BIOCONTROL OF SEEDLING PATHOGENS AND ROOT-KNOT ON VEGETABLES

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Seedling pathogens and root-knot nematodes can cause significant economic losses in a wide variety of crop plants. These pathogens are often controlled by fumigation with methyl bromide for tomato, pepper, and to a lesser extent, cucumber. We are investigating biological control with beneficial bacteria and fungi as an alternate disease management strategy for these pathogens on tomato, pepper, and cucumber. We perform research directed at identifying beneficial microbes for use in biocontrol strategies and at understanding how these beneficial microbes associate with plants and suppress disease.

Our approach is to test beneficial bacteria and fungi with known activity against soilborne pathogenic fungi or nematodes for efficacy in controlling damping-off, caused by *Pythium ultimum*, and root-knot (*Meloidogyne incognita).* Previously unidentified bacterial strains isolated from cucumber, tomato, and pepper rhizosphere are also screened for efficacy in controlling these pathogens. These bacterial isolates are identified by fatty acid methyl ester analysis prior to incorporation in disease suppression assays. Identification of bacterial isolates prior to screening minimizes incorporation of similar strains in disease suppression assays.

Pythium ultimum damping-off assays are conducted in growth chambers at 22^{o}C. Candidate bacterial isolates are applied as seed treatments in a gelatin formulation and the coated seed subsequently sown in soilless mix infested with sporangia of *P. ultimum*. Seedling stand is determined after 14 days. To date, these assays have been largely limited to cucumber. A number of potential bacterial biocontrol agents have been identified from the genera *Bacillus, Burkholderia* (Li et al., in press), *Enterobacter, Pantoae*, and *Serratia.*

Assays with bacteria and fungi with known disease suppressive properties have been conducted to assess the efficacy of these isolates in suppressing *M. incognita* on tomato, pepper, and tomato. Candidate strains are applied as seed treatments in a gelatin formulation and, in the case of tomato and pepper, a drench at transplant. Plants are challenged with eggs of *M. incognita* at transplant and the number of galls, eggs, and second-stage juveniles of *M. incognita* determined at 10 weeks after transplanting. These assays are conducted in the greenhouse in steamed soil. To date an isolate of *Trichoderma virens* and *Burkholderia*

ambifaria BC-F have shown promise for suppression of *M. incognita* on pepper (Meyer et al., 2001) and an isolate of *Bacillus cereus* shows promise for suppression of this pathogen on cucumber in preliminary experiments.

An approach employing transposon mutagenesis is being used to determine how beneficial microbes associate with plants and suppress disease. These studies have been largely limited to the interaction between cucumber, *Enterobacter cloacae*, and *Pythium ultimum*. Thus far several mutants of *E. cloacae* have been isolated that are reduced in colonization of cucumber and other crops. One mutant, strain A-145, with a transposon insertion in *rpiA*, is impaired in colonization and disease suppression. *RpiA* encodes ribose phosphate isomerase, an enzyme functioning in the pentose phosphate pathway. Some studies have also been initiated with quorum sensing mutants of *B. ambifaria* BC-F.

Hopefully, these approaches will allow us to identify microbes with superior disease suppression capabilities and to understand how these microbes associate with plants and suppress disease.

Li, W., D.P. Roberts, P.D. Dery, S.L.F. Meyer, S. Lohrke, R.D. Lumsden, and K.P. Hebbar. Broad spectrum anti-biotic activity and disease suppression by the potential biocontrol agent *Burkholderia ambifaria* BC-F. Crop Protection. In press.

Meyer, S.L.F., D.P. Roberts, D.J. Chitwood, L.K. Carta, R.D. Lumsden, and W. Mao. Application of *Burkholderia cepacia* and *Trichoderma virens*, alone and in combinations, against *Meloidogyne incognita* on bell pepper. Nematropica 31: 75-86. 2001.