Straw Competition and Wheat Root Endophytism of *Trichoderma gamsii* T6085 as Useful Traits in the Biological Control of Fusarium Head Blight

S. Sarrocco [(1)]*, P. Esteban [(1)], I. Vicente [(1)], R. Bernardi [(1)], T. Plainchamp [(2)], S. Domenichini [(2)], G. Puntoni [(1)], R. Baroncelli [(3)], G. Vannacci [(1)], M. Dufresne [(2)]

(1) Department of Agriculture, Food and Environment, University of Pisa, 56124 Pisa, Italy
(2) Institute of Plant Sciences Paris-Saclay, UMR9213/UMR1403, CNRS, INRA, Université Paris-Sud, Université d'Evry, Université Paris-Diderot Sorbonne Paris-Cité, Saclay Plant Sciences, 91405 Orsay, France
(3) Instituto Hispano-Luso de Investigaciones Agrarias, Departamento de Microbiología y Genética, Universidad de Salamanca, Villamayor, 37185 Salamanca, Spain
* Corresponding Author: sabrina.sarrocco@unipi.it

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Trichoderma gamsii T6085 has been investigated for many years as a beneficial isolate for use in the biocontrol of Fusarium head blight (FHB) of wheat caused primarily by *Fusarium graminearum*. Evidence acquired in previous works demonstrate that the application of T6085 to wheat spikes at anthesis reduce disease incidence, whereas application to soil before or at sowing has received limited attention. The wider use of soil conservation strategy, such as minimum tillage or sod seeding, facilitates survival and reproduction of *F. graminearum* by reducing the degradation of wheat residues in soil. In the lack of control measures, the presence of such residues promotes FHB epidemics. In the present study, the competitive ability of T6085, alone and along with an isolate (7121) of *Fusarium oxysporum,* on wheat residues against *F. graminearum* and its ability to colonize endophytically wheat roots and to induce the expression of defense related genes, were investigated. *F. oxysporum* is a well-known natural competitor on wheat plant residues and the isolate 7121 was previously collected from a wheat field with a previous history of FHB. The two antagonists were inoculated on wheat straw at the same time of the pathogen or 48 hrs later, to evaluate the role of application timing on competition for the substrate. Results showed that, in any of the tested combinations (T6085 alone or along with *F. oxysporum* and when the antagonists were applied at the same time or after 48 hrs of the pathogen), a significant reduction of wheat straw colonization by the pathogen and of the development of pathogen's perithecia occurred. These results confirm the antagonistic potential of *T. gamsii* T6085 against *F. graminearum*, one of the main agents of FHB, in wheat straw, the natural niche where *F. graminearum* grows and produce the primary inoculum for FHB disease.
Confocal microscopy observation showed that T6085 was able to endophytically colonize the cortex area of wheat roots growing both inter- and intra-cellularly, without reaching the vascular system. This intimate interaction with the plant resulted in a significant increase of the expression of the plant defense-related genes *PAL1* and *PR1*, suggesting that both SAR and ISR could be induced, even if at two different levels of overexpression of the related genes.
Taken together, competitive ability, endophytic behavior, and host resistance induction represent three important traits that can be of great interest in the development of T6085 as a biopesticide against FHB to be used not only on spikes at anthesis but potentially also in soil before or at sowing. The positive/neutral interaction with another saprotroph (in our case *F. oxysporum* 7121) make T6085 fit for the integrated use with other selected beneficial organisms widening the range of possible field applications.

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