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Solar Photo-inactivation of Phytopathogens by Trace Level Hydrogen Peroxide and Titanium Dioxide Photocatalysis

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Plant pathogenic bacteria in recirculated greenhouse water were inactivated by two distinct photochemical approaches: photo-inactivation in the presence of 0.005% to 0.01% hydrogen peroxide (H_2O_2), and photocatalytic inactivation with 0.01% titanium dioxide (TiO_2). In both processes photo-inactivation is achieved by exposure to sunlight. Total inactivation, with 6–8 log units decrease in viable counts, was achieved in the study of the phytopathogens *Erwinia carotovora* (*E.c.*), *Clavibacter michiganensis* (*C.m.*) and *Pseudomonas syringae* pv. *tomato* (*P.t.*) by 10 to 30 min solar irradiation, in the presence of 0.15 to 0.3 mM (50–100 mg l^{-1}) H_2O_2. Different responses of the examined pathogens towards TiO_2 photo-inactivation were noticed. Whereas 10 min of solar illumination in the presence of both 100 mg l^{-1} H_2O_2 and 100 mg l^{-1} TiO_2 resulted in total inactivation of *P.t.* and *E.c.*, this treatment had no effect on *C.m.* However, with traces of H_2O_2 (*e.g.* 50-100 mg l^{-1}), and in the absence of TiO_2, *C.m.* was deactivated by 20 min of solar irradiation. *P.t.* was fully inactivated in the dark by H_2O_2 at 3,000 mg l^{-1} (0.3%), but not with H_2O_2 at $\leq$1000 mg l^{-1}. Also, no inactivation occurred with solar illumination in the absence of H_2O_2. The mechanism of the bactericidal photoreaction and the special significance of plant pathogen inactivation by natural sunlight in the presence of trace levels of H_2O_2 is discussed.
KEY WORDS: Bactericidal effect of TiO_2 - solar photocatalysis; titanium dioxide (TiO_2); hydrogen peroxide (H_2O_2).

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