

Greenhouse Tomato Disease Research in Mississippi

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ABSTRACT

During the past 3-4 years, research has been conducted on three diseases causing economic losses to greenhouse tomatoes in Mississippi and the United States. *Botrytis* gray mold, *Pythium* root rot and bacterial canker research has focused on finding new and alternative products with high food safety and short pre-harvest intervals for managing these diseases in the greenhouse environment. Emphasis has been placed on identifying bio-pesticides with suitable efficacy against the pathogens that cause these diseases. Several bio-pesticides have been identified that have shown effectiveness in managing the major greenhouse tomato diseases. Further research is needed to determine long term efficacy of these products and to continue to test new products as they are brought onto the market.

SUMMARY

There are approximately 850 acres of greenhouse tomatoes (*Lycopersicon esculentum* Mill.) grown in the United States (2). Major producing states include Texas, Colorado, Arizona, Virginia, and Pennsylvania. One of the greatest economic concerns in greenhouse tomato production is that of diseases. Fungi, bacteria, and viruses are responsible for most infectious diseases found in the greenhouse situation. Environmental conditions are also frequently the cause of abiotic problems.

Most growers begin transplanting tomato seedlings into greenhouses about mid-October (6). Harvest begins about January 1 and plants may continue to produce fruit through the end of June, depending on temperature. During November through March, temperatures in Mississippi are cool enough to require supplemental heating. In this situation, greenhouses are closed and little venting to bring in outside air with lower humidity is practiced. Humidity levels are commonly 90% or greater for most of the day. Freestanding water is also common in many operations. These environmental conditions are ideal for the initiation and proliferation of gray mold (3). Gray mold caused by *Botrytis cinerea* Pers.: Fr., is probably the most ubiquitous disease of tomato. In addition, many days during this period are cloudy and rainy, resulting in an inability to maintain dry canopy conditions. Tomatoes also tend to grow rapidly, producing great amounts of lush, succulent tissue, which shades the lower plant canopy resulting in highly susceptible plant tissues to gray mold infection.

Gray mold affects all aboveground plant parts. The most characteristic symptom is the fuzzy, gray-brown mold growth on plant parts. Conidiophores and conidia are easily observed with a hand lens and spores can be dislodged by shaking, creating a cloudy mass. Gray mold causes a soft rot of fruit with visible whitish mycelium produced on the fruit surface. Another interesting aspect of gray mold is the occurrence of “ghost spots”

on fruit. The spores germinate and the germ tube penetrates the fruit surface, however, the mycelium aborts, leaving a necrotic fleck with a whitish halo around it. Ghost spot symptoms are most apparent on mature green fruit.

Research on gray mold has been directed at finding bio-pesticides that are efficacious either alone or in combination with traditional fungicide chemistries. Three years of research indicate that the bio-fungicides Milsana and Serenade are effective in reducing disease severity of gray mold on tomato foliage. Marketable and total yield have been increased by 10-18% (expressed in pounds per plot), but these yield increases have not been shown to be statistically significant. Milsana and Serenade have also been shown to be similar in effectiveness as the standard, Decree. Having the ability to alternate these products will assist growers with resistance management issues associated with this pathogen.

Pythium root rot has been a continuous problem in the ornamental (5) and greenhouse tomato industry. Aboveground symptoms in the plant manifest as chlorotic, generally unthrifty plants that may wilt during the heat of the day. These plants can be easily visibly discerned from healthy plants by the general lack of vigor. A survey of Pythium species occurring on greenhouse tomatoes in Mississippi was conducted during 2003-2004. Eleven locations were surveyed. Growing media consisted of pine bark fines (ground pine bark) or perlite. Ten random samples were collected from each location (non-destructive grab samples from three plants constituted each sample). Twenty root pieces (1.0 cm in length) were cut at random from each sample and plated onto water agar. Pythium colonies growing from the root pieces were individually cataloged and placed in storage for identification. One hundred percent of greenhouses were infected with Pythium. Incidence ranged from 3.5% to 36.5% and was generally dependent on the age of the growing medium. The older the growing medium was, the greater the incidence of Pythium. Three species were isolated; *Pythium myriotylum* (79.4%), *Pythium ultimum* var. *ultimum* (14.9%), and *Pythium spinosum* (5.6%). In the laboratory, fungicide sensitivity tests revealed that *P. myriotylum* was not able to grow on either of two fungicides, even at 0.01 ppm after 48 hours. *Pythium ultimum* and *Pythium spinosum* were able to grow at a concentration of 0.01 ppm after 48 hours, suggesting the possibility of fungicide resistance in some of the population. Products such as etridiazole have been labeled for Pythium root rot in greenhouse tomatoes as a result of this work.

Objectives of Pythium research over the last three years have been identical to that of gray mold; searching for bio-fungicides to use either alone or in combination with traditional fungicide chemistry for the control of root rot in tomatoes. The bio-fungicides Mycostop and Companion have proven to be effective in reducing disease severity of Pythium root rot, with respect to root symptoms observed and visual assessments of plant vigor. However, there are the same problems with showing significant yield benefits from using these products. The standard fungicide, Terramaster, performs consistently well when used alone or in combination with these bio-fungicides. Having the ability to alternate these products provides growers the ability to assist with resistance management issues associated with this pathogen.

Bacterial canker, caused by *Clavibacter michiganensis* subsp. *michiganensis* (Smith) Davis et al, is a destructive disease of tomato, both in field and greenhouse production systems (4). Symptoms of bacterial canker generally include a systemic wilting of the

entire plant, marginal necrosis of leaflets and the upward curling of leaf edges. The disease usually develops on the lower part of the plant, however if there is a wound in the upper part of the plant then the disease can develop there and rapidly move downward resulting in plant death. Stems may display external discoloration but often cankers are not formed. The vascular tissue of infected plants turns a reddish-brown color, which is especially prominent at the nodes. The bacterium also may affect fruit resulting in a symptom called bird's-eye spot, which gives the fruit a rather scabby appearance from lesions produced on the surface. The lesions on fruit have brown centers and are surrounded by a white halo.

Copper bactericides are labeled for bacterial canker on other crops but efficacy on bacterial canker in tomato is uncertain. Recently, a company in Utah has begun to develop specific bacteriophages (AgriPhage®, OmniLytics, Inc., Salt Lake City, UT) for the control of bacterial spot and speck (1) in field grown tomato. A bacteriophage is basically a virus that is pathogenic to the bacterium and results in lysis of the bacterial cells. The grower sends a diseased plant sample to the company who then finds a bacteriophage that is highly pathogenic on that isolate of bacteria. The product (AgriPhage) is formulated and shipped to the grower, who then applies the product.

With one year of experiments completed, the best inoculation procedure has been identified; wounding plant tissue and introducing the bacterial inoculum into the wound. Agriphage and ProPhyt products show promise in reducing leaf area necrosis caused by the bacterium, however, more research needs to be conducted in this area.

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