

Importance of Vermicomposting in Modern Agriculture

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ARTICLE ID 35

Introduction

Vermicomposting is described as "biooxidation and stabilization of organic material involving the joint action of earthworms and mesophilic micro-organisms". Under appropriate conditions, worms eat agricultural waste and reduce the volume by 40 to 60%. Vermicompost produced by the activity of earthworms is rich in macro and micronutrients, vitamins, growth hormones, enzymes such as proteases, amylases, lipase, cellulase and chitinase and immobilized micro flora. The enzymes continue to disintegrate organic matter even after they have been ejected from the worms. Reduced use of water for irrigation, reduced pest attack, reduced termite attack, reduced weed growth; faster rate of seed germination and rapid seedlings growth and development; greater numbers of fruits per plant (in vegetable crops) and greater numbers of seeds per year (in cereal crops) are only some of the beneficial effects of the vermicompost usage in agricultural production. Earthworms and vermicompost can boost horticultural production without agrochemicals. In spite of the benefits associated with vermicompost, its use is not widespread yet. The beneficial effects in using vermicompost based substrates in agriculture it accelerates growth; increases crop yields; creates a favorable environment for beneficial micro-organisms; permanently improves soil structure; increases plant secretion; in case of plants with longer growing season, additional fertilization with bio humus or its lection is sufficient, provision of mineral fertilizers is not necessary in this case; 100% natural, ideal for use in organic farming and in artificial environments.

What is vermicomposting ?

Vermicomposting or worm composting is a process that uses earthworms in order to decompose organic matter. During this process, the worms cocoon organic material into something called castings or vermicast. The end product is very rich in nutrients and contains

more than double the nutritional value of ordinary soil. The key to safe and efficient home-based composting is using a good container. Inexpensive bins can be as simple as hay bales or wooden pallets, but sometimes the best available material is actually an old portable plastic playpen. Thus comes the many different composting methods that exist now. They all come with their own advantages and disadvantages. Thus we have the best guide on learning how to make our own compost bins and getting compost from them. The result of this method can be used as fertilizer for plants and vegetables at home or on farming sites that complement conventional methods very well. There are many benefits to using vermicompost over traditional fertilizer and other methods.

Composition and quality of vermicompost

The agro-industrial wastes are huge source of plant nutrients and their disposal means the ultimate loss of the resourceful material. Vermicompost is a peat like material containing most nutrients in plant available forms such as nitrates, phosphates, calcium, potassium, magnesium etc. It has high porosity, water holding capacity and high surface area that provides abundant sites for microbial activity and for the retention of nutrients. The plant growth regulators and other plant growth influencing materials i.e. auxins, cytokinins and humic substances etc. produced by the microbes have been found in vermicomposts. Vermicomposting technology is a suitable tool for efficient conversion of agro-industrial processing wastes, which serves as a rich source of plant nutrients. These waste materials are packed with a tremendous source of energy, protein and nutrients, which would otherwise be lost if they are disposed as such in the open dumps and landfills. Moreover, with the use of vermicompost as organic amendments in the agriculture, recycling of the nutrients back to the soil takes place, in turn, maintaining the sustainability of the ecosystem.

Table1. Potential agro-industrial processing wastes

Agricultural wastes: Rice husk, cereal residues, wheat bran, millet straw etc.
Food processing waste: Canning industry waste, breweries waste, dairy industry waste, sugar industry waste press mud and trash, wine industry waste, oil industry waste-non edible oil seed cake, coffee pulp, cotton waste etc.
Wood processing waste: Wood chips, wood shavings, saw dust
Other industrial wastes: Fermentation waste, paper and cellulosic waste, vegetal tannery waste

Local organic products: Coco fiber dust, tea wastes, rice hulls etc.

Fruits and vegetable processing waste

Benefits of vermicompost: Red worm castings contain a high percentage of humus. Humus helps soil particles form into clusters, which create channels for the passage of air and improve its capacity to hold water.

- Humus is believed to aid in the prevention of harmful plant pathogens, fungi, nematodes and bacteria.
- A worm casting (also known as worm cast or vermicast) is a biologically active mound containing thousands of bacteria, enzymes, and residues of plant materials that were not digested by the worms. Castings contain nutrients that are readily available to plants.
- The activity of the worm gut is like a miniature composting tube that mixes conditions and inoculates the residues.
- Worm castings are the best imaginable potting soil for greenhouses or houseplants, as well as gardening and farming.

Plant Growth Regulating Activity: Some studies speculated that the growth responses of plants from vermicompost appeared more like "hormone induced activity" associated with the high levels of nutrients, humic acids and humates in vermicompost.

Ability to Develop Biological Resistance in Plants: Vermicompost contains some antibiotics and actinomycetes that help in increasing the "power of biological resistance" among the crop plants against pest and diseases. Spray of chemical pesticides was significantly reduced by over 75% where earthworms and vermicompost were used in agriculture.

Ability to Minimize Pests Attack: There seems to be strong evidence that worm castings sometimes repel hard-bodied pests.

Ability to Suppress Plant Disease: Studies reported that vermicompost application suppressed 20%–40% infection of insect pests i.e. aphids (*Myzus persicae*), mealy bugs (*Pseudococcus* spp.) and cabbage white caterpillars (*Pieris brassicae*) on pepper (*Capiscum annum*), cabbage (*Brassica oleracea*) and tomato (*Lycopersicum esculentum*).

Vermimeal Production: With the increasing demand for animal feed protein bolstered by the continuing growth of human population and food source, the production of vermimeal be considered as the most economically feasible application of vermiculture.

Effect of vermicompost on agricultural crop performance

- **Yield:** Studies on the production of important vegetable crops like tomato (*Lycopersicon esculentum*), eggplant (*Solanum melongena*) have yielded very good results. Similarly the overall productivity of potato was significantly higher on vermicompost applied about 6 tons/ha as compared to control. Vermicast produced higher garden pea green pod plants, higher green grain weight per plant, and higher green pod yield as compared to chemical fertilizer. The use of vermicompost as a source of organic manure in supplementing chemical fertilizer is becoming popular among the farmers of the country. Vermicompost increase the crop yield probably because of higher nutrient uptake.
- **Growth:** Worms and vermicompost promoted excellent growth in the vegetable crop with more flowers and fruits development. Vermicompost can have dramatic effects upon the germination, growth, flowering, fruiting and yields of crops. Vermicompost stimulated growth of tomato transplants, with up to a 2.2-fold increase occurring in shoot biomass. Differences in growth were attributed mainly to differences in nutrient content of the potting mixtures, but some changes in physical and biological properties of the substrate could also be responsible. Application of vermicompost increased seed germination, stem height, number of leaves, leaf area, leaf dry weight, root length, root number, total yield, number of fruits/plant.
- **Nutrient content:** Vermicast produced higher percentage of protein content and carbohydrates in garden pea as compared to chemical fertilizer. Application of vermicompost increased chlorophyll content, pH of juice, total soluble solids of juice, micro and macronutrients, carbohydrate (%) and protein (%) content and improved the quality of the fruits and seeds. Studies suggested that treatments of humic acids, plant growth promoting bacteria and vermicomposts could be used for a sustainable agriculture discouraging the use of chemical fertilizers.
- **Plant protection:** The most significant observation was drastically less incidence of diseases in worm and vermicompost applied plant. Accordingly, vermicompost also

protects plants against various pests and diseases either by suppressing or repelling them or by inducing biological resistance in plants. The healthier and more vigorous the plants are with the microbiology in their root zone, the more the plants are able to thwart attacks from destructive crop pathogens and insect pests," he elaborates Recent Ohio State University studies also concluded that crops fed with vermicompost are also more resistant to blight, bacterial wilt, parasitic nematode attacks and powdery mildew than those on synthetic fertilizers.

- **Human health:** Organically grown fruits and vegetables especially on 'earthworms and vermicompost' have been found to be highly nutritious, rich in 'proteins, minerals and vitamins' and 'antioxidants' than their chemically grown counterparts and can be highly beneficial for human health. They have elevated antioxidants levels in about 85% of the cases studied. They have been found to be protective against several forms of 'cancers' and against 'cardiovascular diseases'.

Conclusions

Vermicompost produced by the activity of earthworms is rich in macro and micronutrients, vitamins, growth hormones, enzymes such as proteases, amylases, lipase, cellulose and chitinase and immobilized microflora. Vermicompost is optimal organic manure for better growth and yield of many plants. It can increase the production of crops and prevent them from harmful pests without polluting the environment. Application of vermicompost increased growth, improved plants nutrient content, and improved the quality of the fruits and seeds.