The Potential Use of Vermicompost in Orchards

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Abstract

Vermiculture is a biological method for processing organic waste using earthworms. It is based on the capacity of earthworms to use as feed organic waste from various sources such as crop residues remaining after deforestation, vegetable debris from greenhouses, but also from the field, the waste left after cleaning the gardens and parks, damaged fruits and vegetables. All of them are converted into organic fertilizer with a high content of macro-elements, micro-elements and humus. Farmers of the world must move towards more productive and sustainable systems to enhance the need of food for a growing population and to meet the climate change, said Food and Agriculture Organization of the United Nations (FAO). Other authors stipulates that conventional industrialized agriculture affects the appearance of soil, water, land, biodiversity and the services provided by an intact ecosystem. One way of solving this problem is Vermiculture, which transforms very well organic waste into humus and humus liquid extract. In the process of obtaining vermicompost, the most suitable earthworm species are those with a fast rate of breeding and development and not very demanding regarding the nutritional conditions. From what is known until now, the most suitable species *Eisenia foetida* (striped worm manure) and *Lumbricus rubellus*.

Keywords: *vermicompost, organic fertilizer, vegetal waste, orchard.*

Carl Linnaeus (1707-1773), in his work "Natural system" (1758), included for the first time a kind of worm named, *Lombricus terrestris*. After that, in 1826 Savigny described some species of lumbricide. Later, taxonomists like Holfmeister (1845) and Righi (1979) have studied and write books about earthworms. The term „vermiculture" has its origins in 1936 (Taylor, 1948) in Los Angeles, USA with Dr. Thomas Barrett. (Rodríguez, 2000)

The importance of earthworms in decomposition of organic matter and release of nutrients has been known for a long time (Darwin 1881). This was clearly demonstrated by the fact that certain species of earthworms are specialized to live in decaying organic matter and transform this matter to the stage of fine particles rich in nutrients with significant market potential (Edwards şi Bohlen 1996) cited by (Edwards *et al.*, 2006). For example, earthworms are able to process sewage sludge from wastewater and solid waste from the paper industry, waste from supermarkets and restaurants, animal waste from poultry, pigs, cattle, sheep, goats, horses, and rabbits and horticultural residues of plants, household waste and waste from mushroom industry. (Edwards & Neuhauser, 1988) cited by (Edwards *et al*., 2006).

Earthworms are considered a good "biological indicator" of soil fertility being a "soil improver". This leads to better physical (porosity and soil loosening), chemical (pH optimum and essential plant nutrients) and biological (microorganisms) soil quality and land on which they live. Only 5-10 percent of soil chemical compounds are absorbed into the body by ingestion, and the remainder is excreted as mucus coated granular aggregates called vermicompost, which is rich in NKP (nitrates, phosphates and potassium), micronutrients, beneficial soil microorganisms (Scheu 1987) cited by (Sinha *et al.*, 2010)

Vermicompost can be produced by all farmers in their farms, while chemical fertilizers are produced in factories with very high economic and environmental costs (Hussaini, 2013).

Researches regarding the vermicompost and its process and also related economic studies about the use of this matter started in countries like England, France, the Netherlands, Germany, Italy, Spain, Poland, United States, Cuba, Mexico, Bahamas, China, Japan, Philippines, India and other parts of Southeast Asia, including Australia, New Zealand, America Samoa, and Hawaii, and in many countries in South America (Edwards *et al.*, 2006).

The benefits that plants receive from vermicompost depend on the plant ability to extract from the fertilizing substrate the substances needed for the growth and development (Bohlen et al., 1995). Plant reaction to fertilizers is directly proportional to the quality of fertilisers used in substrate of culture and therefore the utilization of vermicompost in horticulture is highly recommended.

The earthworm activity in the soil leads to restoration of N and P quantities; the earthworms are eating organic waste collected from livestock and vegetable farms and produce a well decomposed organic matter accessible to plants (Dominguez, 2004). The vermicompost is basically composed of C, H and O and contains nutrients such as NO3, PO4, Ca, K, Mg, S, nutrients on plants that have the same effect as in the case of the inorganic fertilizers administration Singh (2008) cited by (Theunissen *et al.*, 2010).

Vermicompost contains high percentages of humic substances (humic acids, fulvic acids) that contribute to numerous chemical reactions. Also this matter is full of microbial components that enhance plant growth and disease suppression by bacterial activity (Bacillus), the yeasts (Sporobolomyces and Cryptococcus), and the fungus (Trichoderma), and chemical antagonists such as phenols and amino acids (Nagavallemma, *et al.*, 2004).

Micronutrients and macronutrients that vermicompost contains and the presence of accessible mineral forms recommend it as a crop fertilizer, and several authors (Chanyasak *et al.*, 1983; Riffaldi *et al.*, 1986; (Atiyeh *et al.*, 2000); Contreras-Ramos *et al.*, 2005; Ali *et al.*, 2007) suggests preparation of physico-chemical tests to determine its effectiveness (Warman *et al.*, 2010).

Vermicompost can be used in any culture and in any quantity, but purely economic reasons through research was tried to optimize the quantity of vermicompost applied to different cultures (Crida 2009) cited by (Sinha *et al.*, 2010).

Growth hormones (cytosine, auxin and gibberellin) of compost needed for plant growth are soluble in water and have a very high rate of degradation when subjected to sunlight. If they are absorbed by humic acids, they become much more stable and hormones will persist much longer in the soil and will continue to contribute to the development of the plant (Arancon et al., 2003). Some studies have speculated that the growth responses of plants are induced by hormonal activities associated with a high level of nutrients and humic acids from the vermicompost (Atiyeh, *et al*., 2000).

Vermicompost greatly improves seed germination, seedling growth and increased productivity well above by simply converting soil minerals to easy accessible substances for the crops. There are studies that reported high contents of vermicompost on growth hormones such as auxins, cytokinins and gibberellins (Grappelli and Galli 1995) cited by (Sinha *et al.*, 2010)

From worm castings one can obtain worm tea. This derivate is used mainly for spraying plants, but recently was introduced in fertirigation circuit systems due to the high concentration of nutrients (Jarecki *et al.*, 2005). Regardless the high content of nutrients, the liquid is remarcable by the presence in its composition of humic acids with an important role in the plant growth. The humic acids are also helping to a good absorption of micro and macroelements (Ordoñez *et al.*, 2006)

Based on many years of observations, it was found that vermicompost and worm tea obtained from the vermicompost produced by *Eisenia foetida* contains enzymes known as various forms of chitinase. Chitinase is a great insect repellent. Chitinase break down chitin; chitin is a organic substance that is present in the cell wals of fungi and in the exoskeleton of insects (Subha *et al.*, 2010). The organisms that produce this enzyme are present in vermicompost and consist of four bacteria, four fungi and five actinomycetes (Yasir *et al.*, 2009). This compost contains triggers that activate proliferation of this kind of organisms that produce chitinase. Chitinase producing microorganisms are extracted by plants roots and

are transported through the vascular tissues. In this manner, one can find in the plant chitinase enzyme produced by bacteria that were dormant, other than those already in vermicompost. Chitin is distributed than in plant tissues and has the effect of destroying the exoskeleton of insects by ingestion of the plant (Yasir *et al*., 2009).

Worms tea can be applied on leafs or roots by sprinkler or irrigation method, diluted or not. Dilution does not affect the qualities of the extract in the preparation. Thereof the „worm tea" can be diluted up to 1:10. The extract is not toxic, does not burn the plants, no restrictions on use, can be used in any culture in greenhouses or in the field especially on organic cultures. Another positive aspect of the worm tea dilute is the fact that does not provide living conditions for *Escherichia coli* (Gutierrez-Miceli *et al.*, 2008)

CONCLUSIONS

Using vermicompost in horticulture is a robust perspective that could be useful for the efficacy of organic fertilizers that attempt to achieve an increased production. Moreover, according to the nowadays trend of consuming organic and ecological produced fruits, the use of chemical fertilizers are more and more questioned by the consumers and health practitioners. In this light, we considered that the subject is one of interest and more research is needed, especially regarding the effect of the vermicompost when used as a fertilizer or pesticide on the fruit trees.

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