Title: Field Testing Of Resistant Tomato Lines To Control Late Blight And Early Blight In Conventional And Organic Growing Systems.

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State(s) involved: NY and PA

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B. Nontechnical Summary.

The recent creation of tomato inbred lines possessing LB resistance and/or EB resistance created the opportunity to restructure integrated strategies for the control of these diseases. Prior work funded by USDA CAR has defined some of the parameters for a coordinated control strategy using the available resistance and control compounds. Integration of genetic resistance and reduce risk fungicides and biological controls are urgently needed. For the NE growers to use this approach, these resistant lines and strategies must also fulfill the needs of the shorter, cooler season characteristic of the NE growing regions. Our goal is to finalize the development of the tomato lines possessing resistance to LB and EB, then to test the best of these lines under traditional and organic growing systems. This work will result in the development of a coordinated total disease control program for NE tomato production using the genetic resistance to provide more reliable disease control and also significantly reduce reliance on chemical control.

C. Introduction.

Tomatoes are an important part of a diverse and balanced diet. One medium fresh tomato (135g) provides 47% RDA of Vitamin C, 22% RDA Vitamin A and 25 calories (135g). Tomatoes are rich in the anti-oxidant lycopene, a compound that protects cells from oxidants that have been linked to cancer.

Although greater production occurs in Fl and Ca, tomato is also an important vegetable crop in NE states, including NY, NJ and PA. The acreage in PA, NJ, and NY was 11,000 A with a value in excess of $68 million during 2002 (USDA Statistics, 2002).

LB and EB have resulted in numerous epidemics of tomatoes throughout North America, causing considerable loss of yield and crop quality. In the NE in both 2003 and 2004, LB and EB were major problems for tomato production, and heavy losses were sustained. These diseases are a high priority for both NY and PA (see letters of support from NY and PA Vegetable Grower's Associations, and from individual growers and IPM Educators).

Presently, NE growers rely on multiple fungicide applications to achieve the current levels of disease control. New immigrant forms of *P. infestans* have introduced both metalaxyl-resistance and the capability of oospore survival, which will make LB disease management even more difficult. Chemical control measures can be an effective means of managing LB, and are usually guided by forecasts of blight-favorable weather conditions, but chemical applications are both time- and cost-dependent, and may be of reduced efficacy if weather conditions are particularly conducive for the disease. Similar fungicides used to control LB also control EB. Copper fungicides are used in organic fresh market tomato production; however, copper has been shown to only suppress late blight. Fungicide sprays add a great financial burden to growers. In PA, for example, the average cost of each spray is about $20 per acre, for a total of $200 per season (average of 10 sprays per season). That adds up to over $1,000,000 per year in just one state, which when extrapolated over the entire county, is a tremendous expense to growers, consumers, and to the economy. Recent research has also demonstrated the greater challenge of controlling EB disease caused by the light variant of *A. tomatophila*. All of these factors have generated considerable interest in alternative methods for LB and EB control.

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D. Objectives.

Objective 1. Identify appropriate LB and EB resistant lines for use in regional trials and possible release.

The NY breeding program has recently created 32 LB and EB resistant Freshmarket breeding lines, and 17 LB resistant processing tomato lines. The PSU tomato breeding program has also been developing fresh market as well as processing lines with improved EB resistance. Although these are not as advanced as the NY lines, they also should be evaluated for use in the Northeast. This abundance of material is advantageous, since it allows selection of the materials with optimal horticultural characteristics for the NE, but there are more than we could include in regional trials. Therefore a limited number of large trials will compare these lines to determine the best subset of lines for extended regional testing in year 2.

Objective 2. Test EB and LB resistant lines in regional trials to determine their performance and utility in traditional and organic systems.

The trials of the lines selected in year 1 are still ongoing as of 8/28/06. One alteration in the plans is that for the trials in 2007 will expand to focus on hybrids that possess LB/EB resistance, and even better horticultural type through combination of the parent of the hybrids. Seed for the year 3 hybrid trial will be generated in year 2.

Objective 3. Release materials and information to enable NE growers to use the new strategy.

The information generated by this work will be provided to extension personnel and growers through a variety of channels including publication or articles, and the web site http://vegetablemdonline.ppath.cornell.edu/Home.htm, presentations at demonstration days held at the research plots, and at stakeholder meetings in both states. The tomato lines will

be released through appropriate channels to promote their use. Complete information will be provided to seed companies along with the releases to guide their use of the materials in developing and releasing varieties for use in NE. This objective will be accomplished year 3.

E. Approach. The approach is to use tomato lines or hybrids combining LB and EB resistance, and adaptation to conditions in the North East to detemine the best lines and the best use of these lines in control of LB and EB in North East tomato production under standard or organic practices,

F. Progress.

Year 1: In the first field season, all of the lines available were evaluated in trials in NY under standard and organic practice and PA under standard practice to determine the best lines to include in more extensive trials in the second field season. The trials were successful, and a subset of lines with confirmed resistance to LB and EB and the best horticultural characteristics were selected for testing in year 2, and for creating hybrids to be tested in year 3. Therefore this objective has been accomplished

The results of the Early Blight trial confirmed that the Cornell lines were fixed for the early blight resistance. The results of this early blight trial also demonstrated the difference in the degree of disease control the resistance provides on stems vs. on the foliage. The stem ratings on all of the resistant lines are uniformly very low (from 0.0 to 0.2), in contrast to the ratings of the susceptible controls (>4.0). However foliar symptoms, as measured by the % defoliation on the last reading date (19 Sep) or by area under the disease progress curve (AUDPC), were not as well controlled as the stem symptoms. There was also considerable variation among the resistant lines for foliar disease development. This could have been due to differences among these lines for maturity and fruit load/development, rather than any true difference for resistance.

The results of the trials allowed the selection of lines with the best horticultural characteristics in addition to disease resistance. The better inbreds in terms of production, fruit size, as well as fruit characters such as shape, smoothness, blossom end scar (data not shown) have high production levels, through fruit size was smaller than that of the hybrids.

Year 2: The year 2 season is currently underway. The subset of LB/EB lines selected in year 1 is being tested in expanded trials in NY and PA summer 2005. We are also testing these lines in disease trials with modest input of chemical controls, in addition to the resistance, to extend control of foliar symptoms of early blight. The establishment and growth of the trial plots have been very favorable. Data collection is proceeding.