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RESEARCH ARTICLE

STUDY OF AGRICULTURAL WASTE (PADDY STRAW) DURING VERMICOMPOSTING WITH RESPECT TO CHANGES IN NUMBER OF EARTHWORMS AND COCOONS

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ABSTRACT

The increasing rate of agricultural wastes due to the large scale of urbanization and a consequence of economic development has become a problem that produces the huge quantities of waste in India and causes a serious environmental problem which is difficult for management. For the present research work, composting of paddy straw 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 material quickly by secreting enzymes along with increase in number of earthworms and cocoons in the paddy straw vermicompost . As earthworm number increases from initial 15 to control 23 in control to 49 in final set up where as cocoons number in control was 8 to last set up were 23. As paddy straw supports more number of earthworms and cocoons when treated with various fungal strains.

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INTRODUCTION

In recent years, human activities have reached such a point of progress that the recycling capacity of nature has been exceeded, and the accumulation of waste has become a serious environmental and economic problem. The increasing rate of agricultural wastes due to the large scale of urbanization and a consequence of economic development has become a problem that produces the huge quantities of waste in India and causes a serious environmental problem which is difficult for management. According to Appelhof (1981), the appropriate disposal of waste should involve both maximum cost effective recovery of recyclable constituents and transformation of non-recoverable material into forms, which do not present environmental hazards. Each year human, livestock and crop produce approximately 38 billion metric tons of organic waste worldwide.

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Composting is defined as a method of solid waste management whereby the organic component of the solid waste stream is biologically decomposed under controlled conditions to a state in which it can be handled, stored and/or applied to the land without adversely affecting the environment (Golueke, 1977). It is an important technique for recycling organic (agricultural/industrial) wastes and for improving the quality of organic fertilizers. Composting with microorganisms is very helpful process because microbes are responsible for biochemical degradation of organic matter. While bacteria play greater role in the decomposition of animal matter, fungi play a dominant role in the decomposition of plant materials. 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. One such biological method is to eradicate the waste with the help of microorganisms such as use of fungi. If you use different types of fungi in combination it gives you better result. Most of the fungi which are helpful in degradation of organic waste material are belongs to class ascomycetes and basidomycetes.
Vermicomposting is defining as low cost technology system for treatment of organic waste (Hand *et al*; 1988b).

Vermiculture biotechnology is, therefore, an aspect of biotechnology involving the use of earthworms as versatile natural bioreactors for effective recycling of non- toxic organic wastes to the soil, resulting in soil improvement and sustainable agriculture. Earthworms feed on partially decomposed matter, consuming organic matter five times of their body weight. The earthworms species having the capability to colonize organic matter, throw away naturally, high rates of organic matter consumption, digestion and assimilation, able to tolerate a wide range of environmental stress, having high reproductive rates by producing large number of cocoons having short hatchling time, rapid growth and maturation rate of hatchlings to adults are suitable to be used in vermicomposting process (Dominguez and Edwards, 2004).

MATERIALS AND METHODS

- **Collection of agricultural waste (Paddy straw):** collected from the local supplier (Ghatkpoar), Mumbai. Paddy straw waste chopped into 2-3cm pieces 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.

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

FOR PADDY STRAW: (Each category done in triplicates)

Category 1: Control (Only paddy straw) (P)

Category 2: Paddy straw + *Pleurotus sajor-caju* (P+*P.s*)

Category 3: Paddy straw + *Pleurotus sajor-caju* +*Trichoderma harzianum* (P+*P.s*+*T.h*)

Category 4: Paddy straw+ *Pleurotus sajor-caju*+ *Trichoderma harzianum* + *Aspergillus niger* (P +*P.s*+*T.h*+*A.n*)

Category 5: Paddy straw + *Pleurotus sajor-caju* + *Trichoderma harzianum* + *Aspergillus niger*+ *Chaetomium globosum* (P+*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 (P) 21.33, P+*P.s*+*T.h* 25.66, P+*P.s*+*T.h* 31.33, P+*P.s*+*T.h*+*A.n* 31.33 and P+*P.s*+*T.h*+*A.n*+*C.g* 49.66. Number of cocoons also increased from 8.33→10.33→13.66→19→23.33.

Table 1. Changes in the number of earthworms and cocoon during vermicomposting of paddy straw

Treatment	Number of Earthworms	Number of Cocoons
control (p)	21.33±1	8.33±1.52
p+ *p.s*	25.66±2.51	10.33±1.15
p+*p.s*+*t.h*	31.33±1.52	13.66±2.08
p+*p.s*+*t.h*+*a.n*	31.33±1.52	19±2
p+*p.s*+*t.h*+*a.n*+*c.g*	49.66±4.72	23.33±3.05

Note: All values are mean and standard deviation of three replicates (M±SD).

Initial number of earthworms = 15

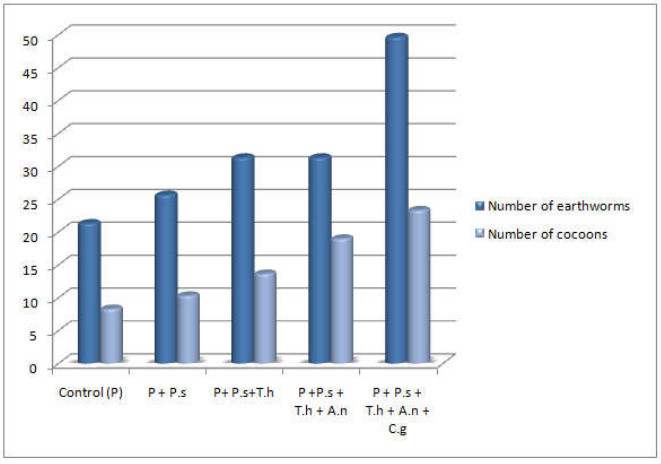
Control (P) ─ Paddy straw (without any bioinoculants)

P+ P.s ─ Paddy straw + *Pleurotus sajor-caju*

P+P.s+T.h ─ Paddy straw + *Pleurotus sajor-caju*+*Trichoderma harzianum*

P+P.s+T.h+A.n ─ Paddy straw + *Pleurotus sajor-caju*+*Trichoderma harzianum* +*Aspergillus niger*

P+P.s+T.h+A.n+C.g ─ Paddy straw + *Pleurotus sajor-caju*+ *Trichoderma harzianum*+*Aspergillus niger* + *Chaetomium globosum*



Figuree 1. Changes in the number of earthworms and cocoons during vermicomposting of paddy straw

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). 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. Reinecke and Viljoen (1991) reported less number of cocoons when they are crowded. Similar observations on effect of crowding on population growth rate have been reported in *E. eugeniae* worms (Hegde *et al.,* 1997). The worm cast is a fine, odourless and granular product. This product can serve as a biofertilizer in agriculture (Ghosh, 2004; Bezboruah and Bhargava, 2003; Sannigrahi and Chakrabortty, 2002). 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 above research it can be concluded that composting along with microorganisms and vermicomposting technology used for the agricultural waste (paddy straw) showed good result for the growth of earthworms and cocoons. Paddy straw vermicompost treated with various fungal strains in combinations showed more number of earthworms and cocoons compared to control. As microorganisms play important role in degradation of the organic waste i.e paddy straw. Due to degradation of the waste material earthworms got proper environment for the growth. Vermitechnology helpful to convert the waste into value added product that is vermicompost. This technology can be used as an ecotechnological tool to manage the problem of organic wastes such as agri-cultural waste.

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