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Use of Vermicompost

and its Impact on Plant Growth and Soil Properties

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Abstract

Vermicomposting is the process of converting organic waste into nutrient-rich compost with the help of earthworms. The earthworm casting contains humus, NPK, micronutrients, beneficial microorganisms, antibiotics, enzymes, growth hormones, and other nutrients. Vermicompost is a high nutrition biofertilizer with diversified microbial communities that plays a significant role in increasing the growth and yield of various field crops, vegetables, flower and fruit crops. The resulting vermicompost has been found to have multiple kinds of beneficial effects on plant growth and health.

Introduction

Vermicomposting is the process of converting organic waste into nutrient-rich compost using earthworms. Soil earthworms are vital in agriculture because they breakdown dead organic material by devouring it and releasing it as cast. Earthworms boost up the breakdown of plant litter and organic debris and enhance soil fertility by releasing mineral elements in forms that plants may easily absorb. Vermicompost contains various nutrients in plant available forms like nitrates, phosphates, calcium (Ca) and Potassium (K). Earthworm compost contains numerous kinds of enzymes, hormones, vitamins, antibiotics, and many critical nutrients required for plant growth. It also plays a crucial part in enhancing soil structure and water retention capacity, hence improving crop yield and quality. There are around 3000 earthworm species in the soil, but only 8-10 are acceptable for vermicompost preparation. Non burrowing, organic debris consuming *spp*. of earthworms, such as *Eisenia foetida*, *Eudrilus eugeniae*, *Feretima elongata*, *Perionyx excavatus* are good for vermicomposting.

Nutrient value of vermicompost

The nutrients in vermicompost vary based on the waste sources utilised in compost preparation. If the waste components are diverse, the compost will contain a diverse variety of nutrients. If the waste products are homogeneous, only particular nutrients will be available. The following plant nutrients are available in vermicompost:

S. No.	Name of nutrient	Nutrient content
1.	Organic carbon	9.5-17.98%
2.	Nitrogen	0.5-1.5%
3.	Phosphorus	1.0-1.5%
4.	Potassium	0.15-0.56%
5.	Calcium & Magnesium	22.67-47.60 meq/100g
6.	Sulphur (S)	128-548 ppm*
7.	Iron (Fe)	2.0-9.3 ppm
8.	Cu	2.0-9.5 ppm
9.	Zn	5.7-11.5 ppm

ppm* - parts per million
Source: Online:http://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html;http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-3610/Lecture-10-BINM-Vermicompost.pdf

Use of Vermicompost in Soil

Vermicompost can be used in most crops including field and horticultural crops. A simple way to apply vermicompost is to apply it as a thin layer to the soil around the plant and mixing vermicompost with soil. Generally, Vermicompost should be applied to soil at last ploughing Of field. The amount of vermicompost applied depends on its quality, nutritional content and the crop to which it is applied. In field crops, apply 5-6 t ha^{-1} vermicompost, 10-12 t ha^{-1} for vegetables, and 8-10 kg per fruit tree depending on age, whilst in flower pots, use 100-150 g of vermicompost per pot.

Applying Vermicompost in the Garden

1. **Vermicompost as soil treatment for Vegetable Gardens:** Vermicompost can significantly improve the nutrient profile and texture of vegetable garden soil. It is used as a soil treatment. Before planting, sprinkle a layer of vermicompost about 1-2 inches deep over the garden soil. Gently incorporate it into the soil's upper layers.
2. **Application of Vermicompost in Potted Plants:** Vermicompost is also ideal for growing plants in pots. To make a nutrient-rich medium for plants, combine it in a 1:3 ratio with potting soil or coco peat.
3. **Using vermicompost as a Mulch and for Moisture Retention:** When applied as mulch, vermicompost helps to maintain soil moisture, inhibit weeds, and regulate soil temperature. Apply a 2–3-inch layer of vermicompost around the plants, making sure it doesn't come into direct contact with the stems. It will continue to replenish the soil with nutrients as it decomposes.

Recommended quantity and time of application of vermicompost for crops

A study conducted by the Central Research Institute for Dryland Agriculture in Hyderabad, India, provided the following report:

Crop Name	Quantity of Vermicompost	Time of Application
Rice	1 tonne	After transplanting
Sugarcane	1.5 tonnes	Last ploughing
Cotton	1 tonne	Last ploughing
Chilli	1 tonne	Last ploughing
Groundnut	0.5 tonne	Last ploughing
Sunflower	1.5 tonnes	Last ploughing
Maize	1 tonne	Last ploughing
Turmeric	1 tonne	Last ploughing
Grape	1 tonne	June-July
Citrus, pomegranate, ber, guava	2 kg per tree	At planting time and before flowering in 1–2-year-old trees
Mango, coconut	2 kg per tree 5 kg per tree 10 kg per tree 20 kg per tree	At planting time 1–5-year-old trees 6-9-year-old trees Trees older than 10 years
Onion, garlic, tomato, potato, bhindi, brinjal, cabbage, cauliflower	1-1.5 tonnes	Last ploughing
Teak, red sandal- wood, mangium	3 kg per tree	At planting time

Source: CRIDA (2009) Vermicompost from Waste; Pub. Of Central Research Institute for Dryland Agriculture; Hyderabad, (Unit of Indian Council for Agricultural Research).

Impact of Vermicompost on Plant Growth

Vermicompost is a good source of carbon (C), hydrogen (H), and oxygen (O), and it contains nutrients like NO^{3-}, HPO_4^{2-}, Ca^{2+}, K^{+}, Mg^{2+}, S^{3-}, and other micronutrients that have the same effect on plant growth and yield as inorganic fertilizers. Vermicompost also contains a significant amount of humic substances, such as humic acids, fulvic acids, and humin, which provide numerous sites for chemical reactions and microbial components that promote plant growth and disease suppression through the activities of bacteria (Bacillus), yeast (*Sporobolomyces* and *Cryptococcus*), and fungi (*Trichoderma*), in addition to chemical antagonists such as phenols and amino acids. The use of vermicompost boosted paddy growth and yield while also boosting total nitrogen, accessible phosphorus and potassium, and micronutrient levels in the soil. Microbial metabolites, primarily plant growth regulators, are responsible for the fertilising impact of earthworm casts. Earthworm casts improved the root initiation and biomass. The use of chemical fertiliser in conjunction with vermicompost boosted nutrient uptake and net production of wheat and sugarcane. Vermicompost outperforms normal compost in terms of promoting the growth of cardamom seedlings.

Impact on Physico-Chemical Changes in Soil after Vermicompost Application

In terms of aeration, soil supplemented with vermicompost has a substantially lower bulk density, is highly porous and lighter, and is never compacted. In the long run-on, recurrent application, vermicompost increases the physical, chemical, and biological qualities of soil. The concept of vermiculture of organic material with earthworms gives the most valuable organic manure while simultaneously minimising environmental pollution and health hazards. Not only does vermicompost increase soil structure and aggregation, but it also enhances organic matter level, nutritional status, cation exchange capacity, microbial activities, microbial biomass carbon, and enzymatic activities. As a consequence, this input has proven to be a benefit to farmers. To get the most out of vermicompost, plough it deeply into the soil before planting. The use of vermicompost on crops can help to reduce the need of expensive chemical fertilisers.

Conclusion

Vermicomposting is an alternate waste management technology that produces vermicompost with a higher nutrient content than compost and manures. As a result, it can be used to transition away from chemical fertilisers in order to lessen the detrimental effects of chemicals on both crops and humans. The use of vermicompost, either alone or in conjunction with fertilisers, increases crop production. Vermicompost enhances soil physical conditions, allowing for increased aeration of plant roots, drainage of water, facilitation of cation exchange, continuous availability of nutrients, and thus improved plant growth.

Fig. Vermicompost