Critical components of bacterial canker surveillance and management in field and greenhouse tomatoes

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Outbreaks of bacterial canker in open field and greenhouse tomatoes can be economically devastating. The pathogen, *Clavibacter michiganensis* subsp. *michiganensis* (Cmm), is seedborne but can also survive in the environment in temperate climates for several years. As for most other bacterial pathogens, the earlier plants are infected the more severe the epidemic; in general "primary canker" results from seedling infections while "secondary canker" results from field or production greenhouse introductions and can often be managed or tolerated. As highly effective host resistance and post-infection bactericidal treatments are not available at this time, disease management requires strict and costly sanitation measures to prevent mechanical secondary spread. Once an outbreak has occurred, it is helpful to pinpoint the source of the initial inoculum in order refine management practices to contain active outbreaks and prevent future ones. Molecular fingerprinting tools that exploit Cmm genetic diversity offer the ability to trace strains within production systems. We designed a multivariate matrix using geographical information, propagation and production flow diagrams and varietal and seed source data superimposed with repPCR fingerprints and dnaA sequence analysis of Cmm strains. While originally targeted to the greenhouse industry, the matrix may have value in field systems where Cmm introduction and spread is more difficult to define. The multivariate matrix allows Cmm phenotypic and genotypic information to be recorded and transmitted at any specific point in a production system and the point of origin of each strain can be quickly identified. This will help to identify critical control points in Cmm management, such as seed source and handling, seedling grafting and pinching, irrigation and relative humidity management in greenhouses, general crop work and harvesting. Outbreaks of bacterial canker in field and greenhouse tomato production systems will be described to illustrate the use of the multivariate matrix, and management practices designed to target critical control points will be presented.