EFFECTS OF VERMICOMPOSTING ON THE SOIL FERTILITY AND GROWTH ATTRIBUTES OF CROP PLANTS IN THE FARMING SYSTEM

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Abstract

Vermicompost is the name given to organic material that has been converted from practically any organic waste into a beneficial fertilizer and soil conditioner. Chemical substances that have been widely used for many years have harmed soil fertility and microbiological activity dramatically. Vermicompost products provide the soil with plant nutritional components, hormones, enzymes, humic chemicals, and mostly organic matter. As a result, it improves soil structure while also creating a suitable environment for plant development. It's a material with exceptional water retention and nutrient exchange properties. It also has a positive impact on soil ventilation. It also permits plants to utilise plant nutrients in the soil more efficiently. Our country's soils have a low average organic matter content (2 percent or less) (2 percent or less). Vermicomposting should be encouraged for all of these reasons. The goal of this study is to give information on vermicompost characteristics and their influence on plant development and soil structure, as well as to provide a current literature source.

Keywords-Earthworms, vermicomposting, nutrients, plant growth regulator, plant hormones

Introduction

Vermicomposts may boost plant (millet crops i.e. Jawar/Bajara) development by increasing beneficial enzyme activity and microbe populations, as well as by containing physiologically active chemicals that influence plant growth, such as plant growth regulators or plant hormones104 and humic acids. Vermicompost was shown to have a greater level of dehydrogenase activity than commercial medium, which is typically used to measure the respiratory activity of microbial communities [1]. Soil dehydrogenase activity in vermicompost treated plots was significantly lower at the time of transplantation. This might be due to the exotic micro flora being inhibited by 'foreign' soil microbes from vermicomposts. Microbes have begun to compete as a result of this phenomenon [5].

To activate the nitrogenase enzyme in legumes, the use of vermicompost as a bio-inoculant helps to introduce beneficial microorganisms into their rhizosphere. Nitrogen availability will be increased in the soil as a result of the enhanced nitrogen status of the soil. Vermicompost might potentially be used to boost the availability of phosphate due to the increased phosphatase activity. When organic manures (farmyard manure, vermicompost neem cake, and ash) and bio fertilizer were applied, the activities of dehydrogenase and acid phosphatase were increased in soil. Glycosidase and phosphatase are important enzyme activities to monitor organic matter stabilization processes since they are hydrolytic enzymes involved in the C and P cycles [3]. It is hypothesized that certain biochemical properties in the soil may be indicators of soil quality. Treatment of vermicompost in large amounts in the field suppresses many plant diseases by reducing parasite fungi including Pythium, Rhizoctonia, and Verticillium. 67 Vermicomposts reduce plant parasitic nematodes while increasing the activity of vesicular arbuscular mycorrhizae [8]. According to data, Eiseniafetida reduced plant-parasitic nematode populations by more than 60% in soil cultures, by 98.8% in casts, and by 50% in cultures utilizing alfalfa root tissue. Eight lumbricid species, on the other hand, reduced the amount of plant parasitic nematodes.

When it comes to microbial activity and retention, vermicompost has a larger particle surface area than other composts. In general, composts help the body absorb and assimilate nutrients by acting like hormones. For better plant growth and fruit production, the production of plant growth regulators such as hormones or humates in the vermicomposts may lead to large increases in soil microbial biomass following the application of vermicomposting treatments. Biomass buildup is positively correlated with nutrient mineralization pattern, indicating that vermicompost treatment improves nutrient release and uptake synchronization [2]. However, productivity is negatively correlated with soil nitrogen availability. Increased plant biomass was achieved by reducing the rate at which fertilizer was applied. Vermicomposts were less likely to generate salt stress than compost and commercial fertilizers. In general, these plant growth-regulating compounds are created by earthworms and microorganisms such as fungus, bacteria, and actinomycetes. For example, microorganisms may produce a broad variety of physiologically active substances, including plant growth regulators. They can also mineralize complex molecules into plant-available nutrients. Vermicomposts, despite this, lack study information on the type and degree of plant growth regulator effects induced by soil microbial activity.

Physical Characteristics of Vermicompost

Organic wastes are given to specialized worm species, and the process known as "vermicomposting" is used to transform this material into a useful fertilizer. "Bio-humus" or "vermicompost" is the term used to describe the finished product. Granularity is a characteristic of vermicompost. It is, nevertheless, a dark, odourless substance with a consistent appearance. A long-lasting food supply is provided by this material since it dissolves easily and releases slowly.

In addition to its high mass density, vermicompost has another distinguishing feature. In addition to its positive influence on plant growth, mass density also has a positive effect on soil porosity, aeration, and moisture. Low or high mass concentrations have a detrimental impact on these contents. Aerobite bacteria suffer from a lack of air in the soil [11]. At the same time, the roots are struggling to meet their energy needs owing to a shortage of oxygen. This has a detrimental impact on the development of plants.

Pore aeration ranges from 20-30% to 55-75% in an excellent vermicompost product, with porosity accounting for 70-80% of total volume [12]. Plant growth was the primary consideration in the development of these recommendations. After the vermicomposting process, the moisture content ranges from 50 to 90 percent.

Chemical Characteristics of Vermicompost

More useful than thermophilic compost and synthetic fertilizers is vermicompost. Further fragmentation results in vermicompost, which includes plant nutrients in a form that plants may directly benefit.The substrate material used has the largest influence on the vermicompost product's composition. Quality of the vermicompost, mineralization of organic matter, an increase in microbial viability, carbohydrate breakdown, and the presence of high humic acid fractions all influence its chemical composition [7]. Vermicompost products contain a variety of minerals, vitamins, growth hormones, humic chemicals, enzymes, and antioxidants as a consequence of the breakdown of plant and animal organic wastes.

Chemical compositions of vermicompost products can vary widely. Waste from various animals, municipal wastes and vegetable wastes are all causes that contribute to this situation of disintegration. For example, the pH of sheep dung is 8.6, while animal manure is 6.0-6.7 [4]. Vermicompost may be made from different waste materials, such as sewage that has a pH of roughly 7.4. Vermicomposting often incorporates livestock manure, which is a common source of animal waste. The pH ranges from 5.8 to 8.65 in vermicompost samples, according to research.

Vermicompost products are seldom affected by the problem of salt, which has a devastating effect on plant development [9]. There are several reasons why this is true, but one is because the salt concentration of the substrate material does not affect the result as it goes through worms' digestive systems because of biological and chemical processes. From 0.89 to 3.44 dS/m, vermicompost EC values are within the range that causes salt stress in plants.

Vermicompost materials generally have higher C and N content than other compost products. Vermicomposting calls for an organic material with a C:N ratio of 20 to 22. There may be problems with this material's stability because of the organic carbon, therefore a higher ratio suggests that it is not a good match. The vermicompost material's macro and micronutrient composition also varies widely. There were three ranges of soluble phosphorus (P2O5), soluble potassium (K2O), Ca2+, Mg2+, Fe2+, and Cu2+ concentrations [15].

Compost values derived from animal, plant, and municipal waste can have a wide range of values, even when produced in the same region. There are noticeable variances even among samples taken from different parts of the production process. Climate, humidity, microbiological densities, and substratum characteristics are all thought to be at blame for these anomalies [10,13]. An important factor in determining the pH, EC, and organic carbon concentrations in vermicompost is the substrate material used. While the organic material's carbohydrate content decreases, total soluble carbon and humic matter ratios increase as a result of the vermicomposting process.

Biological Characteristics of Vermicompost

Composting and vermicomposting are two of the most widely used techniques for re-establishing the ecological balance of organic wastes. While microorganisms break down organic matter in the composting process, soil worms and vermicompost microorganisms work together to create bio-oxidation of the organic waste. Mesophilic decomposition is another characteristic of vermicompost. For this reason, vermicompost products increase microbial activity and diversity. Research on the effects of Vermicompost products on soil structure and bacterial activity is conducted using molecular methods and enzyme activities [4]. Vermicompost products surpass other organic fertilizers in terms of the microbiological activity of bacteria, actinomycetes, and fungi. It is possible to enrich organic matter that has a low population of bacteria, fungi, and actinomycetes by the process of vermicomposting. Microbial populations thrive in environments with low C:N ratios. Because microorganism multiplication relies so heavily on nitrogen as a nutrient [6].

Microbial communities require carbon-rich compounds. Fungi, on the other hand, prefer C compounds that are more difficult to get. Com-610 pounds is preferable for Fungi. This is due to the more complicated structure of the carbon. As a result of vermicompost by-products, C mineralization is also helped. For each community, the application of several organic fertilizers increases microbial activity by an additional 16-20 percent.

However, short-term effects of Vermicompost have not always been demonstrated. On the other hand, regular and long-term treatments increase soil microbial biomass and diversity. For those who don't know, beginning materials like substrate and other compost products have far fewer enzymes like dehydrogenase and other enzymes than vermicompost does. No matter how high the vermicompost dose is, NH4-N, NO3-N, and orthophosphate molecules are what stimulate dehydrogenase enzyme activity.

The use of heavy inorganic fertilizers to improve output depletes soil fertility and hinders agricultural sustainability. The organic carbon, active hormones, and enzymes that Vermicompost supplies to the soil can enhance soil production. Inorganic fertilizer uptake is also boosted by the presence of humic acid. The section on compost's influence on soil structure and plant development went into additional detail on this subject.The starting material has an effect on biological characteristics as well. A higher microbial population can be achieved by employing animal dung as a substrate in the production of vermicompost.

Effect of vermicompost on the nutrient quality of soil

Recent studies have shown that organic fertilizers like vermicomposting improve soil organic matter, microbial biomass, and activity. Vermicomposts may boost plant development by increasing beneficial enzyme activity and microbe populations, as well as by containing physiologically active chemicals that influence plant growth, such as plant growth regulators or plant hormones and humic acids. Vermicompost was shown to have a greater level of dehydrogenase activity than commercial medium, which is typically used to measure the respiratory activity of microbial communities. Soil dehydrogenase activity in vermicompost-treated plots was significantly lower at the time of transplantation. This might be due to the exotic microflora being inhibited by 'foreign' soil microbes from vermicomposts. Microbes have begun to compete as a result of this phenomenon.

As a bio-inoculant, vermicompost helps introduce helpful microorganisms to the plant's rhizosphere. This activates legume nitrogen fixation enzymes. Vermicompost. Nitrogen availability will be increased in the soil as a result of the enhanced nitrogen status of the soil. Vermicompost might potentially be used to boost the availability of phosphate due to the increased phosphatase activity. An organic manure (farmyard manure, vermicompost, neem cake and ash) and bio fertilizer mixture increased the activities of dehydrogenase, acid phosphatase and glycosylase in soil. Glycosidase and phosphatase, as hydrolytic enzymes involved in the C and P cycles, are critical for monitoring the stability of organic materials. It is hypothesized that certain biochemical properties in the soil may be indicators of soil quality. Treatment of vermicompost in large amounts in the field suppresses many plant diseases by reducing parasite fungi including Pythium, Rhizoctonia, and Verticillium. 67 Vermicomposts reduce plant parasitic nematodes while increasing the activity of vesicular arbuscular mycorrhizae. According to data, Eiseniafetida reduced plant-parasitic nematode populations by more than 60% in soil cultures, by 98.8% in casts, and by 50% in cultures utilizing alfalfa root tissue. Eight lumbricid species, on the other hand, reduced the amount of plant parasitic nematodes.

When it comes to microbial activity and retention, vermicompost has a larger particle surface area than other composts. In general, composts help the body absorb and assimilate nutrients by acting like hormones. For better plant growth and fruit production, the production of plant growth regulators such as hormones or humates in the vermicomposts may lead to large increases in soil microbial biomass following the application of vermicomposting treatments. When it comes to biomass accumulation, vermicompost treatment has an advantage over other methods due to the better timing of nutrient release and uptake. This is demonstrated by the strong positive correlation between biomass accumulation and the pattern of nutrient mineralization, but a weak negative correlation between productivity and soil nitrogen availability. Increased plant biomass was achieved by reducing the rate at which fertilizer was applied. Vermicomposts were less likely to generate salt stress than compost and commercial fertilizers. In general, these plant growth-regulating compounds are created by earthworms and microorganisms such as fungus, bacteria, and actinomycetes. For example, microorganisms may produce a broad variety of physiologically active substances, including plant growth regulators. They can also mineralize complex molecules into plant-available nutrients. Vermicomposts, despite this, lack study information on the type and degree of plant growth regulator effects induced by soil microbial activity.

Conclusion

Vermicompost is a way to recycle plant and animal waste. Vermicompost increases soil's physical, chemical, and biological qualities and organic matter in agricultural settings. This material, rich in minerals, hormones, vitamins, enzymes, and humic compounds, can aid agricultural soil degradation. Vermicompost improves plant growth and product quality when applied in manufacturing zones. Studies prove it. Increase vermicompost output and utilization. Soil organic matter and production will rise.

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