Virulence, host-selective toxin production, and development of three Cochliobolus phytopathogens lacking the Sfp-type 4′-phosphopantetheinyl transferase Ppt1

ABSTRACT

The Sfp-type 4′-phosphopantetheinyl transferase Ppt1 is required for activation of nonribosomal peptide synthetases, including Ŭ-aminoadipate reductase (AAR) for lysine biosynthesis and polyketide synthases, enzymes that biosynthesize peptide and polyketide secondary metabolites, respectively. Deletion of the PPT1 gene, from the maize pathogen Cochliobolus heterostrophus and the rice pathogen Cochliobolus miyabeanus, yielded strains that were significantly reduced in virulence to their hosts. In addition, ppt1 mutants of C. heterostrophus race T and Cochliobolus victoriae were unable to biosynthesize the host-selective toxins (HST) T-toxin and victorin, respectively, as judged by bioassays. Interestingly, ppt1 mutants of C. miyabeanus were shown to produce tenfold higher levels of the sesterterpene-type non-HST ophiobolin A, as compared with the wild-type strain. The ppt1 strains of all species were also reduced in tolerance to oxidative stress and iron depletion; both phenotypes are associated with inability to produce extracellular siderophores biosynthesized by the nonribosomal peptide synthetase Nps6. Colony surfaces were hydrophilic, a trait previously associated with absence of C. heterostrophus Nps4. Mutants were decreased in asexual sporulation and C. heterostrophus strains were female-sterile in sexual crosses; the latter phenotype was observed previously with mutants lacking Nps2, which produces an intracellular siderophore. As expected, mutants were albino, since they cannot produce the polyketide melanin and were auxotrophic for lysine because they lack an AAR.

Keyword: Sfp-type 4′-phosphopantetheinyl transferase Ppt1; PPT1 deletion; Virulence; Host