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A Review Study on Minimizing the Use of Inorganic Fertilizers and Their Implications on an Enhancement in Crop and Soil Quality

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ABSTRACT

Farmers increasingly depend more on artificial fertilizers, which provide vital minerals for increasing crop yields. Minerals, organic matter, microorganisms, water, and air all cohabit in good soil. However, prolonged use of chemical fertilizers without sufficient organic inputs may limit microbial diversity and interfere with soil biological processes. Composting turns organic waste into a stable, nutrient-rich product that may be added to soil to increase plant growth and fertility .The primary objectives of this study were to examine recent studies on adding nutrients to compost and the role played by the microorganisms involved (or introduced) in their transformation during the composting process . The current study's approach has been meticulously crafted to guarantee scientific precision, repeatability, and analytical rigor, especially when assessing the impact of integrated nutrient management and biocompost on crop performance and soil health.

By integrating soil, plant, and microbial subsystems into a cohesive analytical framework, the technique integrates systems thinking. By integrating soil, plant, and microbial subsystems into a cohesive analytical framework, the technique integrates systems thinking.

KEYWORDS

Fertilizers, Nutrients,Biocompost, Organic Matter,Microorganisms

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1. Introduction

Agriculture continues to be the cornerstone of the global food system and food security.The demand for agricultural products has increased due to the world's population growth, which has caused farming practices to become more intensive.Farmers increasingly depend more on artificial fertilizers, which provide vital minerals for increasing crop yields. These fertilizers have been crucial in addressing food shortages.

Biocompost has drawn a lot of interest as a successful soil amendment among other organic fertilizers. The controlled biological breakdown of organic waste products by microorganisms produces biocompost. Composting turns organic waste into a stable, nutrient-rich product that may be added to soil to increase plant growth and fertility. The term "biocompost" describes the organic material created when bacteria, fungus, and actinomycetes break down biodegradable garbage Essential plant nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, and micronutrients are frequently found in biocompost. Compost contains these nutrients as well as helpful microbes that are important for soil biological activity

and nutrient cycling. Usingbiocompost in agricultural systems has a number of benefits. Using biocompost in agricultural settings has a number of benefits.

Inorganic fertilizers have greatly increased crop yields, but their overuse has led to a number of agricultural and environmental issues. . Synthetic fertilizers may change the pH of the soil, decrease the amount of organic matter in it, and have a detrimental effect on the microbial populations.Another important problem is the nitrogen imbalance in soils. Chemical fertilizers often only supply three nutrients: potassium, phosphorous, and nitrogen. Environmental pollution is a significant consequence of excessive fertilizer use. Nitrogen fertilizers are especially prone to leaching and can contaminate groundwater with nitrate. The excessive amounts of nitrate in drinking water pose a major risk to human and animal health.

Sustainable farming methods are greatly aided by biocompost. The breakdown of organic matter and the cycling of nutrients depend on soil microbes.

Biocompost not only increases agricultural yield and soil fertility but also helps mitigate climate change. Adding organic matter to soil improves carbon sequestration, which lowers carbon dioxide levels in the atmosphere. Additionally, organic amendments lower greenhouse gas emissions linked to the manufacture and overuse of chemical fertilizers. Developing sustainable agricultural systems that strike a balance between productivity and environmental protection requires an understanding of how biocompost affects soil fertility and crop productivity

Understanding the impacts of biocompost on crop development, soil fertility, and nutrient dynamics requires experimental research. These studies offer useful information that can help farmers and decision-makers implement sustainable farming methods. The best rates and combinations of compost and inorganic fertilizers needed for various crops and soil types are .

By encouraging the recycling of organic materials into useful agricultural inputs, research on compost utilization advances better waste management techniques also determined by research findings.

India, which is home to 1214 million people and accounts for 17.6% of the world's population, needs a lot of chemical fertilizer to meet the country's growing food needs. The main component of contemporary technology, chemical fertilizers have been crucial to the expansion of Indian agriculture. Globally, more chemical fertilizers are being used to produce cereals (Abril et al., 2007). Because fertilizers are essential for guaranteeing the sustainability of agricultural production and, consequently, achieving food security, increasing fertilizer usage globally is crucial to increasing agricultural productivity (Loganathan et al., 2008).

To attain a high crop yield in production systems, intensive crop cultivation and the application of chemical fertilizers are essential (Ghulam et al., 2010). India's agriculture sector was unable to meet all of its fertilizer needs due to an imbalance in requirements and indigenous fertilizer output due to the high cost and shortage of inorganic fertilizers. Inorganic fertilizers, especially N, P, and K, alter the chemical, physical, and biological characteristics of the soil either directly or indirectly. The quality and productive potential of soils are thought to be significantly impacted by these long-term changes Through the process of mineralization, organic manure gradually releases organic chemicals (Bationo et al., 2004). These substances may function as chelates that aid in plants' uptake and absorption of nutrients (Marschner,2022).

The application of organic manures increases the soil's organic carbon, accessible nutrients (micro and macro), microbial population, and enzymatic activity (Moola et al., 2011; Patra et al., 2011). In most developing countries, such as India, flower waste occurs to a significant degree at temples, weddings, events, and so forth. The degradation of floral debris is a very slow process.

According to recent research, adding cow dung to biomass from the palm oil sector improves the physical, chemical, and nutritional properties of compost. The quality of the compost was greatly improved in terms of pH, electrical conductivity, and the C:N ratio when palm oil biomass and cow dung were mixed in a 1:3 ratio (Vakili et al., 2014). Cow dung can therefore be used as a soil conditioner and as an alternative to chemical fertilizers because it enhances organic matter (Bélanger et al., 2015; Garg & Kaushik, 2005). One method of making insoluble phosphorous available to plants is by using microbes to solubilize it (Swain et al., 2012). In order to improve soil fertility and boost agricultural productivity, cow dung microorganisms are currently being used. A rich source of plant nutrients, compost is a mixture of decomposing plant detritus, organic matter, food, etc. It can keep the soil in a healthy state for the growth and development of plants. As a result, fewer chemical fertilizers may be used in agriculture, directly improving the environment (Rahman et al., 2012). Cellulose and hemicelluloses are abundant in the agro-industrial waste of sugarcane bagasse and rubbish Cellulose, pentose, and lignin make up the majority of bagasse. 45–55% cellulose, 20–25% hemicelluloses, and 18–24% lignin make up its composition (Wan Surya et al.,(2015). According to some research, bagasse can be turned into value-added compost, which could increase crop yield and lessen environmental pollution.

Suriyanarayanan et al. (2010) state that solid waste from the paper industry is usually produced at various stages of the paper production process, including the raw material handling and preparation sections as sludge from the effluent treatment facilities and the causticizing section in the chemical recovery unit as lime mud. Sludges, which are rich in nutrients and an excellent source of microbial inoculum, are the solid wastes produced in the pulp and paper mill during the production of paper and wastewater treatment. For the majority of businesses, including the pulp and paper industries, the disposal of solid waste is a significant issue.

According to Paul Sebastian (2008), adding organic matter to soil has a significant impact on its ability to retain water because it increases the soil particles' specific surface area, porosity, and bulk density. The physical and biological characteristics of the soil were enhanced by the addition of organic fertilizers; mineral fertilizers seemed to have a similar impact. While gypsum reduced the solubility of P, Na, Fe, Cu, Zn, and B, it enhanced the solubility of N, K, Ca, Mg, Mn, Cl, and S in the soil (Elrashidi et al., 2010). According to Patel and Powar (2005), more water, gypsum, and organic amendments are required to improve fine-textured saline-sodic soil than is typically advised.

Nanocomposite synthesis

Because of its small particle size, direct use of nZVI particles in water treatment systems may result in iron pollution and rapid nZVI particle loss. Therefore, in order to treat pollutants, nZVI particles must be loaded onto supporting materials. Nano Zero Valent Iron (nZVI).

Synthesis According to Zhang and Elliott (2006), the nZVI particle has been identified as an excellent electron donor with a propensity to release electrons in the environment.

Conclusion

The current study assessed how various organic treatments, such as vermicompost, biocompost, and integrated nutrient sources, affected soil characteristics, earthworm dynamics, plant growth, and yield parameters. The treatments improved soil physicochemical characteristics and biological processes, which are crucial for sustainable agriculture, in addition to increasing growth and production The study also emphasizes the significance of integrated nutrient management, in which organic input combinations have synergistic effects that outperform those of isolated applications. This serves as the foundation for suggesting the best treatment combinations to increase crop productivity.

The research unequivocally shows that:

- Organic treatments greatly enhance soil qualities, plant growth, and yield.
- Vermicomposting improves soil health and nutrient availability.
- The best outcomes come from integrated methods.

Overall, the findings support the idea that crop yield and environmental health can be enhanced by sustainable farming methods that use organic amendments

This study offers a thorough assessment of how biocompost and inorganic fertilizers affect crop development, yield, and soil health, both separately and in combination. During, the early phases of crop growth inorganic fertilizers supply easily accessible nutrients that promote quick establishment and vegetative development. Biocompost, on the other hand, serves as a slow-release nutrient reservoir, guaranteeing a steady supply of necessary components in subsequent phases.

Plant height, leaf development, and root architecture are areas where integrated nutrition management has a particularly noticeable impact on growth characteristics. The steady availability of nutrients under integrated treatment is reflected in the progressive increase in plant height seen from early to later stages of growth. creation of biomass exhibits a similar pattern, with the maximum accumulation of plant dry matter coming from integrated treatment. This suggests that when nutrients are balanced, plants can make better use of the resources at their disposal. In addition to increasing yields, the buildup of biomass is crucial for preserving soil fertility when crop leftovers are put back into the field.

Under integrated treatment, both grain weight and grain number—two crucial measures of yield quality—saw notable improvements.Proper grain development and filling are ensured by sufficient nutrition availability during reproductive phases.

The study offers compelling scientific proof that sustainable agriculture requires the joint use of biocompost and inorganic fertilizers. Long-term soil health is maintained, crop growth is enhanced, and yield and quality are improved. In order to meet future food demands while protecting natural resources and guaranteeing environmental sustainability, integrated nutrient management strategies must be adopted.

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