

利用表达分析和基因沉默方法研究硫代硫酸硫转移酶基因 *TaTST* 与小麦抗白粉病反应的关系

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Gene Expression Profiling and Silencing Reveal the Relationship between *TaTST*, a Wheat Thiosulfate Sulfurtransferase Gene, and the Resistance Response of Wheat to Powdery Mildew

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摘要

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**摘要** 硫代硫酸硫转移酶参与植物体内的硫代谢、氰化物的清除以及活性氧的生成与清除, 与植物抗病反应密切相关。小麦抗、感白粉病近等基因系材料在接种白粉菌后均诱导表达硫代硫酸硫转移酶基因 *TaTST*, 并在接种后0~48 h内呈现2次诱导峰值, 分别与白粉菌初次接触识别和附着胞侵入、吸器形成时间相对应, 也与2次氧突发时间对应。*TaTST*在感病材料上的诱导表达水平明显高于在抗病材料上, 由此导致的活性氧过度清除可能是导致感病反应的原因之一。*TaTST*也参与抗病反应过程。利用病毒诱导的基因沉默技术(virus-induced gene silencing, VIGS)创造了*TaTST*基因沉默的抗病植株。尽管充分发病时间后沉默植株叶片上并未观察到肉眼可见的病斑, 但侵染早期白粉菌成功侵入频率的增加和次级菌丝的有限伸长说明*TaTST*沉默植株抗病水平下降。*TaTST*沉默导致致突密度下降和H<sub>2</sub>O<sub>2</sub>在细胞内的扩散时间延迟。因此, *TaTST*可能通过调节活性氧的积累和扩散、乳突的形成等小麦-白粉菌互作早期的寄主细胞反应而参与小麦对白粉菌的抗侵入过程。

**关键词:** 小麦 白粉菌 硫代硫酸硫转移酶 VIGS

**Abstract:** Plant thiosulfate sulfurtransferase (TST), which participates in sulfur metabolism, removal of cyanide, generation and removal of reactive oxygen species (ROS), is closely related to plant disease resistance. The wheat TST-encoding gene *TaTST* was induced by the powdery mildew pathogen fungus *Blumeria graminis* f.sp. *tritici* (*Bgt*) in both the resistant and the susceptible wheat near-isogenic lines. Two expression peaks of *TaTST* were found from 0 to 48 h after inoculation of *Bgt*, corresponding to the initial contact and recognition between the host cell and *Bgt* and the invasion attempt of appressoria and haustoria formation. The two expression peaks were also in agreement with the two oxygen burst reactions. The induced expression level of *TaTST* was significantly higher in the susceptible line than in the resistant line, which may result in excessive removal of ROS as a response to *Bgt* infection and so contribute to the process of disease susceptibility. *TaTST* also involved in the process of disease resistance. The method of virus-induced gene silencing (VIGS) was used to silence the *TaTST* gene of the resistant line. Although *TaTST*-silencing plants did not produce visible mildew spots or lesions, they showed reduction of resistance to powdery mildew with the increased successful penetration rate and limited elongation of secondary hypha. Decreased density of papilla and delayed H<sub>2</sub>O<sub>2</sub> spreading in the *Bgt*-challenged host cells of the VIGS plants suggest that *TaTST* possibly affects the *Bgt* penetration process in resistance response through participating in the ROS accumulation and spread and the papilla formation at early stage of wheat-*Bgt* interaction.

**Keywords:** Wheat *Blumeria graminis* f.sp. *tritici* (*Bgt*) Thiosulfate sulfurtransferase (TST) VIGS

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