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Nanoparticle bio-pesticide to improve crop health, germination, and overall yield

A material and method of application for improving crop health and yield.

IP Status: US Patent Pending

Technology ID

2020-068

Category

Engineering & Physical Sciences/Chemicals
Engineering & Physical Sciences/Materials
Engineering & Physical Sciences/Nanotechnology
Life Sciences/Industrial Biotech
Agriculture & Veterinary/Ag Biotechnology
Agriculture & Veterinary/Food Science & Nutrition

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Related Technology: Mesoporous silica nanoparticles with ultra high porosity

Applications

- Crop fertilizer and pesticides
- Supplementary plant nutrition

Key Benefits & Differentiators

- **Improved plant defense response** chitosan and silica are both beneficial elements capable of stimulating plant metabolic defense mechanisms against diseases, insects, and stress
- **High loading capacity and fast-delivery:** Mesoporous silica nanoparticles have high surface area and pore volumes, which are capable of holding various nutrients within their structure
- **Multiple forms of application:** including seed infusion and foliar exposure

Technology Overview

Each year, approximately 20-40% of agricultural crops are lost to diseases, contributing significantly to global food insecurity and financial loss to farmers. Owing to its antibacterial and antifungal properties, chitosan-based materials are being used as biopesticides and insecticides. More recently, foliar sprays with silica nanoparticles are being applied to crops to boost their defense response against diseases, insects, and stress. However, one limitation with silica applications is that the silicon supply to the plant must be continuous or the disease-suppressing effects will be reduced or non-existent.

To address this limitation, Researchers at the University of Minnesota, in collaboration with The Connecticut Agricultural Experiment Station, have developed a new silica and chitosan-based material, and a novel method of application, where the active components are slowly released to the plants.The material is made up of high surface area mesoporous silica nanoparticles (MSNs) with or without a chitosan coating. By combining the **benefits of chitosan and MSNs for crops, and a novel method of application, the researchers observed significantly reduced expression of stress-related genes, and up to 40% decrease in disease severity** from *Fusarium* wilt in watermelon (*Citrullus lanatus*). In addition, a 70% increase in fruit yield is noted for uninfected watermelon crops. The material has the potential to deliver one or more types of fertilizer and the material properties can potentially be tuned to adjust absorption rate. Thus, a single application of mesoporous silica nanoparticles with or without a chitosan coating as a nanoenabled agricultural amendment to improve crop yield by enhancing resistance against stress and fungal diseases.

Phase of Development

TRL: 3-4
Proof of concept. Field and greenhouse study data has been collected on the efficacy of this material against *Fusarium* wilt (*Fusarium oxysporum f. sp. niveum*) infection in watermelon (*Citrullus lanatus*).

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

Please contact our office to share your business' needs and learn more.

Researchers

- **Christy Haynes, PhD** Professor, Department of Chemistry

References

1. Buchman, J.T., Elmer, W.H., Ma, C., Landy, K.M., White, J.C. and Haynes, C.L.(2019) , https://doi.org/10.1021/acssuschemeng.9b04800, ACS Sustainable Chemistry & Engineering