

Biochar in Plant Disease Management: Harnessing the Potential of a Sustainable Solution

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Plant diseases pose significant challenges to agricultural productivity and food security worldwide. Traditional disease management approaches often rely on synthetic pesticides and fungicides, which can have detrimental effects on the environment and human health. As the demand for sustainable and eco-friendly solutions increases, biochar has emerged as a promising tool in plant disease management.



Biochar, a carbon-rich material produced through the pyrolysis of organic matter, offers multiple benefits that contribute to enhanced plant health and disease suppression.

Biochar composition

Carbon (C): Biochar is primarily composed of carbon, which makes up a significant proportion of its structure. The carbon content in biochar can range from 50% to over 90%, depending on the production conditions.

Minerals: Biochar may contain various inorganic minerals derived from the feedstock and any impurities present. These minerals include calcium, potassium, magnesium, phosphorus, and trace elements, which can contribute to soil fertility.

Volatile Organic Compounds (VOCs): Some volatile organic compounds may be present in biochar, depending on the pyrolysis conditions and

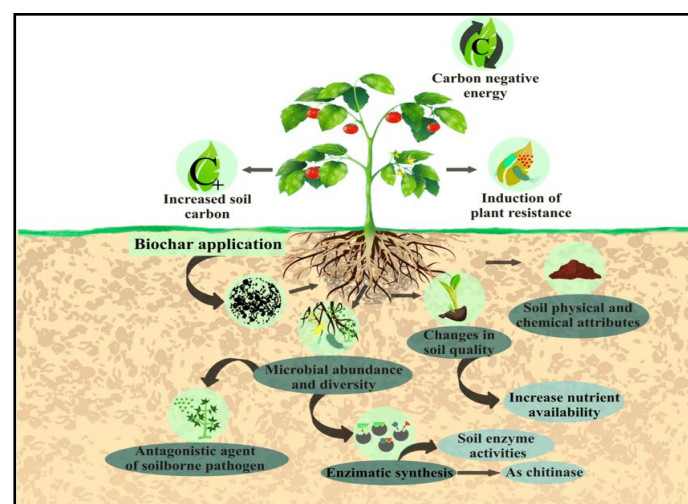
the composition of the feedstock. These compounds can include organic acids, alcohols, and phenolic compounds.

Ash: Biochar typically contains a small percentage of ash, which is the inorganic residue left after the pyrolysis process. The ash content can vary depending on the feedstock and may contribute to the mineral content of biochar.

The specific composition of biochar can impact its properties, such as porosity, surface area, and nutrient-holding capacity. Different types of biochar may exhibit varying characteristics and have different applications in agriculture, horticulture, environmental remediation and other fields.

Benefits of Biochar in Plant Disease Management

Enhanced Soil Health: Biochar improves soil structure, water retention, and nutrient availability.



Healthy soils support robust plant growth and improve their ability to withstand and recover from disease attacks. Moreover, biochar increases beneficial soil microbial populations, including those

with antagonistic properties against pathogens, thereby promoting disease resistance.

Disease Suppression: Biochar has been found to possess inherent antimicrobial properties, capable of inhibiting the growth and development of certain plant pathogens. Its porous structure acts as a physical barrier, preventing pathogen colonisation and reducing disease incidence. Furthermore, biochar's high surface area facilitates the adsorption of disease-causing organisms and toxins, reducing their impact on plants.

Induced Systemic Resistance: Biochar application stimulates plants' natural defense mechanisms, triggering an enhanced immune response known as induced systemic resistance (ISR). ISR strengthens the plant's ability to ward off pathogens, even those that are not directly targeted by biochar. This systemic defense mechanism offers long-term protection against a broad range of diseases.

Nutrient Management: Biochar has the capacity to retain and slowly release essential plant nutrients, such as nitrogen, phosphorus, and potassium. By improving nutrient availability and reducing leaching, biochar enhances plant nutrition,

optimising growth and development. Well-nourished plants are generally more resilient to disease outbreaks.

Environmental Sustainability: Biochar is a sustainable and carbon-negative material. Its production utilizes organic waste streams, such as agricultural residues or forestry byproducts, reducing their environmental impact. Additionally, biochar sequesters carbon in the soil, contributing to climate change mitigation.

Conclusion

Biochar offers an innovative and eco-friendly approach to plant disease management. Its ability to enhance soil health, suppress pathogens, induce systemic resistance, and optimize nutrient management provides multiple benefits for plant health and productivity. Furthermore, biochar's sustainable nature aligns with the growing need for environmentally friendly agricultural practices. As research in this field progresses, harnessing the potential of biochar can revolutionize plant disease management, contributing to sustainable agriculture and global food security.

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