UF IFAS Extension UNIVERSITY of FLORIDA

HS1107

Control of Rapid Postharvest Decays of Tomato Fruit[1]

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What is a rapid postharvest decay? Water-soaked lesions begin within 12 to 18 hours after harvest and continue to develop, producing large amounts of fluids. The decay spreads within cartons of tomatoes, producing wet patches in the bottom and sides of the container, a condition called "wet-boxes." Affected fruit are out-of-grade either prior to shipment or upon arrival at the receiver.

Brief History

Severe outbreaks of postharvest decay have occurred sporadically in the Florida and eastern U.S. tomato production areas. Persistent decay losses typically begin during the summer and early fall in Virginia and Maryland and then appear in north Florida as production areas shift southward. Often the extensive decay development abruptly disappears as weather patterns shift from warm, wet days to predominantly cool, dry days.

Growers suggest that a condition called "tender fruit" is responsible for decay losses. The term "tender fruit" does not have a scientific definition, but to growers it means enhanced bruising during harvest. In 1964, R. S. Cox observed a field disorder, shoulder pox, on tomatoes produced in the lower east coast of Florida, which he attributed to the combination of tender fruit; cool, moist weather; and the application of certain pesticides. However, rapid fruit breakdown noted among packed fruit usually appears during warm, moist weather. The affected fruit also are likely to have been "tender." An abrupt weather change from warm/ dry to cool/wet plus heavy morning fogs also has been associated with tender fruit. These conditions often coincide with persistently wet fields and moist plant canopies. Canopy wetness promotes an increase in the populations of decay pathogens and may lead to infections of maturing fruit as well as stems and petioles. Moisture on fruit at the time of harvest readily disperses pathogens. Recent research has identified vulnerable areas around the stem attachment that become infected if free moisture persists on fruit surfaces. The common recommendation for avoiding decay issues associated with wet plants is "do not harvest if the plants are wet." However, at times, this may not be a viable option due to price, crop-maturity, or labor issues, or to an approaching inclement weather system such as a tropical storm.

Normally two postharvest diseases, bacterial soft rot and sour rot, can produce a rapid breakdown of fruit, which is accompanied by a release of fluids by infected fruit and spread within packed cartons.

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Soft Rot Bacteria (Bacterial Soft Rot)

- Caused by species of *Pectobacterium*. Are found in all humid growing areas and exist in highest populations on plants and in surface water.
- May cause lesions at injuries on stems or petioles if the canopy remains wet for several days.
- Are dispersed among tomato fruit via rain splash, decay fluids movement, storms, insects, equipment, and handling during harvest.
- Infect fruit equally well at any stage of maturity or ripeness.
- Cannot infect directly through intact fruit cuticles. However, naturally occurring gas-exchange pores (Figure 1), cracks at the edge of stem scars (Figure 2), cuticle cracks (Figure 3), or various insect or mechanical wounds are readily infected.

Figure 1. Air bubbles emanate from naturally occurring openings around the stem scar of fruit that are submerged in water or exposed to a vacuum. These openings are required for healthy fruit but if they become water congested, bacteria can internalize.

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- Rapidly dissolve fruit tissues and usually produce cloudy fluids and an unpleasant aroma.
- Lesions first become visible as water-soaking at the initial site of infection.
- Lesions may develop from the inside out if water and bacteria enter fruit tissues (become internalized) (Figures 4 and 5).

Figure 2. In addition to lenticels involved with gas exchange, other cracks may occur around the stem scar. These cracks can be penetrated by particulate matter such as carbon particles as shown here or by microbial suspensions.

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Figure 3. Severe water congestion causes tomato fruit to swell, which leads to cuticle cracking as shown here.

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- Bacterial internalization occurs with persistently wet fruit or fruit that increase in weight (absorb water) during handling such as fruit submerged too long or deeply in dump-tank/flume water or that cool while submerged.
- A white, yeast-like fungus may grow over the surface of the bacterial soft rot lesions (see Sour Rot below).
- Healthy fruit that become contaminated with fluids from decaying fruit likely will become infected both prior to harvest and postharvest.

Figure 4. Bacterial soft rot internal lesion. Bacteria entered into fruit under the stem attachment.

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Figure 5. Bacterial soft rot internal lesions. Internal view of bacterial soft rot that began at blossom and stem ends of fruit.

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- Initial water soaking and disintegration of tissues can become visible within 12 hours of inoculation, particularly among fruit stored at higher temperatures (>80°F).
- The disease is favored by moist conditions (dry wounds may remain free of disease for several days) and develops most rapidly at 77°F–97°F.
- Experimentally, onset of bacterial soft rot was delayed up to 3 days among inoculated fruit stored at 70°F compared with those stored at 86°F.

Sour Rot Pathogens (Sour Rot)

- Include certain *Geotrichum* species as well as bacteria that produce lactic acid.
- Have been isolated from the soil, plant debris, decaying tissues, and garbage, as well as from the canopies of healthy plants (although the latter had only small populations).
- Are dispersed from sources to fruit by splashing rainfall, field crews, equipment, harvest activities, and insects, including fruit flies and those causing surface injuries.
- Cannot penetrate an intact fruit surface (see Soft Rot Bacteria for a description of internal lesions). However, like soft rot bacteria, sour rot pathogens can infect through moist surface cracks including small cuticle cracks.
- Initial symptoms appear as a water-soaking of tissues in or around the edges of wounds including the stem scar, open blossom-end pore or scar, cuticle cracks, etc. (Figures 6–8).

Figure 6. Rain check. Dark checked areas are a severe form of cuticle cracking that develops in wet weather. The cracks enable attack by postharvest pathogens.

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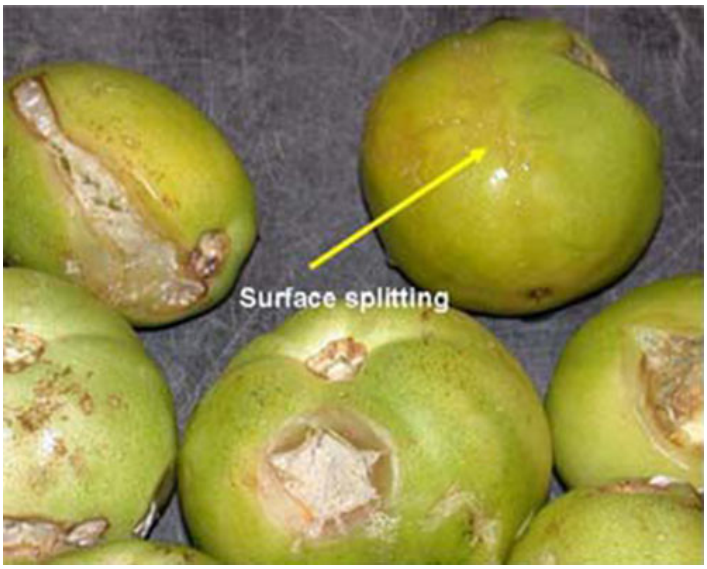

Figure 7. Sour rot from natural outbreak. Dark, rough areas are rain checks. Fruit (upper right) has surface splitting due to decay spread in the carton.

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Figure 8. Sour rot internal lesions from natural outbreak. Rough fruit became infected through blossom-end scars and wounds. Tissues appear to be pickled, with only a little evidence of fungal development at the surface.

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- Lesions do not enlarge as rapidly as those produced by soft rot bacteria.
- The minimum interval between inoculation of wounds and the beginning of water soaking is unclear but appears to take longer than soft rot.
- The liquid seeping out of sour rot lesions is generally clear and has either a distinctive sour odor or no odor at all.
- Lesions usually become covered by a white, yeast-like growth within 24 hours of exposure to air (Figures 6 and 7).
- Warm, moist conditions favor disease development (optimum = 86°F).
- Green tomatoes have been described as resistant to sour rot unless weakened by chilling injury. However, recent tests established that green fruit are susceptible to sour rot if they are congested with water, such as during wet harvests, particularly while fruit are tender (see above) (Figure 9). With exposure to air, sour rot lesions on green fruit that are not water-congested usually become arrested (Figure 10). However, lesions on red tomatoes continue to expand.

Preventing Rapid Postharvest Decays

Field Practices

- Provisions should be made for insuring adequate drainage, particularly if unsettled weather might occur during the production season.
- Recommended disease and insect control practices should be used.

Figure 9. Sour rot infection in green tomato involves high water content. An apparent bruise with infection occurring at tiny cracks in the fruit surface is evidence that this fruit is tender, which likely means high water content.

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Figure 10. Arrested sour rot lesions. Sour rot lesions in green fruit may become arrested when exposed to air. The decay will resume development as the fruit ripens.

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- If at all possible, fruit should not be harvested if the plants are wet, even if there are only a few droplets of free moisture on or at the edges of leaves. Figure 11 illustrates that wet stem scars rapidly internalize decay pathogens that contact the scar surface. (See below about minimizing decay risk associated with wet harvests.)
- Clean and disinfect all harvest containers prior to first harvest and periodically during the harvest season. Some packers clean and sanitize bins after each use.

Figure 11. Fruit picked during a rain shower and then dye added to wet stem scar. The dye was washed off after 2 minutes and the fruit was sliced. Note the green dye (arrows) that has moved down vascular tissues from the stem scar (top).

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- Immediately clean and disinfect any container that has been in contact with decayed fruit.
- Teach harvest crews to avoid handling or picking partially decayed fruit.
- Require harvest crews to wear gloves so that glove surfaces can be washed in chlorinated water immediately after encounters with decaying fruit, as well as periodically during the day (lunch breaks, etc.).
- Avoid mechanically injuring fruit during harvest and avoid excessive load shifting during transport to the packing house.
- Bins or gondolas of harvested tomatoes should not be exposed to rainfall or suffer prolonged exposure to direct sunlight. Loads hauled from fields to distant packing houses should be covered with a tarpaulin.

Packinghouse Practices

- The water in dump tanks and flumes should contain a minimum of 150 ppm free chlorine at pH 6.5–7.5 where fruit enter the system.
- Rapidly removing field heat will slow decay development. Tomatoes cooled to 68°F or lower by forced-air cooling are unlikely to develop lesions quickly. The moving air dries moisture from stem scars and fruit surfaces, which decreases the chances for infection.
- Containers of chlorine products must be kept out of direct sunlight because heating can cause a rapid loss of free chlorine.
- Flumes must be designed to avoid "dead" pockets, where fruit float in an eddy and do not progress promptly to the packing line elevator-conveyor.
- Holding bins of tender fruit overnight to facilitate the disappearance of minor bruises is likely to favor growth of decay pathogens if the pulp temperature remains high (>85°F). However, if the fruit are cool (< 70°F), the overnight holding period should decrease decay risks (dry wounds and stem scars are not as susceptible as wet ones).
- People responsible for culling fruit on the packing line must "cull tight" and remove all injured fruit, even those with minor surface cracks.
- Chlorine concentrations in dump tanks and flumes must be monitored carefully and should not be excessive. High chlorine concentrations will not control decay any better than recommended levels.
- Bins of fruit harvested from wet fields contain leaves and other debris and the fruit may appear "grimy." Such loads are likely to have an unusually high chlorine demand and quickly depress active chlorine levels in the dump tank and flume.
- Maintaining adequate free-chlorine concentration and pH in dump tank water during these periods requires vigilance. Frequent free-chlorine measurements are recommended, even if an automated oxidation-reduction measurement (ORP) system is in place. With the latter, false readings may occur due to fouled electrodes or other measurement problems.

For More Information

Handling Florida Tomatoes: Round and Roma Types. EDIS publication SS-VEC-928. http://www.edis.ifas.ufl.edu/vh079.

IPM Guide for Florida Tomato and Pepper Production. https://edis.ifas.ufl.edu/topic_series_ipm_guide_for_florida_tomato_and_pepper_production.

Identifying and Controlling Postharvest Tomato Diseases in Florida. EDIS publication HS866. http://edis.ifas.ufl.edu/hs131.

Physiological, Nutritional and Other Disorders of Tomato Fruit. EDIS Publication HS-954. http://edis.ifas.ufl.edu/hs200.