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THE COMBINED APPLICATION OF THE TRICHODERMA HARZIANUM BIOAGENT AND THE SYSTEMIN PEPTIDE ON TOMATO PLANTS IS A VERY EFFICIENT STRATEGY FOR PEST CONTROL

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In the current scenario, the plant protection provided by induction of systemic resistance is an efficient and simple strategy for pest and disease management programs. The resistance of plants to pathogens can be enhanced by the application of natural bioactive compounds and biological agents. The latter ones can induce resistance against various diseases caused by many pathogens. *Trichoderma* spp. are the most widely applied beneficial fungi in commercial agriculture. Their ability to promote plant responses against different biotic and abiotic stresses has been widely described. However, one novel approach aimed to increase the effectiveness of the fungi in pest control, is to combine them with other agents such as metabolites of plant origin. Among these systemin, the first bioactive peptide hormone identified in plants, is very efficient in tomato, grapevine, and eggplant protection. The modulation of defenses triggered by systemin in tomato plants in response to insect and pathogen attack include the production of the plant hormone jasmonic acid and its derivatives, with the final synthesis of compounds interfering with fungal colonization and larval survival; while the induction of resistance by *Trichoderma* spp. is due to the rise in the amounts of defensive metabolites as well as enzymes.
Although, the biological role of these two resistance inducers is well established, little is known about their combined effect on the promotion of plant endogenous defenses. To fill this research gap, the objective of this study was to explore the impact of *Trichoderma harzianum* (strain T22) colonization and systemin treatment on the induction of defense responses in tomato plants (cultivar San Marzano nano). We found that the joint application of Trichoderma and systemin proved more efficient in controlling the noctuid moth *Spodoptera littoralis* and the fungal pathogen *Botrytis cinerea* rather than the single agent alone. The targeted metabolome analysis revealed a wide metabolome alteration in plants treated with the combined application showing an increased accumulation of metabolites involved in ethylene, jasmonate and salicylic acid signaling pathways. These results were corroborated by gene expression analysis, in which Trichoderma-systemin treated plants showed the over-expression of transcripts coding for several defense genes involved in these defense pathways.
Summarizing, our data indicate that the combined usage of different resistance inducers is an interesting strategy for crop protection against several invaders.