

哈茨木霉诱导番茄叶片光合生理变化的研究

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Effects of *Trichoderma harzianum* on Photosynthetic Characteristics in Tomato Leaves Infected with *Fulvia fulva*

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摘要 采用室内对峙培养筛选与田间防效比较相结合的方法, 对哈茨木霉抑制番茄叶霉病菌的机制进行了研究。对峙培养结果显示, 5 个木霉菌菌株均覆盖或侵入了病原菌菌落, 其中菌株TH16 和TH54 对病菌的抑制作用较强。田间防效试验表明, 木霉菌TH16 和TH54 孢子悬浮液浓度在108 个 · mL⁻¹ 时防效最好, 分别为69.4%和60.0%。接种木霉后, 番茄植株的净光合速率 (Pn)、胞间CO₂ 浓度 (Ci)、气孔导度 (Gs)、CO₂ 光饱和同化速率 (Asat)、Rubisco 最大羧化 (Vcmax)、RuBP 最大再生速率 (Jmax) 及Rubisco、

FBPase 活性均明显增加。而接种叶霉病菌导致光合速率下降的同时伴随着Vcmax 和Jmax 的下降。预接种木霉菌能将叶霉病菌导致的Pn、Asat、Vcmax、Jmax 抑制消除并恢复到对照水平。接种木霉能显著增加光合相关基因的表达量, FBPase、FBPA、SBPase 和TPI 分别较对照增加了6.53 倍、3.51 倍、5.17 倍和7.81 倍。

研究结果表明木霉菌通过激活与光合相关酶活性及基因表达缓解了叶霉菌对番茄光合生理的抑制作用。

关键词: 番茄 哈茨木霉 拮抗作用 番茄叶霉病 光合特性

Abstract: The mechanisms of antagonism between *Trichoderma harzianum* and *Fulvia fulva* in tomato leaves were analyzed using combined indoor screening and field efficacy trial. All five testing strains had distinct inhibitory effects to tomato leaf mould disease by the antagonistic experiments. The inhibitory effects of strains TH16 and TH54 were the strongest in all the tested strains. Field efficacy trial results showed that the optimal concentration of spores suspension were 108 per milliliter. The control effects of TH16 and TH54 were 69.4% and 60.0% respectively. Net photosynthetic rate, intercellular CO₂ concentration, stomatal conductance, light saturated rate of the CO₂ assimilation (Asat), maximum carboxylation rates (Vcmax) and maximum RuBP regeneration rate (Jmax) were increased significantly after the inoculation of tomato leaves with *T. harzianum*. Activities of ribulose-1,5-bisphosphate carboxylase/oxygenase Rubisco and stromal fructose-1,6-bisphosphatase (FBPase) and genes expression levels encoded Calvin cycle enzymes increased in tomato plants inoculated with *T. harzianum* TH16. However, leaf mould disease infection resulted in lower net photosynthetic rate, Vcmax and Jmax value. Meanwhile, the inhibition of Pn, Asat, Vcmax and Jmax could be recovered in the plants infected with leaf mould disease if pre-inoculated with *T. harzianum*. The expression levels of the genes encoded Calvin cycle key enzymes could be induced in the plants inoculated with *T. harzianum*. The expression levels of FBPase, FBPA, SBPase and TPI were increased 6.53, 3.51, 5.17 and 7.81 times of the control respectively. The results showed that *T. harzianum* invoked a range of related enzymes and genes to facilitate photosynthetic metabolism against leaf mould disease.

Keywords: [tomato](#), [Trichoderma harzianum](#), [antagonistic effect](#), [tomato leaf mould disease](#), [photosynthetic characteristics](#)

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