen, potassium and phosphorus increased in treated litter than untreated litter (Table 1). The narrow C/N ratio in treated samples indicate enhancement of respiration, influenced by the activities of millipedes, thus rendering the soil for plant growth. The compost recovered from the treated litter was superior in nutrient content than the untreated control. The increase in organic nutrients may be due to the presence of gut microflora of the millipede (Bano, 1981).

Table 1. Nutrient composition of millicompost from *P. hysterophorus* by *H. haydeniana* and *S. colosseus*

Parameters	M1 *Harpaphe haydeniana* (Wood, 1984)	M2 *Spinotarsus colosseus* (Attems, 1928)	C Control Compost
Nitrogen (%)	0.10	0.09	0.08
Phosphorous (%)	0.33	0.17	0.04
Potassium (%)	0.44	0.85	0.4
Calcium (%)	1.84	1.64	4.0
Magnesium (%)	3.46	2.86	0.12
Organic carbon (%)	2.7	2.2	2.0
Cu (ppm)	32	28	14
Zn (ppm)	112	55	42
Mn (ppm)	69	50	40
Fe (ppm)	2035	1595	1254
C/N ratio	12.1	12.7	13.4

Table 2. Effect of millicompost of germination and growth of teak, Gmelina, eucalyptus, casuarinas and Ailanthus at nursery

Compost	Germination (%)	Shoot length (cm)			Collar diameter (mm)		
		Initial	30 days	60days	Initial	30 days	60days
Casuarina equisetifolia (casuarina)							
M1	41	3.12	9.61	13.62	0.63	1.38	1.9
M2	37	2.86	8.07	12.21	0.60	1.20	1.67
C	33	2.30	7.32	9.30	0.55	0.95	1.10
Eucalyptus tereticornis (eucalyptus)							
M1	57	8.9	15.98	32.03	1.12	1.73	3.2
M2	45	7.47	13.28	22.01	1.04	1.25	2.72
C	36	6.93	9.95	11.89	0.84	1.11	1.64
Tectona grandis (teak)							
M1	17	6.0	9.41	16.08	2.25	4.06	5.01
M2	14	5.7	8.82	15.11	2.19	3.69	4.82
C	9	4.07	7.22	9.05	1.58	3.36	4.21
Ailanthus excelsa (Ailanthus)							
M1	87	9.8	18.9	22.5	1.11	2.21	2.89
M2	73	9.1	16.4	21.2	1.03	2.14	2.71
C	40	7.7	14.5	18.2	0.64	1.68	2.24
Gmelina arborea (Gmelina)							
M1	90	13.19	19.66	28.94	2.06	2.94	3.84
M2	80	12.94	18.05	24.88	1.97	2.89	3.60
C	60	7.87	13.36	17.51	1.08	1.79	2.06

The increased level of nitrogen in the millicompost may be due to the excretory products of the millipede (Alagesan *et al*., 2003; Nicholson *et al*., 1966) and nitrogen, phosphorous, ash contents were found to be high in millicompost than vermicompost (Webb, 1977). Similarly, the fecal pellet of millipede increase pH, moisture and carbon than undigested leaf litter (McBrayer, 1973). Diplopods are important sink for calcium and magnesium and accumulate fivefold higher than raw leaf litter (Ramanathan, 2012). Positive effect of millicompost found on germination percentage, shoot length and collar diameter of all tree species tested (Table 2.). These results indicated that compost prepared from *P. hysterophorus* using millipedes viz., *H. haydeniana* and *S. colosseus* were far more superior in increasing the germination and growth of seedlings of eucalyptus, casuarinas, teak, Gmelina and ailanthus than what we obtained without millipedes. The results obtained in the present study revealed that millicompost prepared from leaf litter of *P. hysterophorus* by the millipede *H. haydeniana* was highly potential than the other millipede *S. colosseus*. It is also revealed that the millicompost is superior than conventional compost in terms of nutritional quality and also their effect on germination and growth of the seedlings of selected tree species. This result is in line with previous observations (Ashwin, 2002; Ashwin, 2006; Karthigeyan, 2011; Prabhas, 2011). The quality of millicompost is depend on the materials used (Ashwin, 2002). *P. hysterophorus* is a rich source of N, P, K, Ca, and Mg (10). Millicompost prepared from leaf litter waste of *P. hysterophorus* was rich in nutrient content than other raw materials (Karthigeyan, 2011).

Leaf litter millicompost contained all essential nutrient to enhance the growth of crops than other organic resiudes (Prabhas, 2011). Comparision with millicompost with conventional compost revealed that shift in pH towards neutral, elevation of nitrogen, phosphate, potassium and narrow C/N ratio in millicompost than conventional compost. This indicates millicompost will be an alternate to conventional compost (Ramanathan, 2012). Therefore, potential use of millipedes for composting is an alternate to conventional compost since soil diplopods (Arthropods) are the major saprophagous fauna of forest floor playing very important role in soil formation by breaking down of plant debris and enhance the physiochemical properties of the soil/compost than worms. In conclusion, the Institute of Forest Genetics and Tree Breeding has initiated research on commercially important forest tree species and has its own programme for the increasing productivity of Teak, improvement programme of Eucalyptus, breeding programme for Casuarinas. Research initiatives have been made to domesticate some native tree taxa such as *Ailanthus excelsa,* and *Gmelina arborea* for various end users. Parallely, the Institute is also working to enhance the productivity of the above tree species through silvicultural interventions and application of various microorganisms besides using biofertilizers. As far as nurseries are concerned, generating planting stock in sufficient quantities is not easily available due to lack of nutrient management. Use of earthworm for vermicompost as biofertilizer for nursery technology is well known worldwide.

Currently, efforts are being made to develop biocompost using millipede since millipedes are the major saprophagous fauna of forest floor playing very important role in soil formation by breaking down of plant debris and enhance the physiochemical properties of the soil/compost, thus proved through the present study, hence, the use of millicompost in raising forest nurseries is appreciated.

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