BIOCONTROL OF FUSARIUM WILT OF TOMATO

R. P. Larkin and D. R. Fravel, USDA-ARS, Biocontrol of Plant Diseases Laboratory, Beltsville, MD 20705.

Fusarium wilt diseases, caused by pathogenic *forma speciales* of the soil-inhabiting fungus *Fusarium oxysporum*, can result in severe losses in a wide variety of crop plants. For several crops, including tomato, Fusarium wilt is generally controlled by fumigation with methyl bromide. We are investigating biological control as an alternative strategy for management of this disease. The objective of this research is to develop effective biological control of Fusarium wilt of tomato and other crops of economic importance.

Numerous fungal and bacterial organisms, including existing biocontrol strains with known activity against soilborne fungal diseases, as well as potential new biocontrol organisms isolated from tomato roots in the field, are being tested for their efficacy in controlling disease. Among the organisms being tested are nonpathogenic strains of *F. oxysporum*, *Trichoderma* spp., *Gliocladium virens*, *Pseudomonas fluorescens*, *P. corrugata*, *Burkholderia cepacia*, and others. For initial screenings, tomato seedlings were planted in a soilless mix (Redi-Earth, Grace-Sierra, Inc., Cambridge, MA) in plug trays with the potential biocontrol agent added at seeding as conidial, chlamydospore, or cell suspensions (10^5-10^6 spores/ml for fungi and 10^8-10^9 cells/ml for bacteria). After 2 wk, plugs were transplanted into a sandy loam field soil infested with the pathogen. Disease was monitored for 4-6 wk and the percentage of wilted plants was compared for each treatment.

Thus far, several nonpathogenic isolates of *F. oxysporum* have been the most effective antagonists, providing significant and consistent disease control over repeated tests (TABLE 1). These isolates were also effective against Fusarium wilt diseases of other crops, including watermelon and muskmelon. In addition, the specific isolates which were most effective in controlling disease were the same across all three crops, indicating there is no host-specific interaction. Induced systemic resistance has been determined as the mechanism of action of some isolates. To date, the bacterial isolates tested have not consistently reduced disease when added individually. However, some combinations of bacterial isolates with nonpathogenic *F. oxysporum* or other antagonistic isolates may enhance control.

Research is continuing to improve the level of effectiveness and consistency of control by these and other promising biocontrol agents through: 1) further evaluations of the mechanisms, conditions, and requirements for optimum biocontrol activity, 2) combinations of multiple antagonists utilizing multiple mechanisms, 3) integration of biocontrol with other control strategies, such as sublethal stressing of the pathogen by heat, chemicals, or other soil amendments, and 4) improved formulations and delivery systems.

TABLE 1. Effectiveness of selected nonpathogenic strains of *F. oxysporum* in controlling Fusarium wilt diseases of tomato, watermelon, and muskmelon.

Isolate	Overall[a]		Tomato		Watermelon		Muskmelon	
	% wilt	% reduction	% wilt	% reduction	% wilt	% reduction	% wilt	% reduction
Pathogen only	58.7	0.0	54	0	56	0	66	0
CS-RT2	29.3*[b]	50.3*	28	47	20*	64*	40	39
CS-RW10	24.1*	57.8*	26	51	27*	53*	20*	70*
CS0-RT6	23.1*	60.2*	25*	54*	20*	64*	25*	63*
Fo47	20.4*	64.7*	24*	55*	20*	64*	17*	74*
CSI-21	18.8*	67.4*	22*	59*	19*	67*	16*	76*
CSI-24	17.3*	69.6*	25*	53*	12*	79*	16*	76*
CSI-20	10.7*	81.5*	4*	92*	20*	64*	8*	88*
CS0-RW1	10.6*	81.6*	11*	79*	10*	82*	11*	84*

[a] Overall results represent combined data over all three hosts (isolate × host interactions were not significant). Disease (% wilt) is represented as the percentage of wilted plants over a 4-wk period. Disease reduction (% reduction) represents the percent reduction of disease relative to the pathogen-only control.

[b] Values followed by an asterisk represent a significant reduction of disease relative to the pathogen-only control according to Fischer's LSD test ($P<0.05$).

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