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# Effect of treatment with *Trichoderma harzianum* Rifai formulated in invert emulsion on postharvest decay of apple blue mold

- [Y.A. Batta](#)  
- Laboratory of Plant Protection, Department of Plant Production & Protection, Faculty of Agriculture, An-Najah National University, P.O. Box 425 (Tulkarm), West Bank, Palestine, Via Israel
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## Abstract

Conidia of *Trichoderma harzianum* were formulated in invert emulsion (water-in-oil type) at a concentration of  $6.0 \times 10^7$  conidia/ml of the formulation. Treatments with

conidia in the formulated emulsion and conidia in sterile distilled water were conducted to assess the effect on *Penicillium expansum* Link inoculated on apple fruits. Comparisons were made with control treatments of an uninoculated emulsion and uninoculated distilled water. The *T. harzianum*-containing emulsion significantly ( $P \leq 0.05$ ) reduced the decay-lesion diameter compared to the *T. harzianum*-containing water or the uninoculated emulsion or distilled water controls (17.5, 25.7, 34.0, and 34.2 mm, respectively). Significant differences ( $P \leq 0.05$ ) were also obtained between means of percent reduction in decay-lesion diameter relative to sterile distilled water control in the treatments with formulated and nonformulated conidia and control with uninoculated invert emulsion (48.8%, 24.8%, and 0.6%, respectively). Mean time period needed for sporulation of *P. expansum* was significantly ( $P \leq 0.05$ ) increased when the treatments with formulated *T. harzianum* conidia were applied in comparison with the other types of treatments (14.2 versus 12.2, 9.0, and 8.8 days, respectively, for the other treatments). However, no significant differences ( $P \leq 0.05$ ) were obtained in means of decay-lesion diameter or in means of time period needed for sporulation of *P. expansum* in the control treatments (uninoculated invert emulsion versus sterile distilled water). This indicates that the effect of the formulation ingredients on decay-lesion development of *P. expansum* or its sporulation was not significant. A significant ( $P \leq 0.05$ ) long period of protection from *P. expansum* infection (up to 2 months) was also obtained when unwounded apple fruits were dipped for 30-s period in formulated *T. harzianum* conidia before being inoculated by *P. expansum* compared to the wounded fruits. This indicates the importance of the latter type of treatment in protecting apple fruits from blue mold infection for long time at postharvest stage without refrigeration.

## Keywords

- *Trichoderma harzianum*;
- *Penicillium expansum*;
- Apple fruits;
- Invert emulsion;
- Bioassay;
- Biocontrol

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Figures and tables from this article:

Table 1. Development of *P. expansum* lesions (strain P1) on wounded apple fruits (CV: Golden Delicious) 8 days after treatment with formulated and nonformulated conidia of *T. harzianum* (strain Th<sub>2</sub>) at 20±2 °C



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Table 2. Sporulation of *P. expansum* (strain P1) on wounded apple fruits (CV: Golden Delicious) after treatment with formulated and nonformulated conidia of *T. harzianum* (strain Th<sub>2</sub>) at 20±2 °C



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Table 3. Protection of apple fruits (CV: Golden Delicious) from *P. expansum* infection after treatment with formulated conidia of *T. harzianum* (strain Th<sub>2</sub>) in invert emulsion<sup>1</sup> by fruit dipping followed by pathogen inoculation at 20±2 °C



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