MODE OF ACTION OF BENEFICIAL FUSARIA FOR BIOCONTROL OF FUSARIUM WILT

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Fusarium wilt of tomato, caused by the soil-inhabiting fungus *Fusarium oxysporum* f. sp. *lycopersici*, is currently controlled in tomato by fumigation of soil with methyl bromide prior to planting. We are investigating biocontrol as an alternative to methyl bromide. Previous work in this project identified nonpathogenic F. oxysporum strain CS-20 as having potential for biocontrol. In greenhouse tests, strain CS-20 was found to work in a variety of soil types, over a wide range of temperatures, against all known races of the pathogen, on tomato cultivars with various combinations of disease resistance genes, and to work at population levels 1000-fold less than the pathogen population. Strain CS-20 reduced incidence of Fusarium wilt in two years of field testing on tomatoes and increased the weight and number of tomato fruits in the second year of testing. Strain CS-20 also reduced incidence of Fusarium wilt of muskmelon in two years of field testing. Strain CS-20 was found to work primarily through induced resistance (split-root test) and did not affect saprophytic growth of the pathogen. Recently, we have initiated studies to further elucidate the mechanism of action. Here we report preliminary results comparing mechanisms of five strains of *F. oxysporum* known to provide biocontrol. Strain Fo-47 (C. Alabouvette, Dijon, France) controls Fusarium wilt on several crops and is in the process of registration as a microbial pesticide in Europe. Strain SA70 (G. Lazarovits, London, Ontario, Canada) has shown promise for control of Fusarium wilt of muskmelon, and strains Fo-7 and Fs-7 (C. Howell, College Station, TX) have shown promise for control of Fusarium wilt of cotton.

To determine the effects of the biocontrol agents on saprophytic growth of the pathogen, aqueous suspensions of biocontrol strains (10^3 cfu/g soil) or water were mixed with field soil amended with 0 to 0.5 mg glucose/g soil. Clamydospores of the pathogen on nitrocellulose membranes were buried in these soils. After 24 h, membranes were examined for germination of chlamydospores. Strains CS-20, Fs-7 and Fo-7 did not suppress saprophytic growth of the pathogen, while Fo-47 and SA-70 reduced pathogen clamydospore germination (Fig. 1). Thus, competition for nutrients was not an important mechanism of action for CS-20, Fo-7 and Fs-7, as it is for Fo-47 and SA-70.

Five tomato seeds (Bonny Best) were planted in each cell of a plug tray containing soilless potting mix (RediEarth). Each cell was drenched at seeding and at 7 wk with 5 ml of 10^5 of spores of biocontrol strains or water. At 7 weeks, stems were cut just above the soil line. Plant shoots were immediately placed in water or pathogen spores suspensions. The volume of water taken up by the shoots was monitored over 24 h. Water uptake was significantly different in plants treated with different biocontrol agents (Fig 2). For example, plants treated with water while in the greenhouse then in water took up 4.56 ml of water, while those treated with CS-20 then water took up only 3.90 ml. Plants treated with Fo-47 then water took up 5.84 ml. Strain SA-70 was most similar to Fo-47, while Fo-7 and Fs-7 were similar to plants that received water in the greenhouse. Similar trends were observed for shoots placed in 10^3 spores / ml of the pathogen. All plants placed in the 10^6 spores / ml of the pathogen took up little water and there were no differences due to biocontrol treatment. Thus, strains CS-20, Fo-47 and SA-70 affect the physiology of the plant, while strains Fo-7 and Fs-7 do not appear to affect the physiology of the plant.

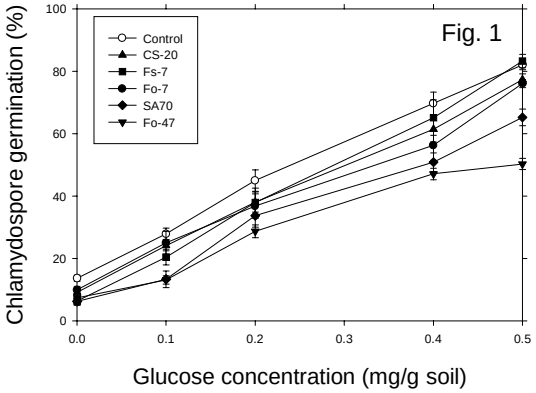

Fig. 1. Germination of pathogen chlamydospores in the presence of biocontrol agents.

Fig. 2. Ability of shoots of plants treated with biocontrol agents to take up water or spore suspensions of the pathogen.