Final VOC Benefits to Crop production
A breakthrough in understanding the actual source of plant bio-stimulants in the soil and air

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February 16, 2025

The potential benefits of bio-stimulant
nt volatile organic compounds (VOCs) from fungi are quite significant in the context of plant growth and health
Here are some key benefits:

Plant Growth Promotion: Fungal VOCs have been shown to enhance plant growth. They can stimulate plant biomass accumulation, improve root growth, and increase photosynthetic activity. For instance, certain VOCs c modify root system architecture, promoting root elongation and lateral root formation, which are critical for nutri and water uptake.
Induced Systemic Resistance (ISR): Fungal VOCs can trigger ISR in plants, enhancing their ability to resist pathogens. This is achieved through the activation of plant defense pathways, often involving phytohormones l salicylic acid, jasmonic acid, and ethylene. ISR can provide protection against a broad spectrum of pathogens.
Enhanced Nutrient Uptake: Some fungal VOCs can improve the availability and uptake of essential nutrients. F example, they might increase the availability of sulfur or other micronutrients necessary for plant growth.
Stress Tolerance: Fungal VOCs can enhance plant tolerance to abiot
ic stresses such as drought, salinity, and extreme temperatures. This stress resilience is crucial for maintaining crop yields under adverse environmental conditions.
Cross-talk with Plant Hormones: Fungal VOCs can interfere with plant hormonal signaling pathways, such as those involving auxin, which plays a critical role in plant development and stress responses.
Biocontrol: Certain VOCs emitted by fungi have antimicrobial properties that can suppress the growth of plant pathogens, thus acting as a natural biocontrol agent.
Sustainability: Utilizing fungal VOCs as biostimulants is an environmentally friendly approach, reducing the ne for chemical fertilizers and pesticides, thereby promoting sustainable agricultural practices.
Overall, the integration of fungal VOCs as biostimulants in agriculture can improve plant health and productivity while minimizing environmental impact. Further research and development are needed to fully understand and harness these benefits in practical applications.

The research documented in the study titled "Exposure in vitro to an Environmentally Isolated Strain TC09 of Cladosporium sphaerospermum Triggers Plant Growth Promotion, Early Flowering, and Fruit Yield Increase" illustrates the benefits of volatile organic compounds (VOCs) produced by the fungus Cladosporium sphaerospermum on plant growth and health. Here are the key findings and mechanisms involved:

Potential Benefits:

Plant Growth Promotion:
The VOCs from Cladosporium sphaerospermum (strain TC09) significantly enhance plant growth. Tobacco seedlings exposed to these VOCs for 20 days exhibited an increase in stem height and whole plant biomass by to 25-fold and 15-fold, respectively, compared to controls.
Early Flowering:
In pepper plants, exposure to TC09 VOCs led to flowering 20 days earlier than in untreated controls.
Increased Fruit Yield:
Treated pepper plants yielded up to 213% more fruit than untreated controls.
Sustained Growth After Transplant:
Plants exposed to TC09 VOCs retained higher growth rates even after being transplanted from in vitro conditio to soil.
Mechanisms of Action:

Gene Expression Modification:
Transcriptome analyses indicated that TC09 exposure results in differentially expressed genes (DEGs) associated with cell expansion, photosynthesis, phytohormone homeostasis, and defense responses.
Photosynthesis and Hormonal Regulation:
The VOCs influence biological processes such as photosynthesis and phytohormone regulation, which are cru for plant growth and development.
Activation of Defense Pathways: