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Unveiling Sudanese Soil Actinomycetes and Their Metabolites as Effective Weapons Against *Phytophthora infestans*

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Soil microorganisms are vital for soil fertility, contributing to processes like organic matter decomposition, nutrient cycling, and interactions with plants. Among these microorganisms, actinomycetes stand out for their ability to produce diverse specialized metabolites, including many antibiotics. Recognizing their potential antimicrobial properties, we investigated the anti-oomycete activity of 175 actinomycetes isolated from rhizosphere and bulk soil samples collected in Sudan. Our primary focus was on assessing their impact on *Phytophthora infestans*, a destructive plant pathogen responsible for late blight disease in potatoes and tomatoes worldwide. Our objectives encompassed examining the anti-*Phytophthora infestans* activity of our collection in both *in vitro* and *in planta* settings, investigating the role of their emitted volatiles in this activity, and identifying the specific compounds responsible for their antagonistic effects. Most strains exhibited significant inhibition of the pathogen in confrontational assays, with some causing alterations in the pathogen's growth morphology. Promisingly, the most effective strains demonstrated potential for protecting potato plants from disease in leaf disc and full plant assays. However, *in vitro* split plate assays revealed varying levels of volatile-mediated inhibition by the strains, with some unexpectedly promoting pathogen growth. Additionally, analysis of volatiles from top inhibitors and from phylogenetically related but inactive strains showed no significant differences in volatile profiles. This lack of differences could be attributed to the observed volatile cross-contamination issues, which complicated the interpretation of results. To further explore the strains' bioactive diffusible compounds, we conducted comparative genomic and metabolomic analyses of phylogenetically related strains with differing anti-*Phytophthora infestans* activities. This led to the identification of compounds such as borrelidin and actinomycin D as potent inhibitors of *P. infestans*, showcasing activities not previously reported. Additionally, our study identified several candidate compounds that may contribute to the observed anti-oomycete activity, holding a promise for the discovery of new bio-derived molecules with potential implications for late blight biocontrol. In conclusion, our research underscores the significant anti-oomycete potential of actinomycetes from soil and rhizosphere environments, hinting at their promise to develop sustainable solutions to protect potatoes and tomatoes from this damaging pathogen. Furthermore, our findings emphasize the significance of comparative genomic and metabolomic analyses on phylogenetically closely related strains of differing activities in identifying bioactive compounds, paving the way for the discovery of novel molecules for sustainable crop protection strategies.

Jury:

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