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STUDY OF CHANGES IN THE NUMBER OF EARTHWORMS AND COCOONS DURING THE PROCESS OF VERMICOMPOSTING OF BAGASSE

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ABSTRACT

In general, the developed countries generate much higher quantities of waste per capita compared to the developing countries of the region. Currently, the management and disposal of agro-industrial waste production is one of the most critical environmental issues. For the present research work, composting of bagasse waste done along with various fungal strains such as *Pleurotus sajor-caju, Trichoderma harzianum* and *Aspergillus niger* and *Chaetomium globosum* in various combination for 40 days and followed by vermicomposting with *Eisenia foetida* for 30 days of period. As fungi helps in degradation of plant biomass rapidly by secreting enzymes along with this also increase in number of earthworms and cocoons in bagasse vermicompost. As earthworm number increases from initial 15 to control 18 in control to 37 in final set up where as cocoons number in control was 4 to last set up were 20. As bagasse supports good number of earthworms and cocoons when treated with various fungal strains.

INTRODUCTION

India has a vast potential of agricultural and agro-industrial wastes. In general, the developed countries generate much higher quantities of waste per capita compared to the developing countries of the region. Global sugar production was nearly 100 million tons in 2002 from sugarcane in over 130 countries (Meuchang *et al*., 2005). Currently, the management and disposal of agro-industrial waste production is one of the most critical environmental issues. Agro-industrial wastes are generated during the industrial processing of agricultural or animal products in various forms. Agro-industries account for production of large quantity of wastes such as coir industry waste, paper and dairy industry waste, biscuit industry waste, fruit pulp industry waste, oil refineries and breweries wastes, stems, leaves, flowers from aromatic oil extraction units etc. Apart from sugar and alcohol as primary products, sugar industries and fermentation units also produce many by-products such as press mud, bagasse, distillery waste, and boiler ash and fermentation yeast sludge.

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All these wastes serve as an excellent source of nutrients. During the production process, lots of amounts of by-products generated such as press mud, bagasse and sugar-cane residue are produced part of these by-products can be utilized for the production of molasses and alcohol; however, there still remains a considerable amount of waste to be disposed. Composting is a controlled biological decomposition process that converts organic matter to a stable, humus-like product and the process depend upon microorganisms, which utilize decomposable organic waste both as an energy and food source (Sajnabath and Sushama, 2004). It is a well known fact that composting is one of the most suitable ways of converting organic wastes into more stable products which are safe and beneficial to plant growth, as well as an environmentally friendly and economical alternative method for treating solid waste (Huang *et al*., 2006). Composting along with microorganisms is beneficial to degrade the plant biomass rapidly by secreting various enzymes. The vital role played by fungi together with the other microbes is the decomposition of organic matter, thus releasing the nutrients locked up in the dead bodies of animals and plants and bringing about the recycling of nutrients in nature. The process by which the fungi are capable of bringing about the decomposition of organic matter is by the secretion of various types of enzymes, such as cellulases, hemicellulases, proteases, pectinases and lignolytic enzymes (phenoloxidases, laccases, peroxidises) into the environment. Vermicomposting technology using earthworms as versatile natural bioreactors for effective recycling of organic wastes to the soil is an environmentally acceptable means of converting waste into nutritious composts for crop production (Graff, 1981; Edward *et al*., 1985; Bano *et al*., 1987). Vermicomposting is defining as low cost technology system for treatment of organic waste (Hand *et al*; 1988b). Although microbes are responsible for biochemical degradation of organic matter, earthworms are the important drivers of the process, conditioning the substrate and altering the biological activity (Suthar, 2007).

MATERIALS AND METHODS

- **Collection of agro-industrial waste (Bagasse):** collected from the Datta sugar factory, Kolhapur (Maharashtra). Bagasse waste which was fine powder, sundried and used for the experimental purpose.
- **Collection of earthworms:** *Eisenia foetida* earthworms were collected from the local supplier, Panvel. Around 225 earthworms collected for the experimental purpose.
- **Source of fungal bioinoculants:** The 4 different fungal strains were used for the composting process. The fungal strain such as *Aspergillus niger, Trichoderma harzianum* and *Chaetomium globosum* were procured from Agharkar Research Institue (NFCCI), Pune and *Pleurotus sajor-caju* was obtained from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.
- **Culturing of fungal strains:** All the four fungal strains were inoculated on PDA (Potato Dextrose Agar) and PDB (Potato Dextrose Broth) plates and slants, kept in incubator at 26^0C after inoculation. After sufficient growth, all cultures were used for further composting of substrates (Paddy straw).
- **Experimental set up:** 15 experimental drums prepared in which 1 kg waste added per drum. This set up kept for 40 days of composting process inoculated with various combinations of fungi. Throughout the experiment temperature maintained and moisture content upto 60 to 80%. Turning/Aeration was done manually after every 4 days. After 40 days, in the same experimental drum 225 earthworms were added (in each drum 15 earthworms) and kept for 30 more days.
- **Counting of total number of earthworms and cocoons:** After 40 days of vermicomposting process, from all experimental drums total number of earthworms and cocoons segregated manually and counted.

The following set up was prepared for earthworms and cocoons development.

FOR BAGASSE: (Each category done in triplicates)

Category 1: Control (Only Bagasse) (B)
Category 2: Bagasse + *Pleurotus sajor-caju* (B+*P.s*)
Category 3: Bagasse + *Pleurotus sajor-caju +Trichoderma harzianum* (B+*P.s+T.h*)
Category 4: Bagasse+ *Pleurotus sajor-caju + Trichoderma harzianum + Aspergillus niger*
(B +*P.s+T.h+A.n*)
Category 5: Bagasse + *Pleurotus sajor-caju + Trichoderma harzianum + Aspergillus niger+ Chaetomium globosum* (B+*P.s+T.h+A.n+C.g*)

RESULTS AND DISCUSSION

As initial number of earthworms were 15 for each experimental drum after 30 days of vermicomposting process it increased in control (B) 18.33, B+*P.s+T.h* 20.33, B+*P.s+T.h* 26.33, B+*P.s+T.h+A.n* 30 and B+*P.s+T.h+A.n+C.g* 37. Number of cocoons also increased from 4.66→6.33→9.66→15→20.33.

Table 1. Changes in the number of earthworms and cocoons during vermicomposting of bagasse

Treatments	Number of Earthworms	Number of Cocoons
Control (B)	18.33±1.52	4.66±0.57
B+ *P.s*	20.33±1.15	6.33±1.15
B+*P.s+T.h*	26.33±2.30	9.66±1.52
B+*P.s+T.h+A.n*	30±2	15±3
B+*P.s+T.h+A.n+C.g*	37±2	20.33±1.52

Note: All values are mean and standard deviation of three replicates (M±SD). Initial number of earthworms = 15

Control (B) ─ Bagasse (without any bioinoculants)
B+ *P.s* ─ Bagasse + *Pleurotus sajor-caju*
B+*P.s+T.h* ─ Bagasse + *Pleurotus sajor-caju+Trichoderma harzianum*
B+*P.s+T.h+A.n* ─ Bagasse + *Pleurotus sajor-caju+Trichoderma harzianum +Aspergillus niger*
B+*P.s+T.h+A.n+C.g* ─ Bagasse + *Pleurotus sajor-caju+Trichoderma harzianum +Aspergillus niger+ Chaetomium globosum*

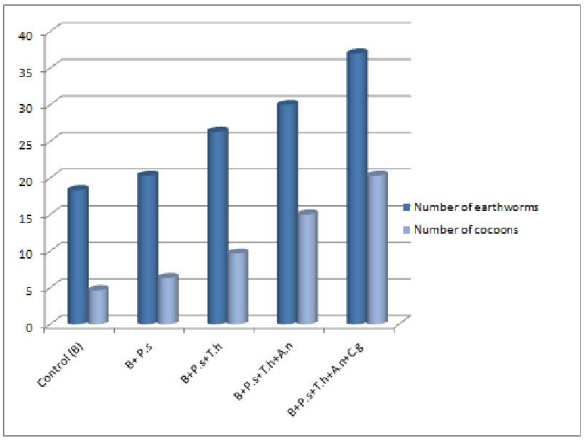

Figure 2. Changes in the number of earthworms and cocoons during vermicomposting of bagasse

A. Singh and S. Sharma (2002) reported a pronounced increase in the number of earthworms as well as cocoons was observed during vermicomposting. Various studies showed that earthworms utilize microorganisms in their substrates as a food source and can digest them selectively (Edwards and Bohlen, 1996).

Suthar (2007) noted the changes in biomass and cocoon production in different waste material by *Perionyx sansbaricus*. P. K. Padmavathiamma *et al,* (2008) reported cocoons/100 gm, 7 cocoons by local worms, 17 by *Eudrillus eugineae* and 11 by *Eisenia foetida*.

R. S. Giraddi, (2008) reported that soyabean waste was found to be significantly good substrate for *E. eugeniae* development with higher cocoons (14.64) and adult worms (58.62). The increase in earthworm's growth may also be attributed to a low C: N ratio (Nedgwa and Thompson, 2001) of the pre-decomposed substrate and positive role of bioinoculants used in the present study. Thus, proper management of the crop residues by utilizing microorganisms may result into availability of good quality manure and biofuels as well as protection of environment from pollution (Sharholy *et al*., 2008; Ulusoy *et al*., 2009).

Conclusion

From the present research work it can be concluded that composting along with microorganisms and vermicomposting technology used for the agro-industrial waste (Bagasse) showed positive result for the growth of earthworms and cocoons at the end of the process. By following composting of these wastes along with bioinoculants and subsequent vermicomposting, will be helpful to convert these wastes into value added product i.e vermicompost, which is nutrient rich and eco-friendly. Vermitechnology is the discipline of sustainable development. Vermitechnology practice can facilitate restoration of the agricultural and agro-industrial wastes for the development, improvement and sustainable ecology, for maintenance of environmental quality and monitoring of the environment for soil fertility organic and heavy metal, non-biodegradable toxic material pollution, etc. The technology of using microorganisms in the composting process to make environment sustainable is one of the aspect. It will be helpful to convert these wastes into value added product i.e vermicompost, which is nutrient rich and eco-friendly.

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