

Update on *Phytophthora capsici* resistance breeding at Cornell

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Oomycetes are a class of plant pathogens that pose new challenges to vegetable growers in New York State. While some such as damping off caused by *Pythium* sp. and root rots caused by *Aphanomyces* sp. have been problems for many years, Phytophthora blight, caused by *Phytophthora capsici*, and downy mildew, caused by *Pseudoperonospora cubensis*, are relatively recent and significant challenges. As a result, there has been a time lag between the emergence of this need and the availability of resistant cultivar choices.

Resistance breeding in pepper has relied on the discovery of resistance in a landrace, Criollo de Morellos 334, that resembles a serrano pepper. While this pepper is fully resistant to strains of Phytophthora that have been found in agricultural production areas, transferring resistance to bell types has been difficult. The inheritance of resistance and bell fruit shape and quality are both complexly inherited and combining this with all the other characteristics that are important for bell pepper production makes creating a pepper with this ideal combination of traits is a challenge.

The approach we have taken is to grow large segregating populations and screen them at the seedling stage in the greenhouse by drenching them with the most aggressive strains of *Phytophthora capsici* available. By selecting only the very few seedlings that survive, we are able to maximize the resistance each generation while backcrossing to bell peppers adapted to NY production. For the past 3 years, we were also able to test our breeding lines on the Phytophthora farm in Geneva to screen our selections for resistance in a more holistic way. We consider a breeding line to be sufficiently resistant when less than 5% of the plants exhibit any defoliation and ideally select for breeding lines that only rarely exhibit any symptom whatsoever.

Through trials and grower evaluations we have worked to refine our breeding. Based on 2011 trial data, our peppers are unsurpassed for yield compared to popular commercial cultivars with very little loss to blossom end rot or silvering (Figure 1). In addition to university research plot trials, we also sent seed to growers in the Eden, Geneva, Albany and Long Island areas affected by Phytophthora. In general, their experiences reflected our trial data and identified a need for the fruit to be larger, blockier, and ripen from green to red earlier. Crosses are underway to increase fruit size and introduce other characteristics like bacterial leaf spot resistance.

We have also been encouraged to diversify the types of peppers with Phytophthora resistance. Based on the results of a grower survey, we have started to cross our most resistant lines into other peppers types. In decreasing order of preference we had requests for jalapeño, banana/hot wax, cayenne, poblano, mini sweet, serrano, anaheim and cherry. Apart from habanero which is a different species, these requests for smaller fruited types are easier than increasing fruit size of bell pepper. The initial hybrids for serrano, jalapeño and cherry already resemble the target market type and given that the resistance and pungency is largely dominant they may already be satisfactory (Figure 2). We will be hoping to test these on the Phytophthora farm in Geneva in 2012.

Figure 1. Cumulative yield of marketable ripe fruit per plant in a 2011 replicated trial of bell peppers. Cornell Breeding lines are designated "Pcap-NY"

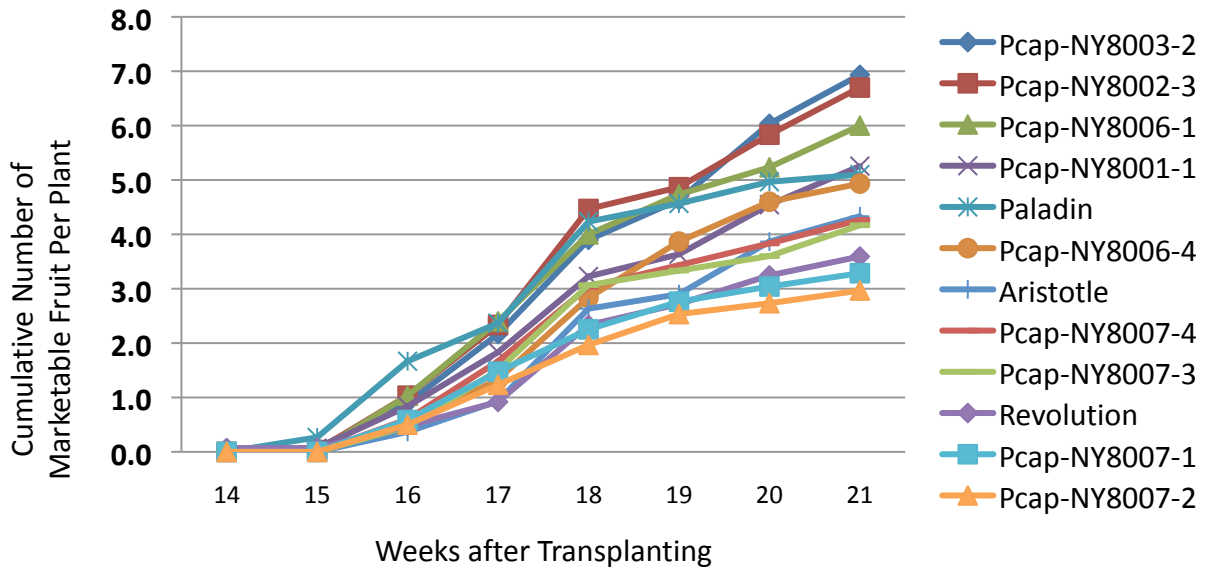
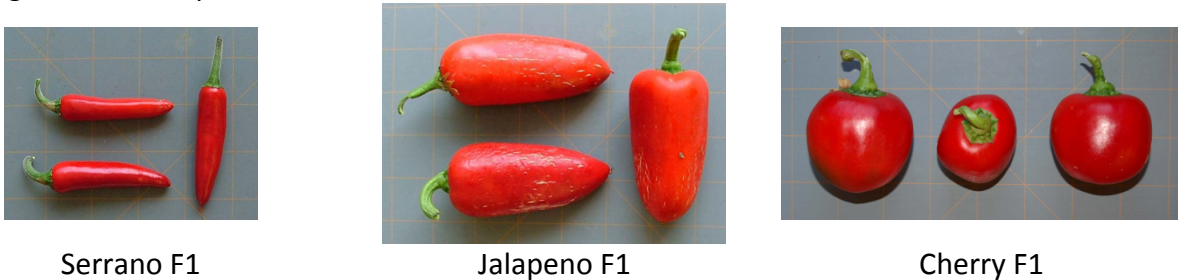


Figure 2. Initial hybrids between *Phytophthora capsici* resistant peppers and hot pepper types. Scale grid = 1 inch squares.



Phytophthora capsici resistance is also a need in squash. Based on a 2010 screen of the entire 800 accession USDA *Cucurbita pepo* collection, we identified seed stocks that contained resistance to downy mildew. Based on both pathogens being oomycetes, the most resistant to downy mildew were also tested for *Phytophthora capsici* resistance on the Phytophthora farm in Geneva in 2011. Two were identified as promising sources of resistance to both diseases and crosses are underway to generate breeding lines resistant to both oomycetes. Similar breeding strategies have already yielded downy mildew resistant cucumber lines at Cornell within 3 years.

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