DEVELOPMENT OF INTEGRATED APPROACHES FOR MANAGING FUSARIUM WILT OF WATERMELON

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Watermelon (*Citrullus lanatus*) is an important food and cash crop in the U.S. with more than 50% of the national production in the southeast. The profitable and sustainable production of watermelon is severely impacted by Fusarium wilt, a destructive disease caused by a fungal pathogen *Fusarium oxysporum* f. sp. *niveum* (FON). The disease is well established in nearly all watermelon growing regions in the U.S. and the world. In recent years, Fusarium wilt causes increasing damage in watermelon production in GA, FL, SC, and other southeastern states. With the phase-out of methyl bromide from use, development of effective alternatives for management of the disease is desperately needed. The objective of this study was to develop an integrated system for managing Fusarium wilt of watermelon using non-fumigant fungicides, soil amendment with cover crops, cultural practices, and biological control agents as alternatives to chemical soil fumigation.

Materials and Methods

Fusarium oxysporum f. sp. *niveum* (FON) isolates were collected from commercial watermelon fields at different locations in Georgia. Effects of prothioconazole and thiophanate-methyl on growth and spore germination of the isolates were determined in lab studies. Partial β-tubulin gene of selected FON isolates found to be resistant or sensitive to thiophanate-methyl in this study was sequenced to identify mutation associated with fungicide resistance. Field experiments were conducted to evaluate fungicides, systemic resistance inducers, biocontrol agents and different application methods for managing Fusarium wilt of watermelon. Cover crops, including rye, wheat, hairy vetch, and crimson clover, were planted in winter 2015 and incorporated as soil amendments in spring 2016 to evaluate the efficacy in disease reduction. Soil microbial community structures in the field plots with different cover crops are being analyzed, commercial watermelon cultivars with potential resistance to the disease are being screened, and effect of different planting dates on disease development is being studied.

Results

Based on *in vitro* mycelial growth assays, all the 100 FON isolates evaluated were sensitive to prothioconazole with an average EC_{50} of 1.62 μg/ml, while 33% and 4% of the isolates were resistant to thiophanate-methyl at 10 and 100 μg/ml, respectively. Microconidial germination assays showed that 36% and 64% of the isolates tested were sensitive or intermediately sensitive to prothioconazole at 100 μg/ml, but the fungicide did not inhibit spore germination at 10 μg/ml. Sequencing partial β-tubulin gene of 8 isolates resistant or sensitive to thiophanate-methyl indicated that fungicide resistance was associated with point mutation at nucleotide position 200 with substitution of phenylalanine by tyrosine. In field studies, soil and root drench with prothioconazole or azoxystrobin reduced disease significantly compared to the nontreated control, with prothioconazole being more effective than azoxystrobin in disease reduction. Integrated use of prothioconazole, acibenzolar-*S*-methyl, and biocontrol bacteria reduced disease significantly. Disease incidence was monitored in field plots with different cover crops incorporated as soil amendments. Disease incidence was the lowest in the treatments where hairy vetch or crimson clover/hairy vetch mixture was used for soil amendment. Studies are in progress to screen and evaluate new biocontrol agents and develop integrated programs incorporating effective planting dates, resistant watermelon cultivars and selected fungicides and cover crops to reduce losses caused by this major soilborne disease.

Summary

With the loss of methyl bromide, alternative methods are needed for managing destructive soilborne diseases such as Fusarium wilt of watermelon that is difficult to control. In this study, certain fungicides and soil amendments with cover crops reduced the disease significantly under field conditions that showed the promise to be used as alternative to methyl bromide for managing the disease. Additionally, this is the first report of isolates of *F. oxysporum* f. sp. *niveum* resistant to thiophanate-methyl, and results of the study suggest that thiophanate-methyl should be used judiciously due to the presence of fungicide resistance.