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Vermicompost: An integral part in urban agriculture

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Abstract
Urban agriculture is increasingly popular due to its focus on organic and sustainable practices. With over 50% of the global population expected to live in urban areas by 2050, urban farming is seen as a crucial solution for addressing food scarcity, rising costs, and sustainable waste management. This review focuses on vermicomposting, a process involving earthworms that transforms organic waste into nutrient-rich compost, benefiting horticultural crops, improving soil fertility, and reducing reliance on chemical pesticides and fertilizers. Vermitechnology plays a vital role in urban agriculture, offering solutions for waste management, soil fertility, and sustainable agricultural practices, ultimately enhancing food security and promoting a healthier urban environment.

Keywords: Earthworm, vermicompost, vermi technology, soil fertility and urban agriculture

Introduction

In the past decade, the term "organic" has gained popularity in urban communities. The organic movement and urban gardening are connected, both reflecting a wider trend towards sustainable and environmentally friendly practices in food production.

Urban agriculture involves growing and processing food in and around urban areas. According to the Food and Agriculture Organization (FAO), over 50% of the global population is projected to live in urban areas by 2050. A recent study (Bhat *et al*., 2020) [11] suggested that urban farming could be a solution to food scarcity and rising food prices. Urban agriculture can contribute to sustainability, improved nutrition, and the efficient use of organic waste. The importance of urban agriculture in an ecosystem was highlighted in a study by Weidner *et al*. (2020) [33], pointing to the relationship between food production, nutrient cycling, carbon footprint, and waste management. The study concludes that food production, waste assimilation, and carbon footprint are closely linked.

Urban agriculture depends on various factors, including climate and geographical location. However, the nutrients obtained from waste can potentially meet the fertilizer needs of urban populations.

Vermicomposting intersects with urbanization as a sustainable waste management practice. Among composting methods, vermicomposting is popular due to its ability to produce a highly stable product, which serves as a valuable nutrient for horticultural crops. Research on vermicompost in potting mixes has shown improvements in seed germination, enhanced growth and development, and increased productivity of tomatoes (Atiyeh *et al*., 2000) [8]. VERMICOMPOST thus substantiates as an influential ingredient in potting media formulated at Multiplex Group of Companies and has given a cutting edge to include in all types of potting mix for vegetable crops, Indoor plants, Succulents and Bonsai plants. The integration of vermicompost into potting media has also demonstrated positive results, particularly in terms of nutrient balance, water holding capacity, and overall plant health. This makes it an excellent alternative to traditional substrates, aligning with sustainable urban agricultural practices.

Earthworm derived products

a. **Vermicompost:** is produced by breaking down organic waste using worms. The wormcasts are known for their high porosity, aeration, drainage, and microbial activity, as well as their water retention capacity. Mixing vermicompost (20-50%) with other potting media has resulted in excellent root to shoot and biomass growth (G V Prasanna Kumar, H. Raheman, 2010) [19]. Vermicompost produced by earthworms is rich in nutrients such as macro and micronutrients, hormones, vitamins, and enzymes like proteases, amylases, lipases, and cellulase, as well as immobilized microflora even after being expelled from the worms (Barik *et al*., 2011: Olle, 2019) [10, 25]. The application of vermicompost has been found to improve crop yield, increase growth, and prevent damage from harmful pests.

b. **Vermiwash:** Vermiwash is a liquid extract obtained from vermicompost production, containing a variety of nutrients, enzymes, and plant growth hormones such as cytokinin, gibberellin, and vitamins (Buckerfield *et al*., 1999) [13]. Research suggests that vermiwash can be an effective biofertilizer for nutrient-deficient soil when combined with animal and kitchen waste. However, further studies are needed to assess its efficiency when used with solid fertilizers and its leaching rate. Microflora analysis of vermiwash extracts has shown the presence of beneficial microorganisms like *Azotobacter*, *Agrobacterium*, *Rhizobium*, and phosphate-solubilizing microbes. Enzymes such as Gelatinase, amylase, and caseinase were also identified, contributing to plant growth and higher yield (Zambare *et al*., 2008) [36].
   Vermiwash has been used as a liquid biofertilizer and biopesticide when applied to tomato crops to control *Helicoverpa armigera*. Combinations of vermiwash with neem oil in a 2:1 ratio or with buffalo dung and municipal solid waste have been observed to promote early flowering and increase productivity (Keshav *et al*., 2016) [18].

c. **Vermicompost tea:** The preparation of vermicompost tea has garnered attention due to its significant effects on plant growth. Research has been conducted to optimize the best ratios and dilutions of vermicompost teas. A comparison study was carried out with different dilutions, ranging from 5% to 20% v/v ratios. Subsequently, it was reported that there was an increase in germination rate, height, and leaf areas. As an extension of the mentioned work, vermicompost teas have also been studied as a disease suppressor. In addition to their effects on germination and growth, it was observed that Verticillium wilt was significantly suppressed after 14 days (Edwards *et al*., 2006) [14].

d. **Vermimeal:** The nutritional analysis of earthworm meal as an organic supplement for commercially farmed animals revealed it to be a rich source of amino acids. The analysis, conducted using HPTLC and LCMS analytical methodologies, was the first of its kind to be reported quantitatively (Veena *et al*., 2016) [34]. In addition, in vivo trials on poultry (Broilers) using the meal as a supplement at 2.5% and 5% resulted in increased biomass yield compared to conventional synthetic meal. Continuous application of vermicompost has shown improved NPK efficiency over the years, with efficiencies greater than 50% of chemical fertilizers (Sinha *et al*., 2009) [32].

Effect of Vermicompost and earthworm on Horticulture Crops

Numerous studies have investigated the impact of vermicompost, earthworms, and chemical fertilizers on crop yield. For example, Agarwal (1999) [2] found a 30% increase in the total number of fruits and a 50% increase in the weight of each fruit in eggplants. Furthermore, Rakesh Joshi *et al*. (2010) [16] analysed the effect of vermicompost on tomato saplings and observed a significant increase in germination percentage compared to the control group. Narkhede S. D. *et al*. (2011) [24] reported a maximum leaf chlorophyll content of 2.9% in capsicum annum crop plots treated with 20% vermicompost. Additionally, studies in Australia (Baker and Barett, 1994) [9] demonstrated a 12% increase in protein value in wheat crops when using vermicompost. It was also found that vermicompost has a positive impact on the nutritional content of various crops, such as tomatoes and spinach, leading to higher levels of antioxidants, carotene, lycopene, crude fiber, iron, zinc, and vitamin C (Shankar *et al*., 2008) [29]. Furthermore, Critina Lazcano *et al*. (2011) [21] found that vermicompost and organic manures resulted in better yield and quality of sweet corn hybrids compared to chemical fertilizers. Investigated the vermicompost requirement for potato, spinach, and turnip crops and concluded that leafy crops like spinach required 4 tons/hectare, while tuber crops like potato and turnip required 6 tons/hectare. Overall, the addition of vermicompost to vegetable crops has been shown to enhance growth, yield, and nutrient content, surpassing the effectiveness of chemical fertilizers and manures.

Vermicompost in potting media

Potting media, as defined by Vishal *et al*. (2021) [35], is a mix of nutrients, water retention capacity, physical support, and drainage for plants. A study on suitable potting media for succulents found that a combination of soil, sand, vermicompost, and charcoal was the most effective, with other combinations such as farmyard manure, cocopeat, and perlite also being considered.

Another study by Ose *et al*. (2021) [26] focused on the impact of vermicompost on *Dracoceplalum moldavica*, comparing its growth and physiological effects with commercial garden soil. The study found that including vermicompost in substrate mixes balanced nutrient composition, resulting in higher plant yield and increased biomass in *D. moldavica*. The study also measured photosynthetic parameters, including chlorophyll and fluorescence.

The impact of compost and vermicompost as alternatives to peat was assessed in a study on tomato saplings (Lazcano *et al*., 2009) [20]. The study found that substituting 10%, 20%, and 50% of peat with compost, and 50%, 75%, and 100% with vermicompost, had significant effects.

Furthermore, a study by Kale (2006) [17] reported positive feedback from farmers on the application of vermicompost to various crops, including cereals, pulses, oilseeds, vegetables, fruits, and ornamentals

Vermicompost – Pest & Disease suppressor

Earthworms have been recognized as disease suppressors due to their ability to increase microbial activity and enrich soil diversity in the ecosystem (Binet *et al*., 1998) [12]. Several reports have confirmed that the application of vermicompost has inhibited soil-borne fungal diseases and suppressed pest populations, including spider mites (*Tetranychus urticae*), mealybugs (*Pseudococcus sp*), and aphids (*Myzus persicae*) (Edwards & Arancon 2004) [15], (Arancon *et al*. (2005 & 2007)) [6, 5]. In various conducted studies, applications of vermicompost have suppressed attacks by fungi such as *Pythium* on cucumbers, *Verticillium* on strawberries, and *Rhizoctonia* on radishes. In support of these findings, field experiments have demonstrated that spraying vermiwash on tomato plants infected with late blight disease caused by *Phytophthora infestans* effectively controlled the disease (Sinha & Valani, 2011) [31].

Conclusion

- Vermicomposting presents a pivotal solution in urban agriculture, addressing both waste management and soil health enhancement.
- The high porosity, aeration, drainage, microbial activity, and water retention of vermicompost contribute to increased plant growth, improved seed germination, and higher yields, as evidenced in numerous studies on crops like tomatoes, strawberries, and peppers.
- Products derived from vermicomposting, such as vermiwash and vermicompost tea, offer additional benefits. Vermiwash serves as a potent liquid biofertilizer and biopesticide, rich in essential nutrients and growth hormones, promoting healthier plant growth and providing effective pest control.
- Furthermore, the use of vermimeal as an organic supplement in animal farming not only supports animal health but also offers a sustainable alternative to conventional feed, contributing to the overall efficiency of nutrient cycles in urban ecosystems.
- The role of vermicomposting extends beyond crop yield and soil health; it also plays a crucial part in pest and disease suppression, reducing the reliance on chemical pesticides and fertilizers. This contributes to a more sustainable and eco-friendly urban agricultural system, mitigating the environmental impact of urban waste.

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