

**Title** Fumigant activity of volatiles of *Streptomyces globisporus* JK-1 against *Penicillium italicum* on citrus microcarpa

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### Abstract

Antifungal activity against *Penicillium italicum* of volatile substances from *Streptomyces globisporus* JK-1 grown on autoclaved wheat seed was studied *in vitro* and in planta. Fungal spore germination and mycelial growth of *P. italicum* cultures as well as sporulation and disease incidence on fungal-inoculated fruit were suppressed in the presence of the volatiles. For naturally infected fruit, disease incidence was reduced from 25% to 7.5%. Suppression of the infection process of *P. italicum* on Shatang Mandarin fruit (*Citrus microcarpa*) was observed via scanning electronic microscopy, showing inhibited spore germination on the Shatang Mandarin, and abnormal morphology for conidiophores and hyphae exposed to the volatiles. Based on gas chromatography/mass spectrophotometric analyses, 41 volatile organic compounds were identified from the volatiles of *S. globisporus* JK-1, and the most abundant compound was trans-1,10-dimethyl-trans-9-decalol (geosmin), an earthy smelling substance. Among these, technical grade formulations of eight were chosen for further study: phenylethyl alcohol, caryophyllene, dimethyl disulfide, dimethyl trisulfide, acetophenone, D-limonene, isodene, and aromadendrene. D-Limonene, isodene and aromadendrene showed no observable antifungal activity *in vitro* and in planta at tested concentrations. Both phenylethyl alcohol and caryophyllene showed weak inhibitory activity *in vitro* but no significant efficacy against *P. italicum* on Shatang Mandarin. Dimethyl disulfide or dimethyl trisulfide showed antifungal activity *in vitro* and efficacious control on Shatang Mandarin at a concentration of  $100 \mu\text{L L}^{-1}$  of airspace in treatment containers. Acetophenone showed antifungal activity *in vitro* at a concentration of  $100 \mu\text{L L}^{-1}$  and efficacious control on Shatang Mandarin at the highest concentration of  $1000 \mu\text{L L}^{-1}$ . Volatiles from *S. globisporus* JK-1 have potential for control of blue mold of citrus species through fumigant action.