Physiological Tomato Fruit Disorders

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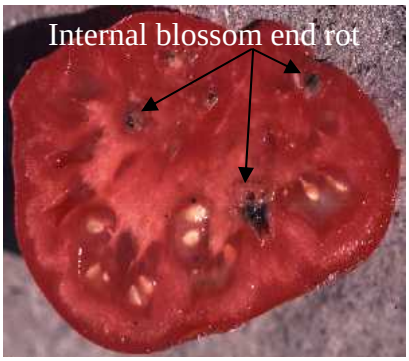
Tomatoes are one of the top three vegetables grown in the mid-Atlantic region. Although easily grown, tomatoes suffer ripening problems and other fruit physiological disorders that on occasion do not have definite explanations as to their cause and possible remedy. This is a list and description of what is known about 15 of the most common tomato fruit problems Maryland growers may encounter in their tomato field.

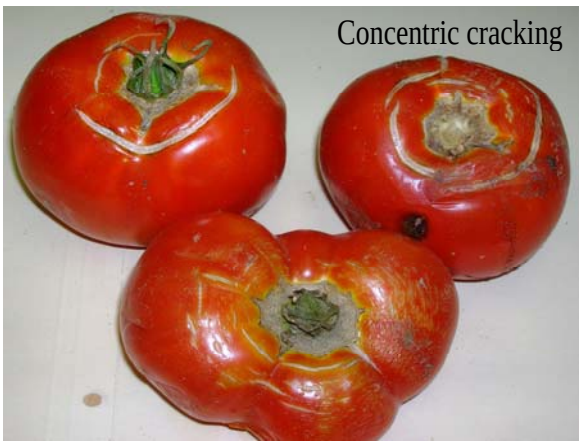
Blossom-end rot begins with tan, water-soaked areas at or near the blossom end of fruit, which usually enlarge and turn black and leathery. This are is then prone to invasion from fungi such as Alternaria. This malady is caused by a localized shortage of available calcium as the fruit develops. While the problem usually occurs externally at the blossom end of the fruit it may also occur internally with no visible symptoms on the outside of the fruit. There are several conditions that may increase the likely hood of blossom end rot. These include: 1. Widely fluctuating soil moisture, which can temporarily reduce calcium concentrations in expanding fruit (because calcium is carried through the plant in the water flow, those plant parts that are rapidly transpiring will have more than adequate levels of calcium, while fruit often receive just adequate levels of calcium. Any moisture stress will reduce calcium uptake and therefore concentration in plants) 2. Nitrogen in the form of ammonium can cause a reduction in calcium absorption and concentration in the tomato plant and 3. Damage to the root system by disease, nematodes or heavy pruning reduces the uptake of calcium from the soil. Foliar applications of calcium do not reduce blossom end rot because the calcium taken up by the leaves is inadequately translocated to the fruit. This fruit problem can be most easily prevented with good water management and proper fertilization.



Catfacing results in fruit with deep indentations in the blossom end or fruit with significant distortions. It is caused by a problem during the formation of the flower that results in the fruit not developing normally. While catfacing is seen every year there is little information as to its exact cause. Temperatures below 50^{o}F that occur 1-2 weeks prior to flowering and fruit set that result in poor pollination can increase the amount of catfacing. Heavy pruning in indeterminate varieties may increase catfacing because of reductions in

auxins in the plant. Jointless tomato varieties seem to be more prone to catfacing than jointed varieties. Unfortunately there is little that can be done for control of catfacing, except selecting varieties that are not prone to the problem. Older cultivars and large fruited varieties are more susceptible.

Growth Cracking in tomato fruit can occur as radial cracking that originates from the stem end down toward the blossom end and as concentric cracking, which occurs as rings around the stem scar. Cracking occurs when internal expansion is faster than the expansion of the epidermis and the outer skin splits. Varieties differ greatly in their susceptibility to cracking. Cracking can occur at all stages of fruit growth but as fruit mature they become more susceptible, especially as color develops. Those varieties that are very susceptible to cracking will crack when fruit is still green while varieties that are tolerant will start to crack at the breaker stage. Management is accomplished by reducing, to the extent possible, large fluctuations in growth rates by selecting tolerant varieties, reducing fluctuations in soil moisture, and maintaining good foliage cover, since exposed fruit are more susceptible.

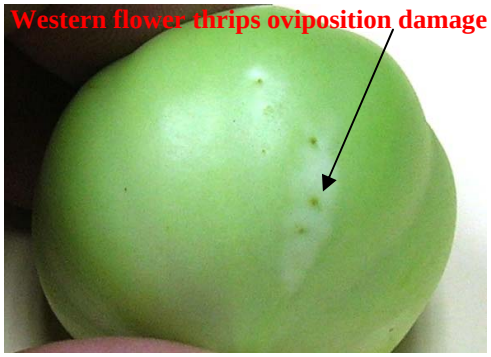


Dimpling is characterized most commonly by a small depression or dimple in the fruit. The injury is usually caused by female thrips inserting an egg into the fruit just below the cuticle with their ovipositor when the fruit is very small. Sometimes dimples are caused by small Lepidopteran larvae that feed briefly (one or two "bites") on very small fruit or by tarnished plant bug feeding. Whichever is the cause, dimpling occurs very early during fruit formation, usually while the flower is still attached. A few dimples usually do not result in grade reduction, however, numerous dimples can reduce grade. Western flower thrips, *Frankliniella occidentalis*, at times causes a noticeable ovipositioning injury on tomato fruit. The damage appears as a round or oval white halo around the center oviposition mark. Unlike damage by stink bug feeding (see below) the cells under this white halo are firm rather than soft and spongy. The dimpling caused by thrips feeding occurs sporadically and

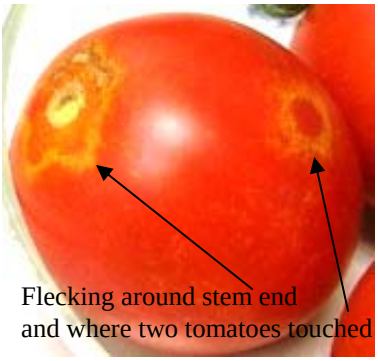

Thrips adult Photo: L. Wilson (CSIRO)

thrips usually do not need treatment. However at times thrips populations can build and cause damage.

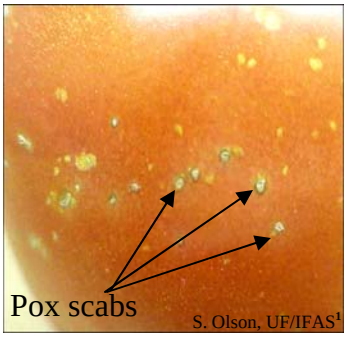
Tomato flowers should be checked by peeling the petals open and observing any movement of thrips within the flower. A 10x handlens is useful for observing thrips. A threshold used in the south is 5 thrips/flower before treatment is justified. If the thrips population in the field consists mostly of Western flower thrips (and transmission of Tomato Spotted Wilt Virus is not a concern) then the threshold is reduced to 1 thrips/flower. You cannot determine thrips species in the field. Adult tarnished plant bugs, which are about ¼ inch long and are brown, tan or greenish with dark markings on their wings and back; prefer to feed on newly formed fruits. They secrete a toxic substance from their salivary glands which kills the cells surrounding the feeding sites. As the fruit enlarges, healthy tissue will expand while the dead tissue does not, which results in distorted and malformed fruit. Malformed fruit may also be invaded by *Alternaria* and become dark in color.



Gold Fleck, or fleck, is included here because some tomato workers believe fleck is caused by thrips or other sucking insect feeding, while others believe its cause is genetic or environmental. Fleck develops as small irregular green spots found randomly on the surface of green fruit which become yellow (gold) as the fruit ripens. Spots can vary from few to many. There is evidence from NC that insecticide use can greatly reduce flecking, however other work has shown fleck appearing when no thrips or sucking insect was present. Certain varieties show a predisposition to developing fleck, whatever its cause. In Florida fleck is not associated with thrips feeding even though they have thrips present in the field 8 or 9 months of the year. The most common thrips species in Florida tomato fields is *Frankliniella bispinosa*, Florida flower thrips (unless the field has real problems and then it is usually *F. occidentalis*, WFT). In the north *F. tritic*i (Eastern flower thrips) is probably the most common species found in vegetable fields. The difference in flecking development could be due to the difference in the species of thrips most commonly found in the field.

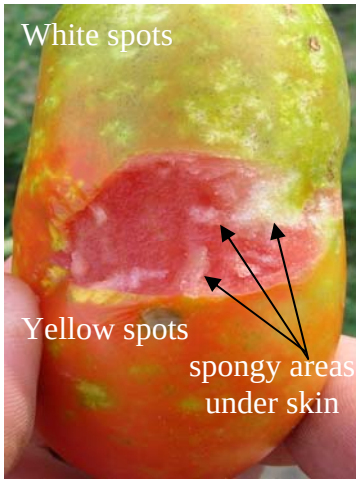


Pox appears as small brown crusty disruptions found on the fruit surface that varies in number from a few to many. The cause is not well understood, but it seems to be genetic in nature. Pox usually shows up on the same fruit as gold



fleck but its association with thrips or sucking insect feeding has yet to be determined. Pox is difficult to work with because it manifests itself only under certain environmental conditions. Not surprisingly there are differences in varieties as to the frequency of pox development.

Cloudy spot can be characterized as pale, yellow, or white spots on the fruit surface with shallow, white spongy areas in the flesh. When the spots are cut open they do not go very deep into the flesh of the tomato. Cloudy spot is caused by stink bug feeding. Stink bugs insert their syringe-like mouth parts into green fruit and withdraw cell contents. This feeding results in empty cells filled with air that is spongy and white. Stink bug feeding rarely results in deformed growth of the fruit. Stink bugs are difficult to scout for in tomato foliage. When the plant is disturbed they drop from the foliage and are rarely observed. When 1 % of fruit show this damage a treatment is warranted for stink bugs.



Sunscald appears as yellow, sunken, wrinkled, areas usually on the shoulder of the fruit. It occurs when tissue temperature rises above 86^0 F. The high temperature causes yellow pigments to develop, but not red pigments. In sever sunscald cases (tissue temperatures above 104^0 F) the tissue turns a bleached white and dies. Damage takes place when leaves are moved about or when there is foliage loss suddenly exposing the fruit to sunlight for a period of time. This can occur following harvesting, excessive pruning, a storm or foliage loss due to disease. Some growers use a sun screen material such as 'Surround' to help reduce sunscald, but the problems with removing the sunscreen material from the fruit at harvest usually make this method non economical on large acreages.

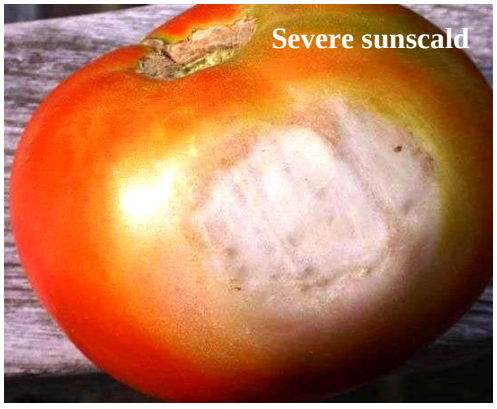
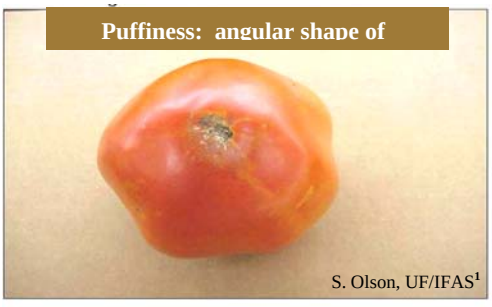


Photo Courtesy Missouri Botanical Garden Gardening Help

Puffiness causes fruit to appear somewhat bloated and flat-sided or angular. When fruit are cut, cavities may be present that lack the normal seed gel. Fruit is less dense and feels very light in relation to its size. Puffiness is caused by incomplete pollination and seed development and inadequate fertilization. Poor pollination can occur at temperatures that are too low or too high during fruit set. Other factors such as low light or rainy conditions can also cause seed set problems.



Rain check appears on tomato fruit as numerous tiny concentric cracks that develop on the shoulder of the fruit. In severe cases, the cracks can extend 1/4 to 1/3 of the way down the side of a fruit. Cracks feel rough to the touch and affected areas can take on a leathery appearance. Green fruits are most susceptible. Damage occurs on exposed fruit when a heavy rain occurs after a long dry period. There are varietal differences in the susceptibility to rain check. Good canopy coverage is necessary to avoid rain check.


Rain check damage

Zippering fruit have lines along the side of the fruit usually from the stem end to the blossom end due to abnormalities in early flower development. At times a "hole" forms on the side of the fruit along the zipper. Although sometimes attributed to high humidity or an anther that is attached to the newly forming fruit the cause of the zipper scar is still unknown. The only control is to select varieties that are not prone to zippering.


'Zipper' line along fruit


'Hole' in zipper line

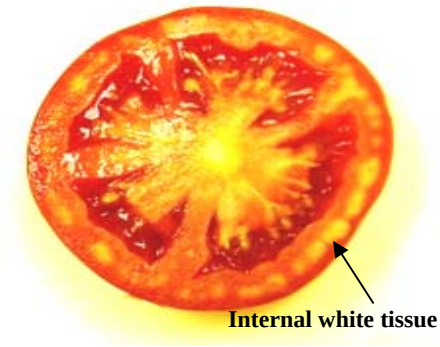
Blotchy or uneven ripening/yellow shoulders of tomatoes is characterized by areas of the fruit that fail to ripen or do so after the rest of the fruit is ripe. White or yellow blotches can also appear on the surface of ripening fruit while the tissue inside remains hard. The affected area is usually on the upper portion of the fruit. This problem is more prevalent in cool, wet, often cloudy conditions. This problem is exacerbated by too much or too little water. Soils high in nitrogen and/or low in potassium will increase its severity. Blotchy ripening appears more frequently on older cultivars. Studies at UC-Davis demonstrate that for uniform color development more available potassium than is necessary for yield alone is needed. Their studies show the incidence of yellow shoulder was lower in fields with a high potassium status of both soil and

Uneven ripening of fruit

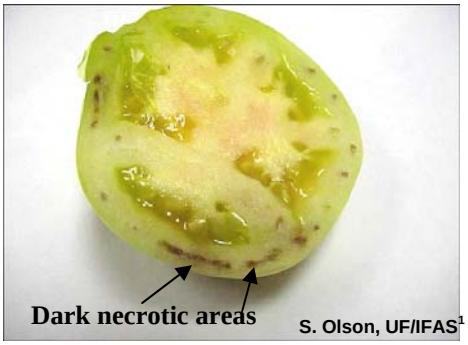

Yellow shoulders

plant. Foliar applications of potassium, however, were not effective in relieving this disorder. Work in the Great Lakes region has suggested the importance of soil organic matter and pH. Tomatoes grown on soils containing greater than 3.5% organic matter produced fruit with a low incidence of blotchy ripening/yellow shoulder while tomatoes grown on soils with organic matter below 2.5% produced fruit with a high incidence of the disorder. Tomatoes produced on soils at a pH of 6.4 had a low incidence of yellow shoulder while tomatoes grown on soils in excess of 6.7 had a high incidence.

Internal white tissue is a disorder where the affected fruit rarely shows any external symptoms. However, when ripe fruits are cut, white hard areas are present in the outer walls. High temperatures during the ripening period seem to trigger the symptoms. Maintaining a sufficient potassium fertilization program (soil exchangeable potassium (K^+) level of 130 PPM in sandy loams) can reduce symptoms but may not eliminate them. As is common with many of these fruit problems some varieties are more prone to the disorder than others.



Graywall appears as grayish often slightly sunken areas of the fruit. It is caused by a partial collapse of the vascular wall tissue causing dark necrotic areas in the outer walls. The collapsed tissue is sometimes present in the cross-walls of the fruit. This problem usually does not affect tomato crops in our area as graywall is more of a problem during cool, short days as is possible to find in a very late season tomato crop in the north. However, when tomato plants are under stress, i.e., drought, high heat index, root problems, severe nutrient deficiencies, etc. even in the mid-Atlantic you can find gray wall in some varieties.



References

[1] Photo from: Document HS-954, one of a series of the Department of Horticultural Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication date: February 2004. Dr. Stephen M. Olson, professor, Department of Horticultural Sciences, North Florida Research and Education Center, Quincy. Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.