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Derleme Makalesi / Review Article

Vermicompost Applications in Soils

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Abstract

Vermicompost is a rich, nutritious fertilizer produced by the digestion and decomposition of organic waste by earthworms. In this process, the worms break down organic materials to produce a humus-like substance. Vermicompost contains high levels of plant nutrients, enzymes, microorganisms and growth regulators. These components make vermicompost an effective natural fertilizer that increases soil fertility and improves plant health. Vermicomposting also provides significant benefits in terms of environmental sustainability. The breakdown of organic waste by worms facilitates waste management and reduces the burden on landfills. In addition, vermicomposting reduces the use of chemical fertilizers and prevents environmentally harmful chemicals from entering the soil and water resources. Vermicompost has great potential for sustainable agriculture and soil health. However, it needs to be used in an effective and balanced manner. This study comprehensively addressed the benefits and potential harms of vermicompost on soil health and agricultural productivity. Future research and applications will contribute to a more effective and sustainable use of vermicompost.

Keywords: Vermicompost, soil, sustainable, agriculture, organic

1. Introduction

Vermicompost is a rich humus-like fertilizer obtained because of the breakdown of organic matter passing through the digestive systems of earthworms. This fertilizer is formed by the decomposition of organic materials under the influence of microbial activity and enzymes during the digestive processes of worms (Ucar and Erman, 2020). Vermicompost is a high-quality organic fertilizer that contains essential nutrients needed by plants, improves soil structure and supports microorganism activity (Edwards and Bohlen, 1996).

Vermicompost contains macro and micronutrients essential for the growth and development of plants (Table 1). These nutrients originate from the organic waste that the worms digest. Vermicompost is a nutrient-rich organic fertilizer produced through the decomposition of organic matter by earthworms. It contains essential macro and micronutrients that are vital for the growth and development of plants (Edwards and Arancon, 2004). Macro nutrients, such as nitrogen, phosphorus, and potassium, are needed in larger quantities and play crucial roles in processes like root development, leaf health, and overall plant vitality. On the other hand, micronutrients, including iron, zinc, and copper, are required in smaller amounts but are equally important for various physiological functions. By providing these nutrients, vermicompost enhances plant health, promotes stronger growth, and improves yield, making it an excellent choice for sustainable gardening and agriculture (Table 1).

Table 1. Nutrient functions in plant growth and development

Nutrient Substance	**Function**
Nitrogen (N)	Plant growth and protein synthesis
Phosphorus (P)	Root development, flowering and fruit formation
Potassium (K)	Disease resistance, water balance and enzyme activity
Calcium (Ca)	Cell wall formation
Magnesium (Mg)	Chlorophyll production and enzyme activity
Other Trace Elements	Various plant functions

Vermicompost contains high levels of organic matter as well as micro and macro nutrients. This organic matter increases the water holding capacity of the soil, improves soil structure and reduces erosion. Organic matter also promotes microorganism activity in the soil and makes nutrients more easily taken up by plants (Domínguez and Edwards, 2011).

Vermicompost is rich in beneficial microorganisms and enzymes. These microorganisms promote nutrient cycling and enrich soil biology by accelerating the decomposition of organic matter. Enzymes, in turn, help to release nutrients needed by plants (Lazcano and Domínguez, 2011).

Vermicompost contains organic acids such as humic and fulvic acids. These acids regulate soil pH balance, increase the solubility of nutrients and allow plant roots to take up nutrients more efficiently (Sinha et al., 2002). Vermicompost contains natural growth regulators (hormones) that promote plant growth. These regulators increase root development, improve germination rate and promote overall plant health (Gajalakshmi and Abbasi, 2004).

The production of vermicompost takes place through the digestion and breakdown of various organic wastes by worms. This process includes the following steps. Organic wastes for vermicompost production are collected from various sources such as vegetable and fruit residues, coffee grounds, eggshells, tea leaves, leaf debris and garden waste (Yadav and Garg, 2011). The organic waste is broken into small pieces and pre-treated to make it easier for earthworms to digest. This process makes the waste more suitable for earthworms (Lazcano et al., 2013). Organic waste is placed in beds where earthworms live. In these beds, earthworms digest the waste and produce a nutrient-rich fertilizer. The most used earthworm species include Eisenia fetida (red California worm) and Lumbricus rubellus (Sinha et al., 2010). Vermicompost matures over a period. At the end of this process, the manure is separated from the beds and harvested. At this stage, the worms and vermicompost are separated and the resulting manure is dried and made ready for use (Ansari and Sukhraj, 2010).

Vermicompost is used in various agricultural and horticultural applications. Vermicompost stimulates the growth and increases the productivity of field crops. The use of vermicompost in vegetable and fruit gardens increases product quality and quantity. Vermicompost promotes healthy growth in ornamental plants and lawns. It is an ideal source of organic fertilizer for plants grown in greenhouses (Arancon et al., 2004).

Figure 1. Vermicompost (Carrol, 2021)

Vermicompost is a high-quality organic fertilizer rich in nutrients, organic matter, microorganisms, enzymes, humic and fulvic acids and growth regulators. This fertilizer improves soil structure, promotes plant growth and enhances environmental sustainability. However, its effective and balanced use is important to maximize its benefits and prevent potential damage (Fig.1).

Vermicompost is a rich, nutritious fertilizer produced by the digestion and breakdown of organic waste by worms. In this process, the worms break down the organic material to produce a humus-like substance. Vermicompost contains high levels of plant nutrients, enzymes, microorganisms and growth regulators (Edwards and Bohlen, 1996). These components make vermicompost an effective natural fertilizer that increases soil fertility and improves plant health.

1.1. Benefits of vermicompost

Effects on Soil Fertility: Vermicompost improves soil structure, increasing water holding capacity and soil aeration (Atiyeh et al., 2000a). This fertilizer stabilizes soil aggregates and reduces erosion (Lazcano and Domínguez, 2011). Furthermore, vermicompost increases the amount of organic matter in the soil, accelerating nutrient cycling and promoting microorganism activity (Arancon et al., 2004).

Effects on Plant Growth and Productivity: Vermicompost contains various nutrients and growth regulators that improve plant growth and productivity (Domínguez and Edwards, 2011). This fertilizer promotes better development of plant roots, increases nutrient uptake and strengthens plant resistance to diseases (Sinha et al., 2002). Vermicompost applications help plants to grow healthy and strong as it contains hormones and enzymes that promote plant growth (Gajalakshmi and Abbasi, 2004).

Microbial Activity and Soil Biology: Vermicompost promotes the growth of beneficial microorganisms in the soil (Lazcano et al., 2013). These microorganisms accelerate the breakdown of organic matter, allowing nutrients to be more easily taken up by plants (Bhat et al., 2015). Furthermore, vermicompost enriches soil biology by increasing microbial biomass and enzyme activity in the soil (Edwards and Arancon, 2004).

Environmental Benefits: Vermicomposting also provides significant benefits in terms of environmental sustainability (Arancon et al., 2004). The breakdown of organic waste by earthworms facilitates waste management and reduces the burden on landfills (Lavelle et al., 1992). In addition, vermicomposting reduces the use of chemical fertilizers and prevents environmentally harmful chemicals from entering the soil and water resources (Kumar and Sharma, 2014).

1.2. Harms of vermicompost

Effects of Overuse: Overuse of vermicompost can have negative impacts on soil health (Singh and Prakash, 2008). High application of vermicompost can lead to excessive salt accumulation and pH imbalance in the soil (Ansari and Sukhraj, 2010). This can lead to burning of plant roots and slow growth (Aira et al., 2007).

Nutrient Imbalance: Although vermicompost has a high nutrient content, it does not contain all plant nutrients in a balanced way (Bhardwaj et al., 2010). For example, vermicompost usually has a high nitrogen content, but other important nutrients such as phosphorus and potassium may not be present insufficient amounts (Ndegwa and Thompson, 2001). This imbalance can result in plants not getting enough of the nutrients they need and reduced growth performance (Atiyeh et al., 2000b).

Pathogens and Diseases: Since vermicompost is produced through the process of decomposition of organic materials, it may contain pathogens and harmful organisms (Yadav and Garg, 2011). Vermicompost produced under poorly treated or unhygienic conditions can lead to plant diseases and pests (Sinha et al., 2010). This can adversely affect plant health and reduce agricultural productivity (Gajalakshmi and Abbasi, 2004).

Economic Costs: Vermicompost production and application can be more costly than conventional chemical fertilizers (Edwards and Arancon, 2004). Vermiculture and fertilizer production processes require initial investments and operating costs (Kumar and Sharma, 2014). Furthermore, vermicompost applications require manual labor, which can lead to additional labor costs for agricultural enterprises (Ansari and Sukhraj, 2010).

2. Results and Discussion

Vermicompost is a valuable organic fertilizer that improves soil health, promotes plant growth and supports environmental sustainability. Thanks to its high content of nutrients, enzymes and microorganisms, it improves soil fertility and supports agricultural productivity (Edwards & Bohlen, 1996). Vermicompost also provides significant benefits in terms of waste management and recycling of organic waste (Sinha et al., 2002). However, some negative impacts such as overuse, nutrient imbalance, pathogen risk and economic costs should also be considered.

More research is needed to balance the benefits and harms of vermicompost (Lazcano & Domínguez, 2011). More information is needed on the effects of vermicompost on different plant species and soil conditions (Arancon et al., 2004). Furthermore, studies should be conducted to provide guidance on appropriate dosage and application methods of vermicompost (Edwards and Arancon, 2004).

2.1. Application recommendations

Balanced Use: Vermicompost should be used in combination with other organic or inorganic fertilizers to avoid nutrient imbalance (Atiyeh et al., 2000b).

Quality Control: Vermicompost must be produced under safe and hygienic conditions. Appropriate processing techniques should be used to minimize pathogen content (Gajalakshmi and Abbasi, 2004).

Education and Awareness: Farmers and agricultural practitioners should be made aware of the benefits and harms of vermicompost. They should be trained on proper application techniques (Singh and Prakash, 2008).

Economic Support: Economic incentives and support programs for vermicompost production and use should be established. This is especially important for small-scale agricultural enterprises (Ansari and Sukhraj, 2010).

3. Conclusions

Vermicomposting offers a sustainable and efficient method for enhancing soil health and fertility. The introduction of earthworms into organic waste decomposition not only accelerates the breakdown of materials but also enriches the resulting compost with essential nutrients and beneficial microorganisms. Studies have shown that vermicompost significantly improves soil structure, aeration, and moisture retention, which in turn promotes robust plant growth. Furthermore, the application of vermicompost can reduce the need for chemical fertilizers, leading to more eco-friendly agricultural practices.

In conclusion, integrating vermicomposting into soil management strategies can foster healthier ecosystems, support biodiversity, and contribute to sustainable agricultural practices. Emphasizing the importance of this method can help address the challenges of soil degradation and food security in an increasingly resource-constrained world.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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