Creating New York adapted Tomatoes with Resistance to Multiple Fungal and Bacterial Diseases

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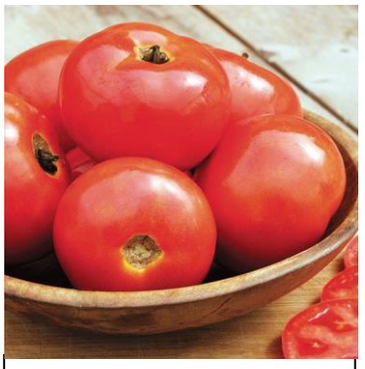
One of the myriad aspects of tomato production in NYS is control of common fungal, oomycete, and bacterial diseases. Control of these diseases by routine application of fungicides contributes to the cost of production. Loss of marketable crop or crop quality can reduce sales and sales price. So reliable disease control, at minimal cost, is important for economic sustainability of tomato production.

The Cornell tomato breeding/genetics program has taken a multiple disease approach to reducing the need for fungicide sprays. Because there are several foliar diseases impacting tomato production, having a hybrid with resistance to one disease will reduce the need for fungicides with targeted activity for it, but not the need to apply broad-spectrum protectant fungicides and targeted fungicides for other diseases. Late blight, early blight, and Septoria leaf spot are the most important fungal and oomycete diseases in NYS. We needed to breed for resistance to ALL THREE of these diseases in order to create lines and hybrids that could be grown conventionally with substantially reduced levels of fungicides, and also used in organic production with much less use of copper sprays.

The Cornell program is not a seed company; it does not create and market hybrids. When improved lines with useful new traits have been developed, they are released to interested seed companies, which use them either as parents to create new hybrids or as breeding lines to create new lines that also possess the new traits, and can be used as parent of hybrids.

Using the lines that have been released since 2010, a number of hybrids with combined resistances to the three main diseases have been created and are now being sold by several seed companies. So, in this article, we list the hybrids currently being sold, and also summarize new traits being added to lines in development, that should result in new hybrids with improved traits.

Current Fresh Market Hybrids with Multiple Disease Resistance: All of the hybrids developed to date using Cornell resistant lines, and listed below, possess combined resistances to late blight and Septoria leaf spot, plus a strong tolerance to early blight that provides good protection of infection on stems and peduncles (the stems on fruit, which protects against internal infection of fruit) and lesser control of blighting of foliage. The hybrids also possess resistance to Verticillium and Fusarium wilts that is standard in modern tomato hybrids. The hybrids differ considerably in other traits, such as maturity and fruit size, which are unrelated to disease resistance.



Iron Lady photo from High Mowing website

Iron Lady (High Mowing Organic Seed) is the first of the resistant hybrids commercialized. This slicer type was developed in cooperation with the tomato breeding program at NCSU, with Randy Gardner.

See: https://www.highmowingseeds.com/organic-non-gmo-iron-lady-f1-tomato-a.html

Stellar (Pan American Seeds). This slicer is different from Iron Lady in fruit size and maturity, and has improved flavor.

See: https://www.panamseed.com/plant_info.aspx?phid=062000001010320

Stellar photo from PanAmerican website

BrandyWise photo from Fruition website

BrandyWise (Fruition Seed Company) is the result of crossing the popular Heirloom Brandywine with a Cornell line. Eating quality is much like Brandywine, but the fruit have greatly reduced cracking and catface. While not commercialized until 2018, this hybrid was a hit for flavor in repeated trials before 2018, and it has become a favorite tomato for the Cornell Freeville research farm crew/staff members.

See: http://www.fruitionseeds.com/Organic-Brandywise-Tomato-p/t42.htm

Summer Sweetheart photo from Fruition website

Summer Sweetheart (Fruition Seed Company, A relatively new NYS seed company) is a Campari type tomato that has superior flavor. It has an indeterminate vine, and is very productive.

See http://www.fruitionseeds.com/Organic-Summer-Sweetheart-Tomato-p/t43.htm)

Best use of these fresh market hybrids: The early blight tolerance provides good protection on stems and peduncles; however this tolerance provides only moderate control of blighting of foliage, so further control by applying fungicides could be needed. The Septoria leaf spot resistance is also strong in its suppression of lesion expansion, and fungal reproduction, but it does NOT prevent the initial lesion formation by this pathogen. Due to the mechanism underlying this resistance, the best degree of control is obtained when the plants are separated from typical Septoria susceptible tomatoes. In our experiments, this separation can be a little as 15 to 20 feet upwind of the susceptible tomatoes. The late blight resistance is extremely strong

Plum Perfect photo from High Mowing website

Plum Perfect (High Mowing Organic Seed) is the most recent of the resistant hybrids to be commercialized with seed first available in 2019. The diseases it has resistance to differ somewhat from the other hybrids: Verticillium, Fusarium (I1, I2 and I3 genes), late blight, root knot nematodes (Mi) bacterial speck (Pto), TSWV (Sw-5), as well as some early blight tolerance. This hybrid is extremely productive, with a heavy crop of large firm jointless fruit, with very good flavor and color, that can be used fresh chopped or cooked. It was developed in cooperation with the tomato breeding program at NCSU, with Randy Gardner.

See: https://www.highmowingseeds.com/organic-non-gmo-plum-perfect-f1-paste-tomato-a.html

Coming Attractions: Even as these hybrids were being commercialized, the Cornell program continued improving lines by adding additional resistances. Attention turned to transferring resistances to bacterial spot and to bacterial speck into our best lines that already possessed late blight, early blight, and Septoria leaf spot resistance. Development of the new lines was either completed in 2018 or will be completed by end of 2019. Bacterial diseases are notoriously difficult to manage with pesticides because the main one used, copper, is inherently not highly effective (contrasting with modern fungicides) and bacteria have proven adept at developing resistance, plus bacteria multiple rapidly. Consequently, having hybrids with bacterial disease resistance will not only enable growers to reduce their need to apply copper but will also improve their ability to manage these important diseases. As we worked on bacterial disease resistance, we unexpectedly discovered an additional resistance for early blight that is particularly effective at suppressing symptoms on leaves. Transfer of this additional early blight resistance into the best Cornell lines will be completed in 2019. As all of the new lines are completed, they are released to seed companies for creation of hybrids with combined bacterial/fungal disease resistance, and/or with substantially better early blight control. Time to release of new hybrids depends on the seed companies involved.

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