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Influence of Vermicomposting on Solid Wastes Decomposition

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One of the major causes of environmental degradation is the excessive use of chemical fertilizers, irrespective of the need of the soil Marinari 2000. These fertilizers, then, leach into the soil, Kun Lia2005, Kramer 2006 etal., reducing their availability to the plants, and get washed into the nearby water bodies or seep into the water table itself, thus, contaminating both these natural resources. The leached chemicals, other than polluting the soil and ground water, cause degradation of soil fertility due to continuous use, resulting in a smaller yield. The production of these fertilizers also causes depletion of fossil fuel and production of carbon - di - oxide in addition to other harmful by products. Most of these fertilizers are non bio - degradable and on entering into the food chain directly or indirectly cause bioaccumulation and bio magnification in animals and human beings, creating long - term effects, like formation of tumors, cancers and the like. Environmentalists, the world over are trying to find ways and means to cut back and even eliminate the usage of these chemical fertilizers.On the other hand, thousands of tons of organic waste, generated from, agricultural activities, dairy farms, animal shelters, house holds (kitchens, gardens, pet waste) is dumped on roads, various corners, in nearby areas outside the cities and in land fills, where it putrefies, causing a great public nuisance and environmental degradation. Some of the dry waste is burnt, causing air pollution as well, but all this waste after proper utilization can be converted to many products Herrera etal.,2008, Zajonc and Sidor,1990, Singha etal., 2011. So, whatever we call waste may not be waste after all, waste materials are nothing but misplaced and / or still undiscovered resources. So waste is a valuable resource and one of the products into which it can be converted is superior quality manure (organic fertilizer with all the essential nutrients) which can be composted out of the so called waste products.

One of the processes which can safely convert waste into, a valuable nutrient rich humus fertilizer is vermicomposting. Vermicomposting is the process of conversion of biodegradable matter by earthworms into vermicast, during which the nutrients locked in the organic matter are partially converted into more bioavailable forms which can be easily taken up by the plants Crescent, 2003. During this conversion some hormones and enzymes from the worms gut, also get mixed with the cast and these are believed to stimulate plant growth and discourage plant pathogens. This compost is also a very good organic fertilizer and soil conditioner.Vermicomposting is a very simple, cost effective, labour effective and space effective method and can be executed even in small spaces by minimum of labour force and at a minimal cost, generating large profits in terms of environment (recycling of waste material, almost pollution free process) protection of natural resources (soil, water and energy) and money.Agricultural residues, all dry wastes, for example, all types of matter left after feeding the cattle or other farm animals, dry leaves of crops and trees, legume stalks viz. pigeon pea stalks, groundnut husk, soybean residues, vegetable wastes, weeds before they flower, fiber from coconut trees, jute fibers and sugarcane trash etc. all can be converted into vermicompost. Gajalakshmi and Abbasi 2004 Animal manures, dairy and poultry wastes, food industry wastes, municipal solid wastes, kitchen waste, biogas sludge and bagasse from sugarcane factories also serve as good raw materials for vermicomposting. Nagavallemma etal.,2004.

Earthworm varieties used for composting:

Earthworms may be of burrowing and non-burrowing types. The burrowing type of earthworms like P. elongata and P. asiatica live deep in the soil. While the non-burrowing types like E. foetida, E. eugenae etc. live in the upper layers of the soil surface. The non-burrowing earthworms eat 10% soil and 90% organic waste materials and convert the organic waste into vermicompost faster than the burrowing earthworms. They can tolerate a high range of temperature ranging from 0 to 40°C the optima for regeneration being 25 to 30°C and 40-45% moisture level. The criterion used for the selection of earthworms for vermicomposting is that they should be easy to culture, should have a high affinity for the substrate to be composted and should have a high rate of vermicast output. Surface dwellers work on the litter layer and convert all the organic waste into manure, but don't modify the structure of soil, where as, the burrowing types both consume the waste and modify the soil as well. Mitchell and Edwards, 1997, Manna etal.,1997.More than 2,500 species of earthworms, the world over, have been identified as vermicompost producing agents, of which more than five hundred have been identified in India. Diversity of earthworm species depends on the soil type. So, wherever possible, local endemic species should be preferred over the exotic ones. Choosing such species are economically as well as environmentally important and feasible. Local species of earthworms generally used in India are Perionyx excavatus and Lampito mauritii. Eisenia foetida, Eudrilus eugenae, Peltophorum sp and Parthenium sp.

Types of vermicomposting:

Vermicomposting can be performed both, on large, as well as, small scales depending upon the amount of waste to be composted or on the basis of composting structures, which again depend on the volume of waste. Vermicomposting on the small scale is usually done to meet the personal requirements of the farmer and the amount produced can be anywhere between 5 - 10 tonnes on an annual basis. On the other hand the large scale vermicomposting is more or less commercial and is done by recycling a large amount of waste with an annual production of 50 - 100 tonnes.

Methods of vermicomposting:

Vermicomposting can be performed by various methods, like the pit method, heaping above the ground or the bed method, above ground tank method, cement ring method and the commercial methods. It can also be done in wooden or plastic crates according to the situation. The most popular, high yielding, cost effective, and labour effective method is the above ground bed method, where the organic matter is heaped above the ground in specially prepared beds.

In this method composting is done on the floor (kuccha / pucca) by making a bed of organic mixture. Here first a cool, moist and shady site is located for the purpose. Cow dung, dry chopped leaves and other organic material are then mixed in a definite proportion and the mixture is, then kept for partial decomposition for 15 to 20 days. Beds of this partially decomposed material are made according to the amount, availability and requirement of the raw material. The earthworms are then released in the upper layer of the bed. This step is immediately followed by sprinkling of water. According to some, the most suitable period for releasing the earthworms into organic residues is between 15 and 20 days after heaping of the organic residues when the temperature is about 25°C. The beds are kept moist by daily watering and covering with gunny bags or polythene. The beds are turned every 30 days or so for proper aeration and decomposition. The compost is finally ready in 45 to 50 days.The process of composting is over when the material to be composted becomes moderately loose and crumbly in nature and its colour becomes dark brown. It is also indicated by the presence of earthworm castings (vermicompost) on the top of the bed. The smell of the compost is should be earth-like. Any bad odour is a sign that fermentation has not reached its final goal and that the bacterial processes are still going on. A musty smell indicates the presence of mold or overheating which leads to loss of nitrogen. If this happens, aerate the heap better or start again, adding more fibrous material and keeping the heap drier.

Harvesting of vermicompost:

Once the compost is ready to use, it is harvested from the beds or the bin or whatever the case may be. It is actually the separation of the earthworms from the compost. To facilitate this separation, many methods and /or their combinations are used.The compost can be made some what drier, by not watering it for two or three days before harvesting, so as to force most of the earthworms towards the bottom of the bed.The worms can also be sieved out by using sieves/meshes. The earthworms and the thicker material, which remains in the sieve, can be reused for the process.

Importance of vermicompost:

The vermicompost produced by the earth worms is actually a boon to both the world and mankind it is actually 'black gold', which provides the soil whatever it needs and to the producer or farmer it means a win - win situation all the way. The vermicompost thus obtained is a pollution free, cost-effective and highly potent fertilizer which also provides the soil with the following: **Higher level of plant nutrients:** Vermicompost is higher in nitrates, the more plant-available form of nitrogen. The supply rate of several nutrients, including P, K, S and Mg, were increased by vermicomposting as compared with conventional composting. The process of vermicomposting increases levels of plant-availability of most nutrients. Arancon etal.,2006, Dobbss,etal., 2010.Stimulation of Plant growth:vermicompost stimulates further plant growth even when the plants are already receiving optimal nutrition. vermicomposted organic wastes have beneficial effects on plant growth independent of nutritional transformations and availability. Vermicompost improves seed germination, enhanced seedling growth and development, and increased plant productivity. Karmegam and Daniel 2000. Warman and AngLopez 2010, Jindo etal., 1012

Disease suppression and microbial activity: Vermicompost is many times as microbially active as conventional compost and is much better at transforming nutrients into forms readily taken up by plants Kalra etal., 2010. Vermicompost protects plants against various diseases due to the high levels of beneficial microorganisms present in it. These protect plants by out-competing pathogens for available resources and also block their access to plant roots by occupying all the available sites. Singh etal., 2012 Fritz etal., 2012.Pest repulsion: The repulsion of hard bodied pests and significant decrease in arthropod (aphid, mealy bug, spider mite) populations, and those of plant-parasitic nematodes is seen in areas treated with vermicompost, leading to subsequent reductions in plant damage. Cochran 2014.

In today's era of high volume waste production, ecological degradation and unemployment of youth, vermicomposting not only resolves the severe problem of biodegradable waste, but also, at the same time provides a small check to environmental degradation, in terms of none or lower usage and production of pesticides, nematicides and most importantly organic fertilizers. Along with that it also provides a check in the consumption of fossil fuel which is necessarily used in the production of the same. Consequently it also checks air and water pollution. That is not all; it is also an excellent farm manure providing many fold benefits to the soil and plants which are provided this compost. It can also provide a means of lively hood to the rural youth bringing in huge profits with lesser means.

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