Blossom End Rot, Internal Whitening, and Rain Check of Tomatoes

Cultivar selection can be daunting because numerous options are on the market, and new ones become available every year.

Since 2007, the Pennsylvania Vegetable Growers Association has provided funding for a team of scientists from Penn State University to evaluate cultivars on four sites across the state to help farmers decide which to grow. We’ve studied bell peppers, winter squash, pumpkins, sweet corn, and spring and fall broccoli and cabbage. This year we started, what we hope to be, an era of evaluating tomato cultivars.

The growing season brought several environment-related challenges for us at the site in central Pennsylvania. Early on, we observed many fruit with blossom end rot, later internal whitening of the fruit and the season ended with a lot of fruit with rain check. These issues appear on field-grown tomatoes frequently; however, blossom end rot and rain check were more severe this year for us, likely due to the weather and a management issue.

Data collected from a nearby weather station by the National Weather Service showed that our site’s mean precipitation for June, July, and August are 4.00, 3.77, and 3.57 inches, respectively. Our site was dry, receiving 2.98, 2.52, and 2.88 inches of rain during these months. Then, in September, the site received 3.34 inches of rain, near the mean average of 3.24 inches. Mean average temperatures for June, July, and August are 67.4°F, 71.6°F, and 69.7°F, respectively. Our site was hotter, with average temperatures of 69.3°F, 74.6°F, and 72.9°F. In fact, these average temperatures ranked as the 25th, 12th, and 13th highest since records have been kept beginning in 1893. And if you want to take it a step further, if you average the temperatures for June, July, and August, we experienced the 9th highest average mean temperature since 1893.

We also experienced some issues with our irrigation water source. Namely, several emitters in our drip irrigation system clogged despite using a disc filter. This was not a problem we had experienced before at the research farm, and it took a little investigating to determine why this happened. We used a different pond to supply water to our tomato plants than in the past. Last year, the pond was unclogged after several years of not being used. During this effort, several fish died, changing the whole ecosystem of the pond. As a result, algae grew unchecked and made their way into our irrigation pipes. The number of algae was too much for the disc filter to remove from the water. Once we figured this out, we added another disc filter to the system and washed the filters more frequently, which fixed the problem. However, our tomato plants were drought stressed for a period of about 2 to 4 weeks.

The high heat and droughty conditions due to less rainfall for the bulk of the growing season and the problem with our irrigation system likely resulted in a higher incidence of blossom end rot in our early harvests. The severe rain check we observed was likely due to the rainfall we experienced in September, after the droughty period.

Blossom End Rot

Symptoms of blossom end rot first appear at the blossom-end (bottom) of green fruit, where you'll see either white or brown, water-soaked or leathery, often sunken areas develop. The rest of the fruit ripens, but the lesions at the bottom of the fruit remain. Fruit that have blossom end rot are unmarketable.

It’s been challenging to determine the root cause of blossom end rot. Through research, we know that plants undergoing environmental stressors, such as high temperatures, light levels, and salinity, are more prone to developing fruit with blossom end rot. Scientists have long believed that blossom end rot was caused by a localized calcium deficiency. More recently, some scientists have speculated that the evidence
shows the opposite; that blossom end rot causes a localized calcium deficiency.

Blossom end rot is rarely accompanied by a lack of calcium in the soil. More often, it signals that the plants are going through or recently experienced a dry period, high heat or light levels, or low humidity. To some scientists, it also appears that plants that are rapidly growing when environmental stressors occur are more prone to blossom end rot.

If you see blossom end rot, check your recent soil test reports, and verify that you are applying enough calcium with fertilizers or organic nutrient sources. If calcium levels are adequate, examine your irrigation regime. You may need to supply water more often so the soil is consistently moist. Some cultivars are less prone to blossom end rot. Less prone is not the same as immune; however, scientists at the University of Illinois found ‘Celebrity,’ ‘Fresh Pak,’ ‘Jet Star,’ and ‘Mountain Pride’ to be less affected, among others. ‘Early Girl’ has also been mentioned as being less susceptible.

Internal Whitening

Symptoms of internal whitening are not present in immature fruit and may or may not appear as green, yellow, or white areas near the stem end of ripe fruit. However, when fruit are sliced open, tomatoes with internal whitening have white or green corky areas in the internal flesh.

Scientists are unsure of the exact cause of internal whitening; however, it appears to be related to potassium nutrition, heat, and plant genetics. It seems that plants growing in soils with low potassium and nitrogen have more internal whitening, and in one study fertilizing with potassium reduced the incidence of internal whitening.

It’s hard to recommend management practices until internal whitening is better understood. It may help to closely monitor fertility practices, especially for potassium. If you have supplied enough potassium and the problem persists, look at calcium and magnesium levels. Potassium is a cation (K + ) and can compete with other cations, like calcium (Ca +2 ) and magnesium (Mg +2 ), for cation exchange sites in soils. If calcium and magnesium levels are high in the soil, potassium may not be available for plant uptake, even if potassium levels are sufficient. You also want to have good soil drainage. Roots grown in waterlogged soils can lose the ability to uptake water and nutrients from the soil.

As with blossom end rot, it’s important to maintain uniform soil moisture. Monitor your irrigation practices, particularly during periods of high heat. Practices that support robust, healthy foliage covering the fruit can reduce stress from high light levels and heat. This can lessen the incidence of internal whitening.

Some cultivars are less prone to getting internal whitening. For example, Gordon Johnson and Emmalea Ernest, scientists at the University of Delaware, looked at 28 cultivars of tomatoes and found ‘Jamestown,’ ‘FTM 6298’, ‘Primo Red,’ and ‘Red Bounty’ to have the lowest incidence of Internal whitening.
Rain Check

At the tomato evaluation site at Penn State University’s Russel E. Larson Agricultural Research Center, we harvested our tomato trial weekly, and at about week 11, we started noticing numerous tomatoes with rain check. Rain check is also known as cuticle cracking, weather check, crazing, and russetting. The rinds of the fruit develop numerous concentric micro-cracks, especially on the shoulders. The micro-cracks can unite and form more extensive lesions. When you touch the lesions, they feel rough and leathery. The area around the micro-cracks fail to ripen and remains green or yellow even as the rest of the fruit turns red. The symptoms we observed were severe.

Scientists haven’t yet determined the exact cause of rain check. We know some cultivars are less affected than others, and large, slicer tomatoes are more susceptible than plum or cherry types. Rainfall has also been implicated. One theory is that heavy rain changes the temperature of the fruit or water uptake, which may affect the development of the rind on the shoulder. Another is that the impact on the fruit by the raindrops themselves may cause micro-cracking. Rain check tends to be more severe when periods of drought are followed by heavy rainfall. This describes the weather pattern we experienced in our field. The site received less rainfall than average in June, July, and August, and temperatures were high. Then, in September, the site received about average rainfall.

Jerry Brust, a scientist with the University of Maryland Extension, found that none of the tomatoes he evaluated growing under 30% shade cloth had rain check last year, while 10–20% of the ones growing in the open field did. Shading or protecting the fruit may be a reason using shade cloth helps. Scientists think cultivars with good leaf cover of the fruit are less likely to get rain check. As with internal whitening, practices that support robust, healthy foliage covering the fruit to reduce their exposure to sunlight can help. Another management strategy is to observe which cultivars are immune or less affected by rain check and grow those when possible.