

**Title of Project:** EPIDEMIOLOGY, PRELIMINARY CONTROL MEASURES AND CHARACTERIZATION OF ISOLATES OF *PHYTOPHTHORA CAPSICI* FROM PEPPER, TOMATO AND CUCURBIT FIELDS IN SOUTHERN ONTARIO

**Principal researcher:** Dr. Raymond Cerkauskas, Research Scientist (Plant Pathology)  
Agriculture & Agri-Food Canada (AAFC)  
Greenhouse & Processing Crops Research Centre (GPCRC)  
Harrow, Ontario N0R 1G0  
Phone: 519-738-2251 ext. 424  
Fax: 519-738-2929 or 519-738-3374  
Email: [cerkauskasr@agr.gc.ca](mailto:cerkauskasr@agr.gc.ca)

**Collaborative researchers:** Dr. Pervaiz A. Abbasi, Research Scientist (Plant Pathology)  
Southern Crop Protection and Food Research Centre,  
Agriculture & Agri-Food Canada (AAFC) 1391 Sandford St.  
London, ON N5V 4T3

Dr. T.C. Wang, Research Scientist (Mycology)  
AVRDC - The World Vegetable Center  
P.O. Box 42, Shanhua, Tainan, Taiwan 741, ROC

**Technical assistance:** Jim Brown, Plant pathology research assistant at GPCRC,  
Jason Hwang – Co-op student at University of Waterloo

**Objective**

Determine the extent of occurrence of *P. capsici* in processing tomato and pepper fields, and later in processing cucumber fields in southern Ontario, initiate field trials for chemical and non-chemical control of phytophthora blight at selected sites where the disease has been identified previously, and investigate the pathogenic, morphologic and genetic variation among isolates of the fungus.

**Materials and methods**

**Field plots:** Plots were established at a commercial field pepper operation (Huffman site), located about 5 km from GPCRC, where *Phytophthora capsici* was reported in 2004. The plots were located at the edge of the field where symptoms of *P. capsici* were most severe on pepper plants in 2004. 'Boynton Bell' pepper plants were transplanted on June 9 in rows 1 m apart with 40 cm between plants. Heinz '9478' tomato plants were transplanted as noted above in rows 1 m apart with 50 cm between plants while cucumber cv. 'Fanci Pak' plants were transplanted on June 14 at 20 cm apart in rows 50 cm apart. For all plants there were 3 rows per treatment plot with 6 plants per row and 4 replicates per treatment. Dual (metolachlor) at 1.14 a.i. kg/ha was applied on peppers, and Dual + Sencor (metribuzin) at 1.25 and 0.375 a.i. kg/ha, respectively, was applied on tomatoes prior to transplanting for weed control. Hand weeding was applied thereafter as necessary. Fungicide treatments consisted of the following: Acrobat 50 WP (dimethomorph) at 455 g/ha, Pristine 38 WG (boscalide + pyraclostrobin) at 775 g/ha, Gavel 75 DF (zoxamide + mancozeb) at 2.3 kg/ha, Kocide 2000 54 DF (copper hydroxide) at 1.8 kg/ha + Acrobat 50 WP at the rate as listed previously, Kocide 2000 54 DF (copper hydroxide) + Gavel 75 DF at rates as listed previously, AG3, and a water check. AG3 is 10.45% phosphonate a.i. For

each sq. ft, need to use 30 mL of AG3 solution in 300-400 mL water. All treatments except AG3 were applied as a spray using a Solo 425 backpack sprayer containing size 4074757 flat spray nozzle at 276-310 kPa (Solo Kleinmotoren GMBH, Sindelfingen 6, Germany). AG3 was poured at the base of the tomato and pepper plants at the time of transplanting on June 9 while the other fungicide treatments were sprayed on June 10. All treatments were applied to cucumber plants on June 14, at the time of transplanting. On tomato and pepper, all treatments except AG3 were re-applied on June 14. All fungicide treatments were re-applied onto respective cucumber, tomato and pepper plots on July 29. Pepper and tomato fruit from three and two plants, respectively, of the middle row of each treatment plot were counted and weighed on August 25 and September 22, respectively. Cucumber fruit were harvested from plants in each treatment plot on July 19 and again on July 25. The incidence and severity of *Phytophthora* blight in each treatment plot for pepper, cucumber and tomato was monitored during the course of the experiment.

**Greenhouse trials:** Soil was obtained from the cucumber, pepper and tomato plots at the Huffman site, and from two other nearby commercial pepper grower sites (Peters, Carreira), located less than one km away, where the disease was observed during the 2004 growing season. The soil samples were taken from a depth of no more than 9 inches using a soil core from five randomly chosen locations at the pepper, cucumber and tomato plots and at the two other grower sites. The samples from each plot or site were combined and mixed by shaking the soil in the plastic sampling bag. The soil was dispensed in cells of 244-cell Plastomer seedling trays with 50 cells per replicate and four replicates. Seeds of zucchini cv. 'Dark Green' were treated with a slurry of the fungicide and allowed to dry overnight before seeding. Fungicide treatments comprised: Allegiance FL @ 0.98 ml/kg of seed, Apron XL LS @ 0.42 ml/kg, AG3 @ 540 ml/6 L of H<sub>2</sub>O, and water. The treatments were arranged in a randomized complete block design. The percent seed germination and the percent stand were evaluated after 7 and 12 days, respectively.

**Data analysis:** Analysis of variance was done using the ANOVA procedure of the Statistical Analysis System (SAS Institute Inc. 1989) and Duncan's Multiple Range Test (Steel & Torrie 1960). Results were considered significant at  $P = 0.05$ .

**Survey:** A survey for *P. capsici* was conducted in September 2005 of 12 commercial pepper fields in Essex and Kent counties representing 353 acres of production. About 30 plants were examined in each field by walking in a diagonal and selecting plants equidistant from each other. Any low spots in fields were also carefully scrutinized.

### Results

**Field plots:** *Phytophthora* blight was not observed on any pepper, cucumber or tomato plants in the plots at the Huffman site, throughout the growing season.

There was no significant ( $P = 0.05$ ) difference among fungicide treatments for marketable number or yield of pepper fruit, although the Pristine treatment resulted in the greatest number and weight of pepper fruit (Table 1).

There were significant differences among treatments for marketable number and yield of cucumber fruit (Table 2). Highest marketable yield and number of fruit was with Pristine. All other treatments showed significantly lower marketable weight while marketable number was similar to Pristine in the AG3, Kocide + Gavel, and Acrobat treatments but not in the water, Gavel or Kocide + Acrobat treatments.

There was no significant difference among fungicide treatments for marketable number or yield of tomato fruit, although the Pristine treatment resulted in the greatest number and weight of tomato fruit (Table 3).

**Greenhouse trials:** Symptoms of phytophthora blight were not observed on any of the susceptible 'Dark Green' zucchini plants. There was a significant difference in percent stand but not in percent seed germination among seed treatments in soil sampled from the "tomato" Huffman field plot with the water-treated seed showing significantly ( $P = 0.05$ ) lower stand (Table 4). There was no significant difference in percent seed germination or in percent stand in soil sampled either from the "pepper" or "cucumber" Huffman field plot (Tables 5 & 6) or from the Peter's field (Table 7). However, in soil obtained from the Carreira site, there was a significant difference in stand but not in germination among treatments with the water-treated seeds showing the lowest stand count (Table 8).

**Survey:** Phytophthora blight was not observed in any commercial pepper field. It was also not observed in the Minor Use trial adjacent to the experimental trials at the Huffman site, where highly susceptible zucchini cv. 'Select' and cantaloupe cv. 'Pulsar' were grown. This trial plot was located in a portion of the field where phytophthora blight had been reported in 2004 and where water from a nearby irrigation pond had spilled into the plot. Additionally, phytophthora blight was not observed on about 25 acres of commercial field peppers adjacent to the trial plot. However, pepper powdery mildew (*Leveillula taurica*) was found during the survey. It was present in 10 of those operations and affected 100% of the field plants in 6 of those sites with a moderate to severe degree of infection. In some cases the incidence and severity of pepper powdery mildew were high although the growers were not aware of the problem because symptoms were not evident on the upper leaf surface. Sporulation was evident only on the lower leaf surface.

### Discussion

The very hot and dry conditions during most of the growing season in south-western Ontario in 2005 precluded the occurrence and development of phytophthora blight (*P. capsici*) on any susceptible hosts such as pepper, cucumber, zucchini, or tomato in the experiment trials or in commercial grower fields in south-western Ontario. Consequently, disease development and subsequent efficacy trials were insufficient for determination of control of *P. capsici*, nevertheless, Pristine provided best yield, percent stand and percent germination under such conditions.

Phytophthora blight remains as a major disease problems in neighbouring U.S. states, consequently, the disease is very likely to develop in nearby south-western Ontario. Further field research under more conducive environmental conditions at high levels of inoculum s required. Work with cultures of *P. capsici*, obtained from the American Type Culture Collection, under greenhouse conditions is to begin shortly. This is supported by the Ontario Greenhouse Vegetable Growers in anticipation of the disease becoming a problem for the greenhouse industry.