Bacterial Disease Management in Tomato

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A combination of cultural practices and copper-based pesticides are the standard control strategy for bacterial pathogens of vegetable crops. The three common bacterial diseases of tomato in New England are bacterial speck, caused by *Pseudomonas syringae* pv. *tomato*; bacterial spot, caused by several species of *Xanthomonas*; and bacterial canker, caused by *Clavibacter michiganensis* subsp. *michiganensis*. Cultural practices including utilization of disease-free seed, sanitation of greenhouse transplant production areas, cleansing of trellising stakes, and working with plants only when the leaves are dry are critical to prevent the spread of bacterial diseases. While copper is effective in slowing the spread of disease, we wanted to determine the efficacy of several newly developed compounds available for control of bacterial pathogens. We have tested plant activators and bacteriaphage as potential control strategies for bacterial pathogens of tomato, and compared them to standard copper-based control strategies. Activators were tested in the field against bacterial speck, while bacteriaphage were tested in the greenhouse against bacterial canker. Additionally, we are now testing surface irrigation water for the presence of plant pathogens, to help growers prevent the spread of tomato pathogens while irrigating.

Compounds that can activate plant defense responses are known as plant activators, plant defense activators or systemic acquired resistance (SAR) inducers and are frequently termed biopesticides. Additionally, many of these compounds are said to increase plant health and yield, and are expected to be environmentally friendly, having no direct effect upon the pathogen. Some activators are certified for organic use, and thus they could also fit into organic production systems. There are two types of plant activators, and one example of each was included in our study. The first type consists of living microbes that colonize plant roots and activate a resistance mechanism known as induced systemic resistance (ISR). These products are frequently plant growth-promoting rhizobacteria (PGPR), or yield-enhancement biologicals, which are thought to increase yield while reducing pathogen problems. PGPR are living bacteria (many are *Bacillus* spp.) which can be mixed in with soil just prior to sowing seed.

A specific plant defense pathway known as systemic acquired resistance (SAR) is induced by the second type of activator. Acibenzolar-*S*-methyl (ASM) is the SAR activator included in this study, which is a salicylic acid analog that is applied to the foliage. In contrast to ISR, there have been several reports of yield decreases following application of an SAR-inducing compound. This is thought to occur from the systemic activation of SAR, which diverts resources away from other areas of the plant, such as growth. While both ISR and SAR induce the plant's natural defense mechanisms, they are not the same and it is unknown which mechanism will have greater efficacy against tomato pathogens in the Northeast. In addition, it is unknown if usage of the two products together could act synergistically to enhance both yield and disease control.

We found that the ASM treatments reduced the number of leaf lesions in each of the three field seasons tested. Additionally, there were no significant differences in yield between any of the treatments. These results are encouraging for growers. In contrast to previous studies, we did not find any decrease in yield relative to the untreated control when ASM was applied to plants. ASM treatments provided the best control of bacterial speck, although they were not statistically different from the copper treatments. This provides evidence that ASM can be a weapon used to compliment a copper spray program. The PGPR product did provide disease control significantly greater than the untreated control, but did not have an impact on yield in our study.

Additionally we have tested bacteriaphage (also known as phage), which are naturally occurring bacterial viruses. There is a company that identifies and produces large quantities of phage that are specific to a bacterial pathogen. These phage can then be sprayed onto plants to kill the bacteria. They are used commercially in Florida and Georgia to control bacterial spot on tomato, and are also used in large greenhouse tomato production to control bacterial canker. In our greenhouse trials testing phage against bacterial canker, we did not see statistical differences between treated and untreated plants, however there did appear to be a reduction in the number of bacteria on plants.

During the growing seasons of 2010 and 2011, monthly sampling of irrigation water from about 20 vegetable farms located throughout the state of New York began. Water samples were analyzed for multiple pathogens including those that are known to be found in irrigation water and are a significant problem on vegetables. Hundreds of potential pathogen isolates have been cultured from irrigation water and are currently being identified.   Along with plant pathogens, we are working with colleagues in food science to test for indicator organisms for the potential human pathogens *Escherichia coli* and *Salmonella enterica*. The presence and spread of human pathogens in irrigation water is a growing food safety concern.

An ultraviolet (UV) treatment system will also be evaluated as a potential means to treat water found to be infested with the pathogens. A commercial UV processing unit used for unfiltered cider that is capable of continually adjusting for dissolved and suspended solids will be used to carry out the treatment. There are high hopes for this UV system to treat irrigation water because of the similar qualities of unfiltered juices and irrigation water, qualities such as high turbidity, color and the presence of particulate matter. The system will be tested with multiple surface irrigation water sources and in the presence of multiple pathogens.