Host Specificity and Genetic Diversity of Floriculture Isolates of
Phytophthora cryptogea and P. nicotianae

Principal Investigator:
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Project Objectives:
- Survey greenhouse production facilities in North Carolina to obtain isolates of Phytophthora species, and identify isolates based on morphological and molecular characterization.
- Characterize mating type and fungicide sensitivity of Phytophthora isolates from the survey.
- Explore the genetic diversity of Phytophthora isolates to see how they are related and how they are being dispersed in the floriculture industry.
- Determine the host specificity for selected Phytophthora species including P. cryptogea and P. tropicalis to better understand disease dynamics.

Accomplishments:
Root rot, crown rot, and foliar blight, caused by species of Phytophthora, are common diseases on ornamental crops and are ongoing problems in greenhouse production. Greenhouse facilities in North Carolina were surveyed in 2007-2008 to expand the data from a 2001-2002 survey. From our 2007-2008 survey, 164 isolates of Phytophthora were collected from 13 host species at 11 facilities. Isolates were identified as P. nicotianae (59 percent), P. drechsleri (23 percent), P. cryptogea (9 percent), P. tropicalis (4 percent), P. sojae-like (4 percent), and P. citrophthora (1 percent) using morphology and sequencing of the internal transcribed spacer (ITS) region of the ribosomal DNA (rDNA).

Growth at 35°C has been used to distinguish P. cryptogea (no growth) and P. drechsleri (growth). Utility of this assay was evaluated with collected isolates. Results were inconclusive. Isolates of P. cryptogea did not grow at 35°C; however, not all P. drechsleri isolates grew at 35°C either.

The P. cryptogea isolates from the 2001-2002 survey in North Carolina are being characterized further. The ITS region was sequenced. Some isolates from the 2001-2002 survey identified as P. cryptogea were re-identified as P. drechsleri based on published sequences in contrast to the earlier identification using ITS RFLP. Sequencing of the Cox region and the inconsistencies between the ITS RFLP and ITS sequence identifications are being explored.

A limited set of P. cryptogea isolates were analyzed with a two marker system involving the Cox 1 and NADH loci to determine the extent of genetic diversity among isolates. Limited results suggest that unique haplotypes occur on the same crop simultaneously suggesting at least some genetic variability with the population of P. cryptogea from floriculture crops. Whether this variation is due to sexual reproduction or dissemination of different clones of the pathogen on different crops to the same location will be investigated further.
Representative isolates of all *Phytophthora* species were characterized phenotypically for fungicide sensitivity and mating type. Mefenoxam sensitivity was tested using growth on mefenoxam-amended medium. Among *P. nicotianae* isolates, 55 (61 percent) were resistant to mefenoxam at 100 ppm, while 8 were resistant at 1 ppm, but showed only intermediate resistance at 100 ppm. Only 27 isolates (30 percent) were sensitive to mefenoxam at 1 ppm. All isolates of *P. drechsleri* were completely resistant to mefenoxam at 100 ppm. In contrast, all isolates of *P. cryptogea*, *P. tropicalis*, *P. sojae*-like, and *P. citrophthora* were sensitive to mefenoxam at 1 ppm. Isolates that grew at 1 ppm mefenoxam were evaluated further for the effective concentration of mefenoxam providing 50% growth inhibition (EC\(_{50}\)). *Phytophthora drechsleri* isolates exhibited the greatest mefenoxam resistance with three of four groups having EC\(_{50}\) estimates over 725 ppm mefenoxam. EC\(_{50}\) estimates for *P. nicotianae* groups were 247, 353, 363, 415, 427, and 429 ppm, respectively. Heterothallic *Phytophthora* species were evaluated for mating type. Both mating types of *P. cryptogea*, *P. nicotianae*, and *P. tropicalis* were found. At two locations, the A1 and A2 mating types of *P. nicotianae* were found. Only the A1 mating type of *P. drechsleri* was found.

**Technology Transfer/Impact:**
- With the North Carolina floriculture industry as a sub-set, growers nationally are now aware that there is a diverse group of *Phytophthora* species that attack a large number of floral crops.
- Growers now know that there is a large, widespread population of certain *Phytophthora* species in the floral industry that are insensitive to mefenoxam.
- Growers can now adjust their fungicide programs to avoid selecting for insensitive *Phytophthora* populations that would otherwise cause severe losses.

**Collaborators:**
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