

## Comparing yield and disease incidence among *Phytophthora* tolerant sweet peppers

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The water mold *Phytophthora capsici* (*P. capsici*) causes Phytophthora blight on peppers, as well as tomatoes, eggplants, summer and winter squash, melons, cucumbers, pumpkins, and snap and lima beans. As those who have dealt with this disease know, the presence of *P. capsici* in a field can result in severe losses due to root, crown and fruit rot. Leaf lesions may also occur. Once *P. capsici* is in a field, planting tolerant varieties is an important component of successful disease management in pepper. There are already a number of sweet pepper varieties being marketed as tolerant to Phytophthora blight, and efforts are ongoing in both the public and private sectors to develop additional varieties. In order to test how these varieties perform in upstate New York, we began screening bell pepper varieties and breeding lines for tolerance to Phytophthora blight in 2007. In the past, these trials have focused on the root and crown rot phase of the disease, but this year we also looked at yield.

Peppers were grown on raised beds covered with black plastic and irrigated with drip tape to simulate standard production practices in New York State. In addition to six commercially-grown varieties with varying levels of tolerance to Phytophthora blight, the susceptible varieties 'Red Knight' and 'Karisma' were included as controls, along with four breeding lines from the Cornell pepper breeding program (run by Dr. Michael Mazourek). Varieties were grown in plots of 10 plants, and the trial was replicated in both a clean field (no history of Phytophthora blight), and at the Phytophthora blight research farm at Cornell University's New York State Agricultural Experiment Station in Geneva, NY. This is an enclosed research field dedicated to the study of Phytophthora blight, where we can simulate disease pressure in an infested field. After the plants were established, peppers at the Phytophthora blight farm were challenged three times (at two week intervals) with spores of a New York strain of *P. capsici*.

Mature green fruit were harvested four times (every two weeks) beginning in the first week of August, and marketable fruit were sorted by diameter (2-2.5 inches, 2.5-3 inches, 3-3.5 inches, or >3.5 inches) and weighed. Fruit less than 2 inches in diameter, or otherwise misshapen or blemished were considered unmarketable. Fruit with at least 1 square inch of silvering were weighed separately.

Beginning one week after the first inoculation, the number of plants in each plot with symptoms of Phytophthora root and crown rot (wilting or plant death) was also counted twice a week for 12 weeks, and these ratings were used to calculate relative area under the disease progress curve (RAUDPC). The RAUDPC value summarizes both the disease incidence (how many plants died over the course of the trial) and disease severity (how quickly those plants died) and is standardized using the number of days over which ratings were taken (to facilitate comparisons between years).

While total marketable yields varied among varieties and breeding lines in the clean field, differences were not statistically significant. Under high disease pressure at the Phytophthora blight farm, the varieties Intruder, Paladin, Aristotle, and the Cornell breeding lines NY 8007-1 and NY 8006-1 had significantly higher total marketable yields than did the varieties Declaration, Karisma, Revolution, and Red Knight (Table 1). Although Cornell breeding lines were competitive with commercial varieties in terms of total weight of marketable fruit, individual fruit tended to be smaller, sometimes with significantly smaller proportions of marketable fruit in the 3.0-3.5 inch and >3.5 inch size categories, especially in the trial conducted in the clean field. Among peppers grown in the clean field, percentages of marketable fruit with silvering were not statistically different. Among peppers with at least moderate tolerance to Phytophthora blight grown at the Phytophthora blight farm, Intruder and Paladin had significantly higher percentages of fruit with silvering than did the Cornell breeding lines, and proportions of marketable fruit with silvering tended to be higher at the third harvest dates (31 Aug and 6 Sep).

The low yields for Declaration, Karisma, Revolution, and Red Knight at the Phytophthora blight farm are probably due in large part to high disease severity in these varieties (Table 2). While it performed poorly this year, Revolution's tolerance has been variable at the Phytophthora Blight Farm over the past five years of trials, ranging from poor to moderate levels of tolerance. The commercial varieties Intruder, Paladin, and Aristotle, as well as all of the breeding lines from Cornell had very high levels of tolerance to Phytophthora blight.

For additional information on Phytophthora blight management and ongoing research at Cornell, visit our Phytophthora blight website: <http://phytophthora.pppmb.cals.cornell.edu/>. The site includes fact sheets that can be downloaded, research updates, management strategies, and lots of images.

**Table 1.** Mean marketable bell pepper yields (mature green fruit) of Cornell breeding lines (preceded by “NY”) and commercial varieties in a clean research field and under high disease pressure from Phytophthora blight. Reported yields are the total weight (lb) of marketable fruit (greater than 2 inches in diameter) summed over four harvest dates.

Variety	Mean marketable yield (lb) per 10 plants	
	Clean field <sup>a</sup>	Phytophthora blight <sup>b</sup>
NY 8007-1	6.53	17.45 a
Intruder	15.89	16.52 a
Paladin	16.53	16.23 a
NY 8006-1	12.60	15.78 a
Aristotle	15.65	14.25 ab
NY 8001-1	8.32	11.35 abc
NY 8002-3	9.85	11.29 abc
Vanguard	21.08	4.67 bcd
Declaration	17.57	3.03 cd
Karisma	17.80	1.47 cd
Revolution	14.86	1.38 cd
Red Knight	18.56	0 d

<sup>a</sup> Differences among varieties and breeding lines were not statistically different.

<sup>b</sup> Yields followed by the same letter are not statistically different from each other.

**Table 2.** Sweet pepper varieties and breeding lines (preceded by “NY”) screened for resistance to Phytophthora blight in 2011. Plants were rated for wilting and death, not for fruit rot. Mean RAUDPC (relative area under the disease progress curve) values followed by the same letter are not statistically different from each other. Smaller RAUDPC values indicate that the plants wilted and died more slowly and are more tolerant to Phytophthora blight.

Variety	Mean RAUDPC
Red Knight	90.24 a
Karisma	77.60 ab
Revolution	67.11 bc
Declaration	57.04 c
Vanguard	49.27 c
Aristotle	13.21 d
Paladin	4.49 d
Intruder	1.29 d
NY 8001-1	0 d
NY 8002-3	0 d
NY 8006-1	0 d
NY 8007-1	0 d