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Blotchy Ripening of Tomato Fruit: Definition, Contributing Factors and Steps to Limiting its Occurrence - *Matthew D. Kleinhenz, Dept. of Horticulture and Crop Science*

Marketable yield is more important than total yield. Physiological disorders like 'blotchy ripening' often have negligible effects on total yield but can reduce marketable yield substantially, to the grower's peril. When it comes to blotchy ripening in tomato, be familiar with how to recognize it, factors that contribute to its development and steps that can be taken to limit its occurrence.

Blotchy ripening is characterized by one or more conditions specific to the external and/or internal color of individual tomato fruit. Idealized versions of individual mature tomato fruit are uniformly red over their entire surface and nearly so throughout their interior flesh. Fruit exhibiting blotchy ripening, however, are not. Instead, defected fruit are mostly red on the outside but marked with areas that remain green, yellow, gray or a much paler red than the remainder of the fruit (e.g., [Figure 1](#)). Blemished areas may be restricted primarily to the half of the fruit nearest the stem. Internally, the flesh, especially vasculature, of fruit exhibiting 'blotchy ripening' may be brown in color or broken down.

Symptoms associated with blotchy ripening can have underlying physiological, disease or insect feeding causes. They can also vary in intensity and frequency; i.e., with regard to the proportions of individual fruit and entire crops or pickings that are affected and to what extent (e.g., of discoloration). Regardless, it is important to note that fruit are said to exhibit blotchy ripening only when they are also in the mid-late stages of ripening as determined by changes in firmness and other variables and when insect (e.g., whitefly) and disease (e.g., TMV) are ruled out as causal agents. These two criteria separate truly 'blotchy'

ripened fruit from firm, immature fruit in the early stages of ripening (which can be mottled in color inside and out) and fruit damaged by the action of pathogens and/or insects. Blotchy ripening is a physiological disorder.

Blotchy ripening has been discussed as a potentially significant marketable yield issue in research and extension publications for at least 76 years. [Seaton and Gray of the Michigan Agricultural Research Station](#) reported on their analysis of the anatomy of blotchy-ripened fruit in 1936 (<http://naldc.nal.usda.gov/download/IND43968800/PDF>). Also, after touring commercial and research farms throughout the U.S., [Minges and Sadik of Cornell University](#) published a protocol for evaluating blotchy ripening in 1964 ([http://fshs8813.wpengine.com/proceedings-o/1964-vol-77/246-247%20\(MINGES\).pdf](http://fshs8813.wpengine.com/proceedings-o/1964-vol-77/246-247%20(MINGES).pdf)). These landmark works provided much needed insight on blotchy ripening but too much about the disorder remains a mystery. Many agree that blotchy ripening occurs more often in greenhouse- and high tunnel-grown crops but open field plantings can also be affected.

What's behind the disorder? Why do certain fruit ripen unevenly? What can tomato growers do to limit the disorder in their crops?

Immature tomato fruit are green and photosynthetic. In fact, early in their development, tomato fruit can produce a significant portion of the sugars found in them through photosynthesis. Later however, the set of pigments found in fruit of most hybrids shifts and red becomes the dominant color.

This shift is pre-programmed but influenced by conditions surrounding the fruit and within the plant and soil. The first and one of the most reliable steps in minimizing blotchy ripening is selecting varieties known to display it very infrequently – i.e., among few crops year to year and among few fruit within a season.

Hybrid tomato varieties are the culmination of huge, coordinated efforts requiring in-depth knowledge of tomato genes. Nearly 100 years ago, these genes were found to include a natural mutation that led individual fruit to ripen uniformly red, today's most common standard. Decades of development of varieties whose fruit turn red over their entire surface and throughout their flesh at precisely the right time relative to other variables related to market-readiness have followed. However, the natural condition of NON-uniform reddening remains in the tomato genome and it shows itself most readily in certain varieties. As a category, heirloom varieties may display the blotchy ripening disorder most consistently. Others claim that indeterminate varieties bred for use in climate-controlled greenhouses but chosen by some high tunnel growers can also show the disorder under some conditions; however, to my knowledge, these claims are not supported by independent research. Regardless, as early steps in avoiding blotchy ripening, consult

reliable reports on variety performance in your area and select varieties that exhibit the problem rarely, if at all. An example of a variety trial report that includes data on blotchy ripening is available [here](https://www2.ag.purdue.edu/hla/fruitveg/MidWest%20Trial%20Reports/tomatoes_centralKY_04.pdf) (https://www2.ag.purdue.edu/hla/fruitveg/MidWest%20Trial%20Reports/tomatoes_centralKY_04.pdf).

A variety's genes may predispose it to physiological disorders like blotchy ripening but this weakness can be minimized or masked with luck and proper management. The causes of physiological disorders can be difficult or take a long time to determine because blotchy ripening and other disorders are difficult to induce experimentally. That said, many years of research and experience have revealed that blotchy ripening is most prevalent when air temperatures during mid-late stages of fruit ripening are extreme (e.g., below 60 deg F and/or above 90 deg F) or highly variable, when humidity levels remain high, and/or when these conditions prevail and light levels are low. Unfortunately, these are exactly the types of conditions common on some farms in the region recently, especially those containing high tunnels. In general, skies have been intermittently cloudy and sunny, temperatures have risen and fallen sharply over short time periods (often reaching below 60 deg F in unheated areas), and rain has been abundant, leading to prolonged periods of high humidity, especially in minimally ventilated high tunnels. These conditions, in combination with varieties susceptible to blotchy ripening, are causing some marketable yield losses.

Nothing can be done to change the weather. Going forward, in addition to careful variety selection, growers are encouraged to minimize temperature extremes and fluctuations as much as possible. As conditions allow, high tunnels should be ventilated so that the interior humidity levels are no higher than ambient, outdoor conditions. Field or high tunnel, though, growers are particularly encouraged to examine their soil fertility and moisture management plans carefully since plant nutrient and water status also influence the occurrence of blotchy ripening.

Most in the extension-research community agree that severe cases of blotchy ripening are most often associated with factors that limit the supply of potassium to maturing fruit. These factors include: waterlogged and/or compacted soils, below-optimal potassium application rates, above-optimal nitrogen application rates, excessive application of potassium competitors, excessively large or dense canopies, and the environmental conditions mentioned previously. Potassium supplies may be restricted for different reasons; so, in evaluating and modifying your irrigation and nutrient management plans, do not over-compensate. Three articles written by Gordon Johnson and Jerry Brust of University of Maryland and University of Delaware Cooperative Extension <http://agdev.anr.udel.edu/weeklycropupdate/?p=1463> and <http://agdev.anr.udel.edu/weeklycropupdate/?p=1503> and

<http://mdvegetables.umd.edu/files/More%20Tomato%20Ripening%20Problems%20and%20Potassium-web%20pg.pdf>) are excellent overviews of the disorder and some peoples' experiences with it. Also, writing in Practical Hydroponics and Greenhouses, Andrew Lee says that supplying too much water on dark days when transpiration is minimal is "by far the most common error." Granted, there is a world of difference between greenhouse and high tunnel and field production systems. However, some of the same principles apply in all of them. So, reviewing Dr. Lee's article (<http://www.grodan.com/files/GR-EN/News/Crop%20technical%20news/Improving%20Tomato%20Fruit%20Quality%20PHG%20may-june%202010.pdf>) is a good idea for many growers.

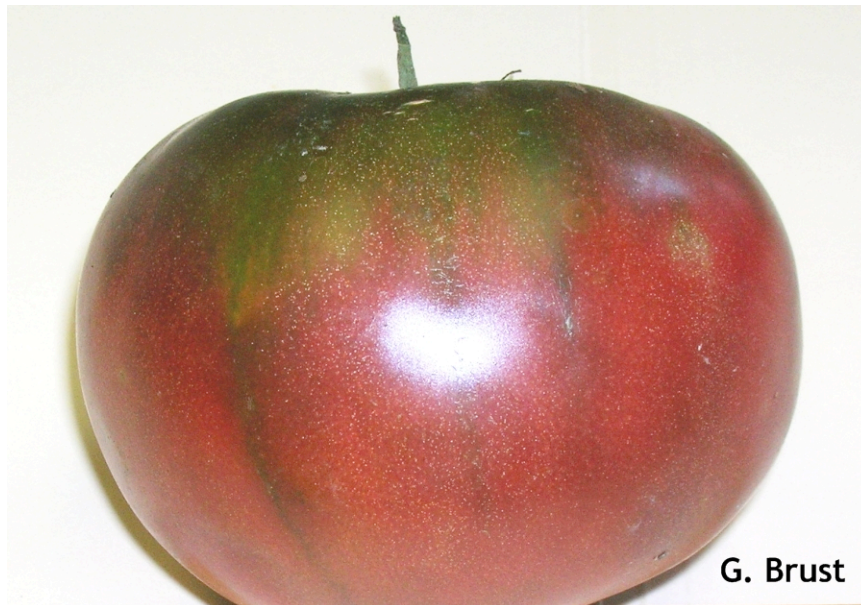
Some speculate that an excessive fruit load may also raise the probability that blotchy ripening will be a problem in some pickings. Data do not yet support research-based recommendations that fruit load be reduced to lessen the occurrence of blotchy ripening. However, growers are encouraged to stay tuned as study results are released and discussed.

Yellow shoulder disorder (YSD) is another type of physiological, ripening disorder. YSD symptoms can be similar to that of blotchy ripening. YSD is also strongly associated with tomato variety and soil fertility. Work by Dr. David Francis and coworkers led to a [website](http://www.oardc.ohio-state.edu/tomato/ysd/newhartzratio.htm) (<http://www.oardc.ohio-state.edu/tomato/ysd/newhartzratio.htm>) that prompts growers to enter basic soil test information to help determine if YSD is a low risk in their soil. Two projects supported by the Ohio Vegetable and Small Fruit Research and Development program (OVSFRDP) in 2013 also hope to shed light on the fertility status of Ohio vegetable soils, especially as it affects marketable yield.

Working from Piketon, Brad Bergesford is documenting the effects of specific fertility programs on total and marketable yield, paying special attention to the occurrence of YSD. Evidence from the 2012 run of the experiment pointed to the benefits of monitoring plant nutrient levels, especially nitrogen and potassium, regularly throughout plant development beginning around the time of first flower cluster formation. When they submit crop tissue for analysis, it is true that results may not be returned to growers in time for them to adjust the fertility program significantly. However, Brad emphasizes that the results from routine analysis can be employed to adjust the program year-year, at minimum, if not planting-planting in a year.

Working from Wooster, Matt Kleinhenz is gearing up to compile an overall report on the nutrient status of Ohio vegetable soils. The goal of the report is to help identify steps the industry can take to enhance its success in soil and nutrient management. All vegetable, including tomato, growers are invited to participate by sharing current soil test information for their farms. Stay tuned for more information on participation and its

benefits.



Understanding the Strobilurin Fungicides (FRAC code 11) – Andy Wyenandt, New Jersey Experiment Station

The strobilurin, or QoI fungicides (FRAC code 11) are extremely useful in controlling a broad spectrum of common vegetable pathogens. You may know some of strobilurins as azoxystrobin (Quadris), trifloxystrobin (Flint), pyraclostrobin (Cabrio), or Pristine (pyraclostrobin + boscalid, 11 + 7). All strobilurin fungicides inhibit fungal respiration by binding to the cytochrome b complex III at the Q₀ site in mitochondrial respiration. Simply said, the fungicide works by inhibiting the fungi's ability undergo normal respiration. The strobilurin chemistries have a very specific target site, or mode-of -action (MOA).

Although highly effective, fungicide chemistries like those in FRAC code 11, with a very specific MOA, are susceptible to fungicide resistance development by some fungi. Why is that? In the strobilurin's, a single nucleotide polymorphism of the cytochrome b gene leads to an amino acid substitution of glycine with alanine at position 143 of the cytochrome b protein.

For us, knowing the specifics on the technical jargon isn't so important, its understanding what is at stake. So,

if we hear someone speak about G143A resistance development to the QoI fungicides (where resistance is already known in cucurbit Powdery mildew and Downy mildew), we know what they are talking about and how important it is! So much so, if cucurbit powdery mildew develops resistance to one strobilurin compound it may develop what is known as cross resistance and become resistant to all chemistries in FRAC code 11, even if only one chemistry has been used!

How do we avoid the chances for fungicide resistance like this to develop? It's simple, don't let the fungus 'figure out' what it is being sprayed with and do this by rotating different fungicide chemistries (i.e., FRAC codes). Proper fungicides rotations are necessary when fungicides with specific MOA's are used in fungicide programs for controlling important diseases. That's why it is important to follow a fungicides label precisely and be certain that some fungicide chemistries aren't overused.

All strobilurin fungicides should be tank mixed with a protectant fungicide, when possible. Remember tank-mixing high-risk fungicides (i.e., FRAC code 11) with low-risk, protectant fungicides (FRAC codes M1-M9) helps reduce (and/or delay) the chances for fungicide resistance development. Never tank mix strobilurins together and never apply any strobilurin fungicide (either the same chemistry or different chemistry) in consecutive applications if stated by the label. Remember, azoxystrobin acts against the fungus the same way as trifloxystrobin does and so on. Even though you are spraying two different fungicides, each has the similar MOA and is acting against the fungus in the same exact way.

Brown Marmorated Stink Bug and Spotted Wing Drosophila Monitoring – Jim Jasinski & Celeste Welty, OSU Extension IPM & Dept. of Entomology

This year we received funding from the Ohio Vegetable and Small Fruit Research and Development Program to monitor for Brown Marmorated Stink Bug (BMSB) and another invasive pest, the Spotted Wing Drosophila (SWD), at about 14 locations around the state.

We've been monitoring for Brown Marmorated Stink Bug (BMSB), a pest of fruits, vegetables, field crops, and ornamental plants, statewide since 2011 using both blacklight and variety of pheromone traps. We have had some detections around the state in the past

few years but only in Columbus has a sizeable population been discovered in crops. So far this year we have had a few detections in Meigs county and Columbus. If you have seen this insect in your fields we would like to know about it. Please report any finds on this website (<http://www.surveymonkey.com/s/bmsb>).

Not sure what BMSB looks like? Take a look at this factsheet, note the white antennal segment along with the abdominal banding (http://bugs.osu.edu/welty/fruit_info1/stinkbug%20info.pdf). There are other “brown” stink bugs in Ohio, such as the spined soldier bug (a natural enemy), the brown stink bug (pest), the one spot stink bug (pest, most common in OH), and the dusky stink bug (pest), so look carefully when you see one.

Control measures for BMSB on various fruit and vegetable crops have been summarized here (http://bugs.osu.edu/welty/fruit_info1/stinkbug%20insecticides.pdf).

Spotted Wing Drosophila has also been detected in Ohio since 2011, and was reported in large numbers at some locations last year. This pest attacks various soft fruits, such as raspberries, blackberries, blueberries, grapes, strawberries and cherries. There are other fruit flies that can be found in these crops which attack damaged or decaying fruit, but SWD can attack ripe undamaged berries. Since the life cycle of this pest is very short, it is important to detect this pest early and apply controls when necessary.

We are trapping for this insect in several locations around the state using apple cider vinegar baited traps. These traps will catch various types of vinegar and fruit flies, but because these insects are so small, it usually takes a microscope to properly identify them. A fact sheet detailing the identification of this fly as well as available treatments if detected is located here (http://bugs.osu.edu/welty/pdf/SWD_Ohio_handoutV9.pdf).

For both of these pests, we are switching to a new method of displaying the trap catch information using a program called MyTraps. This program not only generates an insect trap catch curve from week to week, it also shows spatially where the traps are located in the state. We are just about ready to launch this service to the public, so look for an article soon that details how growers and others can access our trap catch information on these two species, plus all the other insect species we monitor across the state.

Disclaimer

Information presented above and where trade names are used, they are supplied with the understanding that no discrimination is intended and no endorsement by Ohio State University Extension is implied. Although every attempt is made to produce information that is complete, timely, and accurate, the pesticide user bears responsibility of consulting the pesticide label and adhering to those directions.

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