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The Effect of Metabolites of Fusarium solani on the Activity of the PR-Proteins (Chitinase, β-1,3-Glucanase and Peroxidases) of Potato Tubers

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Abstract : Fusarium solani and its variants cause root and stem rot of plants. Dry rot is the most common disease of potato tubers during storage. The causative agents of fusariosis in contact with plants behave as antagonists, growth stimulants or parasites. The diversity of host-parasite relationships is explained by the parasite's ability to produce a wide spectrum of biologically active compounds including toxins, enzymes, oligosaccharides, antibiotic substances, enniatins and gibberellins. Many of these metabolites contribute to the creation of compatible relations; others behave as elicitors, inducing various protective responses in plants. An important part of the strategy for developing plant resistance against pathogens is the activation of protein synthesis to produce protective 'pathogenesis-related' proteins. The family of PR-proteins known to confer the most protective response is chitinases (EC 3.2.1.14, Cht) and β-1,3-glucanases (EC 3.2.1.39, Glu). PR-proteins also include a large multigene family of peroxidases (EC 1.11.1.7, Pod), and increased activity of Pod and expression of the Pod genes leads to the development of resistance to a broad class of pathogens. Despite intensive research on the role of PR-proteins, the question of their participation in the mechanisms of formation of the F.solani–S.tuberosum pathosystem is not sufficiently studied. Our aim was to investigate the effect of different classes of F. solani metabolites on the activity of chitinase, β-1,3-glucanases and peroxidases in tubers of Solanum tuberosum. Metabolite culture filtrate (CF) and cytoplasmic components were fractionated by extraction of the mycelium with organic solvents, salting out techniques, dialysis, column chromatography and ultrafiltration. Protein, lipid, carbohydrate and polyphenolic fractions of fungal metabolites were derived. Using enzymatic hydrolysis we obtained oligo glycans from fungal cell walls with different molecular weights. The activity of the metabolites was tested using potato tuber discs (d = 16mm, h = 5mm). The activity of PR-proteins of tubers was analyzed in a time course of 2–24 hours. The involvement of the analysed metabolites in the modulation of both early non-specific and late related to pathogenesis reactions was demonstrated. The most effective inducer was isolated from the CF (fraction of total phenolic compounds including naphtazarins). Induction of PR-activity by this fraction was: chitinase - 340-360%, glucanase - 435-450%, soluble forms of peroxidase - 400-560%, related forms of peroxidase - 215-237%. High-inducing activity was observed by the chloroform and acetonitrile extracts of the mycelium (induction of chitinase and glucanase activity was 176-240%, of soluble and bound forms of peroxidase - 190-400%). The fraction of oligo glycans mycelium cell walls of 1.2 kDa induced chitinase and β-1,3-glucanase to 239-320%; soluble forms and related peroxidase to 198-426%. Oligo glycans cell walls of 5-10 kDa had a weak suppressor effect - chitinase (21-25%) and glucanase (25-28%) activity; had no effect on soluble forms of peroxidase, but induced to 250-270% activity related forms. The CF polysaccharides of 8.5 kDa and 3.1 kDa inhibited synchronously the glucanase and chitinase specific response in step (after 24 hours at 42-50%) and the step response induced nonspecific peroxidase activity: soluble forms 4.8 -5.2 times, associated forms 1.4-1.6 times.

Keywords : fusarium solani, PR-proteins, peroxidase, solanum tuberosum
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