Agro Vermi Probiotics – An Emerging Novel Approach to Integrated Solid Waste Management

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I. INTRODUCTION

CHANGE and development are essential to human progress, but in this lead, we have over exploited the nature. Demographic growth and rapid urbanization has resulted in rapid increase in the generation of huge quantity of solid waste leading to global environmental crisis (Kaviraj and Sharma, 2005). On the other hand, over the years, synthetic agro chemicals which ushered the 'green revolution' has destroyed the chemical properties and decreased the natural fertility of the soil, resulting in grave consequences to the soil, soil fauna and human health. It is high time to protect the agro soil by giving respective farm inputs to restore and improve soil fertility (Ganihar, 2003). Paper is the largest proportion of salvageable material in municipal refuse. The idea of recycling is especially attractive because it is the process of turning waste into prime products. In developed countries 20 to 40% of papers are recovered from waste paper, but in developing countries like India only less than 5% of used papers are recycled. The economic and environmental benefits of paper recycling are immense.

To create awareness on recycling concept among younger generation, a small Paper Recycle Unit TARA Paper Mek is functioning in the college campus of Seethalakshmi Ramaswami College, Tiruchirappalli. The prime step in the process of paper recycling is mixing used paper with water to break it down physically. More than 99% of the recycling pulp is water; a rich organic resource is recovered back in the subsequent steps of sheet making and this enriched water is being used in vermicompost production. Recent development at the global level is the application of detrivorous epigeic earthworms for vermicompost production from biodegradable organic materials recovered from agricultural lands, agro-based industries and municipal solid wastes (Edwards, 1995). This field study is closely associated with earthworm-microbe interaction. The quality of vermicompost depends on the microorganisms associated with the process of decomposition. The organic composition of the vermin bed influences the microflora associated with earthworm activity (Sharma *et al*., 2005). Probiotics beneficially affect the host by augmenting its intestinal microbial population beyond the level already existing (Kale, 1991). Vermicomposting is a non-thermophilic, bio-oxidative process that involves earthworms and associated microbes. Vermicompost enhances soil biodiversity by promoting the beneficial microbes which in turn enhances plant growth directly by production of plant growth-regulating hormones and enzymes and indirectly by controlling plant pathogens, thereby enhancing plant health and minimising yield loss. In the present study an attempt was made to vermicompost garden litter by making use of the recovered waste water resulting out of paper recycling process and to enrich the predigestion and composting process by supplementing the earthworms with suitable probiotics in the form of microbial consortium, using epigeic earthworm *Eudrilus eugeniae.*

II. MATERIALS AND METHODS

The mixed garden litter was collected from the campus of Vermibeds were prepared with garden litter (GL) and cow dung (CD) in the ratio 1:1 on dry weight basis in plastic troughs of 45x35x15 cms size in triplicates. *Azospirillum* sp., *Psuedomonas* sp. and *Aspergillus* sp. were isolated from the paper recycled water and identified based on the morphological and biochemical characteristics in accordance to the Bergey's

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manual, 2001. The identified microbes were mass multiplied and the cell count was characterized periodically for the preparation of microbial consortium. To compare the process of predigestion, three treatments were planned:

PD1- 1:1 (GL & CD) - Paper Recycled Water (PRW) sprinkled

PD2- 1:1 (GL & CD) - Microbial Consortium (MC) @ 10^8 cells/ml

PD3 - 1:1 (GL & CD) – Tap Water (TW) sprinkled

After pre digestion process is over, fifty numbers of healthy clitellate worms of *Eudrilus eugeniae* were introduced in each trough, in three treatments in vermicompost production.

VC1- 1:1 (GL & CD) - Paper Recycled Water (PRW) sprinkled

VC2- 1:1 (GL & CD) - Microbial Consortium (MC) @ 10^8 cells/ml

VC3 - 1:1 (GL & CD) - TapWater (TW) sprinkled

Control - 1:1 (GL & CD) (C) without earthworms

The substrate was turned once in a week. 80% of moisture was maintained by making use of paper recycled waste water, microbial consortium and tap water. The same was maintained without earthworm as control. The substrate was analysed for physico-chemical parameters such as pH, EC, Organic carbon, Nitrogen, Phosphorus, Potassium. The cocoons and young ones were counted.

III. RESULTS AND DISCUSSION

The pre-digestion period was compared in all the treatments. PD2 showed a pre-digestion period of 16 days, while PD1 completed the pre-digestion in 18 days and PD3 in 21 days. The difference in pre-digestion period of different treatments clearly revealed the influence of microbes in paper recycled water and the microbial consortium even without the earthworms. *Eudrilus eugeniae* converted the garden litter into nutrient rich vermicompost in VC1, VC2 and VC3, but a notable difference was observed in composting performance in all these treatments. The time taken to complete the composting process varied in different treatments. VC2 completed in 15 days and VC1 in 20 days. The time taken for the tap water was 28 days (Fig.1). Worm unworked, the control took 36 days for composting. The important plant nutrients present in the feed material are converted through microbial actions into forms that are much more soluble and available to plants than those in the parent substrate (Sharma *et al*, 2005) The physico-chemical analysis of worm worked and worm unworked were compared (Table.1). The nutrient status of vermicompost depends upon the type of waste materials processed by the earthworms (Uma maheswari and Vijayalakshmi,2004). The activity of earthworms along with microorganisms has brought out a rapid mineralization process and generation of nutrients for plant growth. The nutrient levels of the vermicompost were always in high order when compared to the compost.

The total number of cocoons during harvest in different treatments was counted. The maximum number of cocoons was observed in VC2 (166) and minimum in VC3 (82). Comparison of the results revealed the hatchling production was different among the treatments (VC1- 170, VC2 – 213 & VC3 – 146.). According to Ismail (1997) the reproductive potential of earthworms is highly influenced by quality and availability of food. Tripathi and Bharadwaj (2004) studied the growth rate, rate of maturation, cocoon production and hatching success of cocoons under controlled conditions and stressed the impact of environmental conditions and nutrient status of vermibeds on reproductive potential of earthworms. The present study clearly indicates that the paper recycled water and microbial consortium has favoured and quickened the reproduction of worms. Garg and Kaushik (2005) observed heavy mortality in textile sludge vermibed, but no notable mortality was observed with banana waste (Kavitha *et al*., 2012) and in this study with paper recycled water.

It could be inferred that rather than earthworms the microbes are the stimulants. The heterogenous microbial population in paper recycled water has shown a positive trend that the microbes present in this waste water enhances the vermicomposting process to some extent. But the probiotic supplement of microbial consortium had acted excellently by decreasing the composting period drastically, thereby giving a green signal to develop the technology in full scale to the farmers to take from lab to land. The results are

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encouraging because of the action of microbes used in the consortium. The active role of *Azospirillum* sp. can be justified in converting atmospheric nitrogen into soil nitrogen, while the *Psuedomonas* sp. are active phosphate solubilisers (Pradeepa *et a.*, 2011) and the role played by *Aspergillus* sp. is simply unique because the heavy cellulose load of the mixed garden litter is converted into organic carbon by the cellulolytic activity of this particular organism (Miranda et al.,2011) The present study clearly states that the combination of the microbes has influenced the process of mineralization and release of essential nutrients such as Nitrogen, Phosphorus and Organic Carbon and hence had produced good results. The study suggests that vermicompost production technology could be positively enhanced with proper probiotic treatmend to arrive at good best results.

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