

**Title** Post-harvest management of ber (*Ziziphus mauritiana* Lamk) fruit rot (*Alternaria alternata* Fr. Keissler) using *Trichoderma* species, fungicides and their combinations

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### Abstract

Isolates of *Trichoderma* species from hot arid regions, fungicides and their combinations were evaluated for the management of ber fruit rot at post-harvest stage. Out of 16 isolates of *Trichoderma* species, six isolates checked growth of mycelia of *Alternaria alternata* by more than 55%. A distinct variation in the inherent level of resistance in these six isolates was recorded against 13 common fungicides. None of the *Trichoderma* species grew in PDA amended with carbendazim even at a very low concentration. In contrast, 100 per cent radial growth was observed in *Trichoderma citrinoviride* isolate *T.c*-CIAH224 in the presence of copper oxychloride ( $250 \mu\text{g g}^{-1}$ ) and mancozeb ( $100 \mu\text{g g}^{-1}$ ) in PDA medium. Isolate *T.v*-CIAH240 was antagonistic against *A. alternata* and tolerant to most of the fungicides tested. This isolate was highly compatible with chlorothalonil, dinocap and wettable sulphur even at  $1000 \mu\text{g g}^{-1}$  and produced yellowish instead of normal green coloured conidia. Isolate of *Trichoderma koningii* – *T.k*-CIAH176, *T. citrinoviride* – *T.c*-CIAH224 and those of *Trichoderma viride* – *T.v*-CIAH181 and *T.v*-CIAH240 with inherent tolerance to some of the fungicides have shown better efficacy to suppress the fruit rot pathogen in dual cultures. However isolate *T.v*-CIAH240 was significantly superior *in vitro* in the suppression (71%) of the *A. alternata* through mycoparasitism and apparent secretion of secondary metabolites in the growth medium. Mycoparasitism and competition with the fruit rot pathogen were the mode of action in the majority of the isolates. The growth of *A. alternata* was completely inhibited in PDA amended with dinocap, propiconazole and tridemorph irrespective of the concentrations. In experiments *in vivo*, isolate *T.v*-CIAH240 was significantly effective (75% PEDC- Percent Efficiency of Disease Control) against post-harvest infection by *A. alternata* followed by *T.v*-SBI48 (62 PEDC) and *T.v*-CIAH149 (44 PEDC). Among the individual fungicide treatments, dinocap and copper oxychloride ( $50 \mu\text{g g}^{-1}$ ) resulted in 52 PEDC. However, dinocap caused a scorching effect and a foul smell in fruits. Fruit rot control efficacy was enhanced to >70% by *T.v*-CIAH240 with tridemefon, thiophanate methyl, mancozeb or alcidine at  $50 \mu\text{g g}^{-1}$  and to >80% with  $100 \mu\text{g g}^{-1}$  of thiophanate methyl, chlorothalonil, mancozeb and alcidine in ber fruits (cv. Gola). There was a non-significant latent infection caused by isolates *T.k*-CIAH176, *T.c*-CIAH224 (*T. citrinoviride*) and *T.v*-CIAH240. Such a latent infection was completely suppressed by low concentrations of fungicides when used in combination with *T.v*-CIAH240. The possible hypothesis involved in management of *A. alternata* in ber fruits at post-harvest stages using fungicides, *Trichoderma* species and their combinations is discussed.