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Environmental Precision: Importance of Worm Manure in Sustainable Agriculture

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ABSRACT

Agricultural production is one of the main factors that have significant on environment. Sustainable agricultural systems combine traditional methods and modern techniques to provide a continuous and economic production by considering natural resources and all the environment components. Using of pesticides and chemical fertilizers in agriculture are main pollutant factors to environment due to negative effects on human health, environment security, soil quality and increased pathogen resistance. Soil fauna includes worm, protozoa, nematode etc. animals. Many of worm species fed by residues such as crops, animal wastes, sewage sludge, industrial refuse etc. mediums while *Eisenia fetida* (Savigny) is mostly live in organic wastes and known as an accelerator for waste stabilization by decomposition, mineralization, nitrogen transformations and includes various enzyme, vitamins, amino acids, growing regulators which lead to better medium for plant growing as vermiculture. Besides an increasing tendency for using of worm manure and its developing industry, their lifecycle and activities are studied extensively over world while less studied in Turkey especially about importance in sustainable agricultural systems. Present paper reviews using of worm manure to provide sustainable environment systems that is an issue for human health by functional food production and application of environmental friend production systems.

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Introduction

Historical development of agriculture is closely related with manipulation of plants and ecosystems for the purpose of increase in quality and yield of crops. Selection of superior seed, hybridization and developing of cultural practices for instance tillage, sowing systems, rotation, irrigation, fertilization, disease-insect and weed control, mulching, harvest, industrialization, storage and transportation completely contributed to increase in agricultural production, significantly (Allison and Hobbs, 2007). All the mentioned applications caused to change in ecosystem, environment and human health, fundamentally.

Intensive agricultural production systems caused to an increase in usage of chemical fertilizers and pesticides that is dangerous to environment in long term. Chemical polluted soils negatively affect to human and environment health, seriously. Consequently, human and environment health care based agricultural production systems are developed besides supporting of sustainable systems. Using of organic manure is one of the key issues for that purpose by developing of soil quality and higher yield from unit area by less cost (Eryüksel, 2016).

There is a big demand for production of organic vermicompost worm manure in Turkey and it is increasing day by day due to government supports. Production of *Eisenia fetida* such as microorganisms, enzymes, plant nutrition elements, liquids etc. main substances which support to enrichment of organic matter, balance of pH and soil biological structure, improvement of physical composition which are providing to healthy and fast development of plants, higher yield and quality products and finally sustainability of human health and ecology.

As an essential component in agricultural production systems, manure or fertilization is effective on improvement of yield and quality. Soil fertility is related with biological, chemical and physical factors which are wholly effective on biological environment. Therefore, knowledge about soil system is quite important to providing of sustainable agricultural systems. From this perspective, worm manure is an important component which acts on sustainability. Present paper summarizes sustainable agricultural systems and importance of worm manure in the basis of susceptibility to the environment.

Sustainable Agriculture

Sustainability or sustainable development is described by Bryndtland (WCED, 1987) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" that is a widely accepted concept. Furthermore, food and fiber- the primary need of human is met adequately by protection of balance, environment, quality and natural resources. Furthermore, development of sustainable agriculture can be realized by take care on efficiently usage of non-renewable resources and also natural biological cycles and controls, as well. In that point, conservation of soil and sustainability of its quality is relatively closed to support of sustainable agricultural systems that is also under the effects of cultural practices, tillage, using of pesticides besides climatic conditions and nature of the land surface (Wilson, 1997; Kahraman, 2017).

Soil and Fertilization

Soil is one of the most important resources which supports the life and basically acts on biodiversity, food supplies, filtering of water and global climate as well (Hayhoe, 2013). As it reported in many studies, organic matter in the soil is essential for health of soil and its productivity in addition to toxicity of some elements that are affecting accumulation of dry matter and seed yield while fertilization have significant effects on mineral status of the soil, health of plant and quality of the products (Krzebietke and Sienkiewicz, 2010; Palta and Karadavut, 2011; McPhee et al., 2012; Jankowski et al., 2014). Fertilization by nitrogen is intensively applied over the world to increase in productivity which is addressing to concern about environment. There are various alternatives of chemical fertilizers and pesticides like bioprotectors and biofertilizers to support of ecosystems (Erdinç et al., 2017). Thus, there is an increasing demand for environment friend techniques and sustainability. Term of "soil quality" describes soil capacity to support crop growth by a safe and healthy manner besides harmless to the resource base or environment which means that a medium to crop cultivation, water reservoir, filtration buffer, neutralization and transformation of pollutants in addition to be a habitat for plants and animals that is quite important for protection of genetic biological diversity. All those characteristics are closely related with environment (Wilson, 1997).

Worms and Vermicompost

Earthworms eat the vegetable matters, soil, domestic wastes inside of rich humus and similar matters than extract little pellets which are part of thin ground soil (called as casts) that are rich by nitrogen, phosphorus and potassium. Additionally, they turn the soil which provides air for microorganisms and plant roots. Therefore, earthworms are used for producing of vermicompost (Edwards, 1988; Savala et al., 2003; Chand, 2014) in addition to act as an essential role in protection of soil aggregation and porosity, decomposition of organic matter and cycling of nutrients (Kladivko, 2001; Simonsen et al., 2010). It was revealed that decrease in earth-worm population and biomass is welded by tillage was higher in fine-textured soils than sandy soils (Joschko et al., 2009) similar with the previous reports which emphasized that conservation tillage applications caused to support higher density of earthworms

(Reeleder et al., 2006), soil fungi (Caesar et al., 2010), phytopathogens (Pankhurst et al., 1995) and microarthropods (Miyazawa et al., 2002).

All the species of worms (*Annalide*) able to transforming of organic materials and soil to thin materials by passing intestines and fast fragmentation (Ndegwa and Thompson, 2001). But, vermicompost is obtained by various organic wastes that are mixed as optimum ratios and the worms which are used for that purpose are used in the optimum humidity level (Elvira et al., 1998). Commonly seen worm species that are used for vermicompost activities, aerobic compost or cattle manure are; *Eisenia fetida, Eisenia andrei, Dendrobaena veneta, Lumbricus rubellus, Perionyx excavatus, Eudrilus eugeniae, Fletcherodrilus* spp., *Heteroporodrilus* spp. and *Pheretima excavatus* while the first five of the species present the best results in the organic waste based vermicompost studies (Edwards and Bohlen, 1996; Manna et al., 1997). Furthermore, the most preferred and cultivated species is *Eisenia* spp. over the world due to fast food consumption, highly reproductive and population increasing ratio, high adaptation, able to be a natural colony on most of the organic wastes, tolerant to temperature, able to live in organic wastes which have high moisture (Edwards and Bohlen, 1996). Organic wastes of soil worms rapidly transform to a high qualified product and caused to a new agricultural production sector- called as "vermiculture" that is common in European Countries, India and United States which describes that cultivation of soil worms for various purposes (Şimşek Erşahin, 2007).

Increasing of human population led to growing concern to enhanced agricultural production that is including yield characteristics, quality components of the products and medical usage of plants that are subjected to many scientific researches on behalf of agronomy, biochemistry, breeding, ecology, economy, physiology etc. studies over the world (Onder and Babaoglu, 2001; Peksen, 2005; Ceyhan et al., 2007; Prasad and Nirupa, 2007; Bozoglu et al., 2008). Therefore, using of chemical fertilizers showed an intensive increasing and induced to deterioration the physical structure of soil, losing of organic matter and vitality, aridity, corruption of balance in soil minerals (Küçükyumuk et al., 2014). Vermicompost which is also called as worm manure is obtained from using both of worm manure and organic materials (Garg et al., 2010). Target of vermicompost is reach to the highest yield of worms which realize the transformation of macro and micro nutrients in the nature (Şimşek Erşahin, 2007). A total of 97% plant nutritional elements in the vermicompost-especially for N, P and K are in the directly receivable form in plants during growing period (Barley, 1961).

Intensive applications on soils cause to decrease in organic matter and give rise to using of more nitrogen based fertilizers. Developed countries such as United States, India and Canada use to soil worms to increase in organic matter and prevention of chemical pollution. North California Worm also called as Red Soil Worm (*Eisenia fetida* and *Lumbricus rubellis*) are the commonly used types (Bellitürk and Görres, 2012). Additionally, worms are able to collection of toxic metals of soil (bioaccumulation) and decrease to toxic metal level o the medium (Hartenstein, 1978).

Vermicompost has significant effects on the quality and yield of the crops that was reported 39% on developing of cereals, 35% of harvest yield, 12% of nitrogen in the seeds. Furthermore, similar considerable results were obtained from the researches on greenhouse and laboratories on; meadow, wheat and trefoil besides supporting of root development and reduced root diseases (Mısırlıoğlu, 2011), more resistance to diseases and insects due to antibacterial and antifungal effects and secretion of worm called as "sölom" that is kind of a liquid (Wang et al., 2006). Prices of vermicompost are variable in United States. Low qualified and bulk (non-packed) sold by \$35 ton^{-1} while the price may changed up to \$300 ton^{-1} depending on quality. High qualified vermicompost that is accredited and packed types may be sold \$600-1000 ton^{-1} values that are welded by the higher cost for package (Edwards, 2011).

Liquid Fertilizers Including Worms

A type of worm including commercial fertilizer is known as organic liquid fertilizer including biohumus and improved by nanotechnology in addition to containing plant growing and developing minerals, agronomical useful biological flora, amino acids, enzymes, humic substances, and natural antibiotics. These fertilizers provide sustainability on agricultural production by take care about natural balance. Primary benefits of these fertilizers may be summarized as following. Universality; feasible for using on all plants besides climatic and geographical zones, production environments such as indoor, field and greenhouse. Safety of environment; safe for all living organisms, ecofriendly. Increase in quality (fiber, sugar content, vitamin) and yield; Both effect on leaf and root, optimizing of photosynthesis and regeneration, enhanced accumulation and growing besides storage time. Plant health; enhanced resistance to stress factors, pesticide and disease. Improving of soil; optimizing of soil fertility. Simple application; suitable to use the present equipments and easy application (Anonymous, 2017). There are several types of worm based fertilizer materials in commercial sense. Many of them are used in an increasing scale over the world by more attention about the term of "sustainability" in using of natural resources.

Conclusions

Increasing of nutritional elements and physical characteristics in the soils, growing of healthy plants

besides higher quality and yield are essential factors to supporting of sustainable agricultural systems which will be concluded by production of sustainable functional food production, human health, welfare and getting better environment. As it mentioned above, worm manure acts as an essential factor to achieve the multiple benefits. For this purpose, some proposals are listed in the below:

-All the people have effects on soil; therefore human being should pay attention about their activities that may have direct or indirect effects on it,

-Effective methods about efficiency of fertilizer should be developed by pay more attention to environment in addition to conscious using of fertilizers,

-Crop rotation and reasonable plant cultivation to environment and presence of resources can be mapped,

-Farmers should be noticed that; fertilizing of crops have almost 50% effect on yield while chemical fertilizers are not the only one issue to increasing of organic matter,

-Burning stubble should be restricted by serious penalty to prevention of soil massacre,

-Government and political efforts need to be improved on the basis of agricultural sustainability.

Increasing of attention for sustainable agricultural production systems has been a growing demand for the people over the world. Worm manure is one of the most important components for this purpose. Therefore, there is need to increasing of worm manure applications by using the facilities as possible.

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