



Optimization of solid-state fermentation conditions for *Trichoderma harzianum* using an orthogonal test

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ABSTRACT. The aim of this study was to develop a protocol for the production of fungal bio-pesticides with high efficiency, low cost, and non-polluting fermentation, while also increasing their survival rate under field conditions. This is the first study to develop biocontrol *Trichoderma harzianum* transformants T_{st} that are resistant to benzimidazole fungicides. Agricultural corn stover and wheat bran waste were used as a medium and inducing carbon source for solid fermentation. Spore production was observed, and the method was optimized using single-factor tests with 4 factors at 3 levels in an orthogonal experimental design to determine the optimal culture conditions for *T. harzianum* T_{st}. In this step, we determined the best conditions for fermenting the biocontrol fungi. The optimal culture conditions for *T. harzianum* T_{st} were cultivated for 8 days, a ratio of straw to wheat bran of 1:3, ammonium persulfate as the nitrogen source, and a water content of 30 mL. Under optimal culture conditions, the sporulation of *T. harzianum* T_{st} reached 1.49 x 10¹⁰ CFU/g, which was 1.46-fold higher than that achieved before optimization. Increased sporulation of *T. harzianum* T_{st} results in better utilization of space and

nutrients to achieve control of plant pathogens. This method allows for the recycling of agricultural waste straw.

Key words: Biological pesticides; Conidia; *Trichoderma harzianum*; Solid-state fermentation