DISEASE MANAGEMENT:
Postharvest Diseases of Tomato

Florida tomato production is often challenged by an array of plant diseases promoted by a warm and humid climate. The conditions that promote plant diseases also favor the development of fruit rots, both in the field and during handling and shipping.

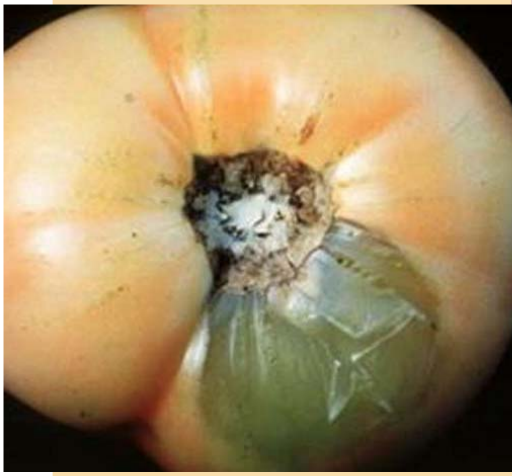

Figure 1. Even a thin coating of water, such as on a wet fruit, leaf, field bin, or on packinghouse machinery, can support rapid movement and growth of bacteria causing disorders such as bacterial soft rot Phtotgraph by: UF/IFAS.

Figure 2. A carton of tomatoes with "nested" *Rhizopus* rot (and some secondary fungi). Photograph by: Michael Mahovic.

Fruit rots are generally caused by opportunistic pathogens, those that cannot directly infect fruit tissues unless the tissues are stressed. These pathogens are ubiquitous (found everywhere) in the natural environment. Mechanical injuries (e.g., bruises, cuts, punctures) that occur during harvest and handling are a predominant cause for decay because they provide infection courts (protected sites) for decay pathogens. Once it initiates a lesion, a decay pathogen often can engulf the rest of the fruit. During the process of invasion, infection, colonization and reproduction, the pathogen usually produces structures and materials that promote the infection and decay of adjacent and nearby fruit. Fruits and vegetables vary in their innate resistance to decay; those crops that have active wound-healing processes are more resistant. Tomatoes form a natural abscission zone at the stem scar and are more resistant to pathogen attack than other crops, such as broccoli, that don't form an abscission zone and must be cut from the plant.

Once harvested, fruits and vegetables have a limited postharvest life. They no longer receive water or nutrition from the plant. Naturally occurring senescence in produce leads to a softening of the tissues and often a loss of preformed antimicrobial substances. These changes in the fruit or vegetable quality also make it less desirable to consumers. This correlation between senescence, susceptibility to decay and loss of edible quality has a great impact on decay control methods. Therefore, handling methods that preserve the fresh-harvest quality of the product are also likely to minimize the development of decay.

FIELD SANITATION:

The implementation of good agricultural practices (GAPs) in the field and at harvest greatly aids in the prevention of most postharvest fruit rots. However, periods of persistent rainfall or chilling temperatures can increase decay losses despite the GAPs. In addition to disease control strategies, the GAPs should include control of chewing insects that create wounds in fruit. Plant management should promote air movement over plant surfaces, particularly those hidden beneath the outer leaf canopy of the plant. This air movement is necessary to dry dew or rainfall from plant surfaces. Tying and harvest operations should be postponed until free moisture has dried from the plant canopies, since wet plants are more prone to mechanical injury (creating wounds), and the free water promotes the spread, survival, and growth of decay pathogens. Drip, furrow, or seep irrigation is preferred to overhead irrigation because overhead irrigation moistens plant surfaces.

FOOD SAFETY CONSIDERATIONS:

Certain human pathogens, including bacteria belonging to species of *Salmonella*, *Shigella*, *Escherichia*, or *Listeria* and certain viruses, may survive on or in fresh tomato fruit. Under certain conditions, bacteria may actually multiply. Sources of the human pathogens include infected workers, domestic and wild animals, raw manure, contaminated equipment/containers/trucks, nearby pastures, or animal confinements as well as open surface water such as swamps or lakes. Dispersal to developing or harvested fruit occurs by direct contact or through contact with rain splash, aerosol drift, run-off water and overhead irrigation with surface water.

Since human pathogens do not visibly affect the fruit, their presence may be unknown at the time of packing and marketing. However, consumers can be infected and an outbreak can have a devastating effect on not only the implicated packinghouse, but also the entire industry. Fortunately, the same sanitation steps that control fruit-rotting pathogens normally control human pathogens.

Prepared by: Dr. Michael Mahovic

PACKINGHOUSE SANITATION:

The potential for development of fruit decay after harvest is least if the plants are dry and free of decay at the time of harvest. However, since harvested fruit will virtually always have some level of contamination by decay pathogens, steps must be taken to prevent fruit contamination when the tomatoes are transferred into the dump tank. Sufficient sanitation requires the inactivation of freshly introduced microbes within about 10 seconds of initial contact in the dump tank water. Suspended microbes that are not killed within 10 seconds may internalize in wounds or stem scars on tomatoes and thus be protected from antimicrobial treatments. "Vigilance" is the key word in preventing decay.

Figure 3. Infiltration of soft rot bacteria through the blossom end led to development of this decay during storage. Photograph by: Michael Mahovic.

Microbe infiltration: Dry surfaces may be penetrated by water suspensions through a process called infiltration. *Infiltration* occurs when the external pressure of the liquid contacting the fruit surface overcomes the natural hydrophobic resistance of the wax and/or presence of air bubbles in openings in the tomato surface. For example, infiltration occurs when warm tomatoes are submerged in cool water as briefly as 5 to 10 minutes. As the fruit cools, air inside its tissues contracts, creating a vacuum that allows the surrounding water (and suspended microbes) to enter openings such as the stem scar or catfaces at the blossom end. Infiltration can also occur when fruit are struck by a high-pressure stream of water such as when tomatoes are flumed from a gondola. We have noticed that some tomato cultivars are more likely to absorb water during postharvest handling than others and we are currently screening the most widely grown cultivars.

Several procedures can minimize infiltration into tomatoes:

- Heating dump-tank water 10°F (about 5°C) above the incoming tomato pulp temperature eliminates fruit cooling.
- Limiting tomato residence time in dump tanks and flumes to less than 2 minutes, and minimizing contact of tomatoes in gondolas with large streams of water will reduce the potential for infiltration.

RECIRCULATED WATER SANITATION:

Chlorine has been widely used in water sanitation for many years. Alternatives to water chlorination for tomato dump tanks have been proposed and several have been tested, however, none of the alternatives appear to be as efficient, inexpensive, easy to apply, and effective as chlorine. A major factor in the effectiveness of chlorine is how rapidly it kills microbes. In laboratory tests, soft rot bacteria were mixed in water that simulated packinghouse conditions. Tomatoes with wounds and stem scars were then immersed in the water. Decay later developed on tomatoes that were immersed for only 5 to 10 seconds. As a result of this rapid internalization, the bacteria were not affected by drying or other surface treatments; they were able to grow and initiate soft rots. But when chlorine was present in the water before soft rot bacteria were added, the immersed fruit were protected from contamination and never developed decay.

The following recommendations are given for effective sanitation of recycled water systems:

Figure 4. An infected tomato can spread inculum to healthy tomatoes in the dump tank. Photograph by: Steve Sargent.

- Maintain free chlorine concentration at 150 to 200 ppm and pH of 6.5 to 7.5.
- Heat dump tank water and flumes at least 10°F (about 5°C) above tomato pulp temperature.
- Keep immersion time less than 2 minutes to minimize water infiltration into the tomato.
- Do not allow tomatoes to float in stagnant water during crew breaks or for longer periods of time; eliminate "dead spots" in the flume system where tomatoes can remain caught.
- Do not allow tomatoes to accumulate to more than a single layer in the dump tank, to minimize water pressure and infiltration into the fruit.
- Use an automated system for continuous chlorine and pH control, with manual measurements recorded hourly. If the manual measurements suggest the automated system is unreliable, the readings should be made more frequently.
- Drain dump tank daily, remove sediments, sanitize, rinse, and refill with potable water.
- Follow local regulations on disposal of treated water, and comply with all chemical labels (for chlorine, acidifier, etc.); *the container label is the law*!

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Sanitation must be effective at each step from harvest through handling. An effective GAP/GMP strategy for sanitation incorporates the recommendations for adequate control of decay pathogens.

Figure 5. A fruit with a fingernail wound (arrow) that later developed into black mold rot. Photograph by: Michael Mahovic.

OTHER SOURCES OF INOCULATION:

Pathogens can be dispersed to fruit through *contaminated equipment or workers*. Therefore, field bins, gondolas, harvest aides and harvest containers should be regularly cleaned and disinfected. All workers should be instructed on the importance of sanitation and on proper personal habits including hand washing. Restrooms should be regularly cleaned and sanitized. Hand washing stations should be conveniently located outside of restrooms as well as near the sorting belts on packing lines. Workers should be encouraged to wash frequently throughout the day. Workers who are or have been recently ill should not be allowed to work directly with fruit.

Mechanical injuries, such as cuts, punctures, abrasions, and bruises provide likely sites for infection to occur **(Figure 5)**. Gentle handling procedures during harvest operations should be enforced to minimize fruit injuries. *Thorough sorting* of injured fruit is essential to minimizing later development of postharvest decays. The sorting area of the packing line should have good lighting so that damaged fruit are easily sorted out. Tomatoes can be *cross-contaminated* by certain types of decay pathogens and other undesirable microorganisms via air movement, insects, and animals. Therefore, the packing area, ripening rooms, and storage areas must be kept free of rodents, birds, and insects, which can disperse various undesirable microorganisms or even be the source of such organisms.

Culled fruit can harbor pathogens and should never be allowed to accumulate near the packing facility. *Trucks and trailers* used to transport tomatoes should be inspected for cleanliness and cleaned and sanitized, if necessary, prior to being loaded. If the truck has previously hauled animal products, it should be steam cleaned before it is allowed to haul tomatoes.

Tomatoes are often harvested at temperatures that are ideal for decay development, e.g. above 86°F (30°C). In our tests, tomatoes that were inoculated with soft rot bacteria developed decay after 18 hours at 86°F. By contrast, when inoculated tomatoes were held at 68°F (20°C), the recommended ripening room temperature, soft rot lesions did not appear until 3 days or more had passed. In fact, inoculated tomatoes often do not develop any soft rot decay when stored at 68°F. Consequently, efforts should be made to remove field heat from freshly harvested tomatoes as soon as possible to reduce postharvest decays.

RECOMMENDATIONS:

- Tomatoes should not be gassed longer than 5 days; 3 days is the preferred maximum for best quality. Extended gassing time (due to unusually high proportion of immature-harvested tomatoes) favors mold growth during gassing and storage.
- Plastic bins are more easily sanitized than unpainted wooden bins. Surfaces that directly or indirectly contact tomatoes should be regularly cleaned and sanitized (picking buckets, bins, gondolas, packing line components, pallets); gassing and holding rooms, walls, floors and refrigeration coils should also be regularly cleaned.
- Quaternary ammonia compounds are effective sanitizers on equipment but may not be approved for direct contact with foods. Bin and packing line surfaces treated with these compounds can cause chemical injury to tomatoes. Prior to reuse, all treated surfaces should be thoroughly rinsed with potable water. *In particular, dump tanks cleaned with ammonia compounds should be thoroughly rinsed with water prior to filling with chlorinated water. Ammonia compounds react quickly with chlorine to form noxious gases.*
- Hand washing facilities should be available at all handling points, beginning in the field. Employees should wash their hands *thoroughly* with soap after each restroom use. "Waterless" hand sanitizers are good supplements to proper hand washing, but are not effective sanitizers when used alone.

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References:

Information excerpted from http://edis.ifas.ufl.edu/HS131.

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Erwinia carotovora subsp. *carotovora* and certain other bacteria

SIGNS & SYMPTOMS:

Fruit: Water soaking, with or without brown discoloration beginning at wounds, edges of stem scar or blossom end followed by rapid softening and liquefaction of the affected tissues. Juices from damaged tissues will spread disease to adjacent or nearby fruit. Lesions may begin internally if fruit absorbs water or wet stem scar contacts inoculum.

Stems and petioles: During wet weather (when plants remain wet for several days), stems and petioles may develop soft rot at injuries associated with tying the plants or where stems are bent due to canopy weight or development. The infected tissues are soft and may show evidence of soupy bacterial development.

DISEASE CYCLE & EPIDEMIOLOGY:

Bacterial soft rot is favored by warm (77-95°F), wet conditions. The bacterium is ubiquitous. Attacks on the plant are favored by injuries including those caused by chewing insects, stink bugs or storm damage. Water penetration of wounds, the stem scar or the blossom scar greatly favors infection.

FIELD SIGNATURE:

- Touch suspect areas with hard probe such as pencil, screwdriver, etc. Affected tissue will be soft and slimy.
- Cut open fruit with a water-soaked spot around or beneath stem scar or stem attachment. Internal lesions are obvious, soft and slimy.

PHOTOS:

Figure 1. Soft rot beginning at old stem puncure. Photograph by: Jerry Bartz.

Figure 2. Cross-section of soft rot infected through blossom pore. Photograph by: Jerry Bartz.

Figure 3. Surface soft rot lesion caused by *Pseudomonas aeruginosa*. Photograph by: Jerry Bartz.

Prepared by: Dr. Jerry Bartz

CULTURAL CONTROLS:

- Avoid working with or harvesting wet plants or fruit.
- Cool freshly harvested fruit promptly to 60-68 °F.
- Control insects and weeds.
- Do not expose freshly harvested fruit to rainfall.
- Remove decaying fruit from field and/or packinghouse.
- Do not allow harvested fruit to absorb water such as by prolonged immersion, immersion too deeply, or immersion where the fruit cools.
- Do not apply high pressure water streams directly to fruit surfaces.
- Make sure fruit surfaces are dry before packaging them.

Figure 4. Soft rot beginning beneath the stem attachment. Risk of bacterial soft rot can be reduced by limiting postharvest fruit exposure to water. Photograph by: Jerry Bartz.

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CHEMICAL CONTROL:

- Nothing available that is effective for controlling bacterial soft rot preharvest.
- Chemicals that sanitize water or fruit surfaces are helpful for minimizing populations of soft rot bacteria in postharvest handling.
- Maintain a minimum of 200 ppm free chlorine at pH 6.5 to 7.5 in dump tanks and flumes.
- Wash field containers and picking buckets with chlorinated water or appropriate surface sanitizer after unloads and prior to taking them back to field.

RESISTANT CULTIVARS:

- None with complete resistance.
- Avoid growing cultivars such as Florida MH-1,47 or 91 that are likely to take up water during times of the year when rainfall is expected (early or late summer into early fall).

FIELD CREW MANAGEMENT:

- Encourage field crews to wear latex or rubber gloves and gloves should be periodically washed in chlorinated water.
- Workers that are ill should not be picking or handling tomatoes.
- Encourage field crews to toss decayed fruit away from healthy ones.
- Minimize injuries.

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POSTHARVEST DISEASES OF TOMATO: Sour Rot

Geotrichum candidum or infrequently species of *Lactobacillus* or *Leuconostoc*

SIGNS AND SYMPTOMS:

Fruit: Pink or ripe fruit are more susceptible, whereas green fruit will develop lesions if chilled, are otherwise stressed or if the inoculum is internalized. In green fruit, lesions are relatively firm and have a pickled odor. With pink or ripe fruit, skin over lesions cracks open and lesion contents may spill out. Most lesion contents are relatively clear and have an acidic pH. White crusty growth often develops on the stem scar or open areas of the fruit surface.

Stems, leaves or petioles: Not described as a pathogen on these organs, but will likely grow on injuries during wet weather.

EPIDEMIOLOGY AND DISEASE CYCLE:

Common inhabitant of soil, wet areas and of decaying plant material. Readily spread by insects such as fruit flies. Will spread among fruit in storage and may accompany bacterial soft rot. Optimum temperature is 85°F. Is strictly a wound pathogen but will infect internal tissues.

FIELD SIGNATURE:

Crusty yeast like growth over ruptures in the lesion surface and odor of pickled tomatoes. Juices from lesions are often clear.

PHOTOS:

Figure 1. Several rough/injured fruit with sour rot beginning at wounds and open stylar pore. Photograph by: Jerry Bartz.

Figure 2. Red fruit that were inoculated by infiltration of the stem scar with spores of *G. candidum*. Photograph by: Jerry Bartz.

Figure 3. Cross section of above infiltrated fruit. Photograph by: Jerry Bartz.

POSTHARVEST DISEASES OF TOMATO:
Sour Rot

CULTURAL CONTROLS:

- Keep fields clean, bury debris especially cull tomatoes.
- Make sure field has adequate drainage and avoid situations and cultivars prone to fruit cracking or the development of fruit roughness.
- Practices that help manage bacterial soft rot will help to minimize this pathogen as well.

Figure 4. Close-up of fruit with sour rot at wounds and stylar pore. Photograph by: Jerry Bartz.

Figure 5. Decay caused by an attack of certain lactic acid bacteria, *Leuconostoc* and *Lactobacillus* sp. Photograph by: Jerry Bartz.

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CHEMICAL CONTROL:

Fungicide sprays are not useful for controlling *G. candidum* even if registered on tomato for control of other fungal pathogens. Chemicals used for sanitation during harvest and at the packinghouse will help to prevent initial infections by both *G. candidum* as well as the lactic acid bacteria (see disease management for bacterial soft rot).

RESISTANCE CULTIVARS:

No resistance known but varieties that resist water uptake and cracking or rough, open blossom pores are less likely to be infected.

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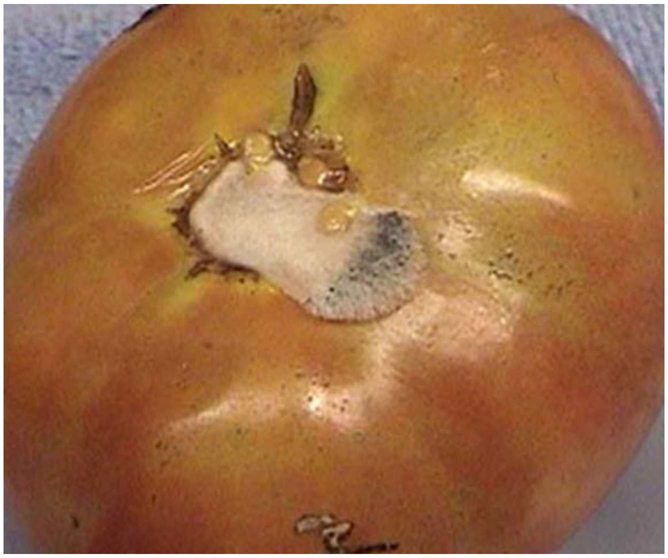

Rhizopus stolonifer

SIGNS & SYMPTOMS:

Fruit: Fully developed lesions on fruit in high humidity have extensive surface coverage by a coarse gray to white mold. Younger lesions develop near wounds, stem scars, or open blossom pores as water soaked areas that rapidly enlarge. The lesion is relatively soft but has some consistency. Nests of decaying fruit and fungal growth may develop in boxes of fruit. Ripe fruit are more susceptible than green ones.

Plant: *R. stolonifer* is not listed as a pathogen of leaves or stems but damage to those organs along with wet conditions may enable this opportunist to develop.

DISEASE CYCLE & EPIDEMIOLOGY:

This pathogen is a common saprophyte and has been found to survive for up to 30 yrs in dried deposits of decayed fruit. It is strictly a wound invader but may directly penetrate an unbroken fruit surface during fruit to fruit spread. The optimum temperature for the disease is 75-80°F. The pathogen may be carried to cracks on fruit by fruit flies, whereas the spores can be carried long distances by air currents. Wet storage conditions favor the disease.

FIELD SIGNATURE:

Water soaked lesions with watery content and coarse mycelium ramifying throughout. There are nests of mold in stored fruit. The liquid from decaying fruit is relatively clear. The aroma associated with this decay has overtones of rotten eggs.

PHOTOS:

Figure 1. Rhizopus rot that likely began at the stem scar. Photograph by: Jerry Bartz.

Figure 2. Rhizopus lesions that began at wound on side of green fruit. Photograph by: Jerry Bartz.

Figure 3. Nest of Rhizopus rot in tomato box. Photograph by: Jerry Bartz.

CULTURAL CONTROLS:

- Bury all debris from previous crops and damaged fruit from the current crop.
- Clean and disinfect fruit containers on a daily basis. Make sure there are no fruit residues left in containers.
- Clean and disinfect the packing line equipment on a daily basis.
- Remove plant debris from around packingline at least daily.

Figure 4. Rhizopus lesion on grape tomato. Photograph by: Jerry Bartz.

CHEMICAL CONTROL:

- Field applications of registered fungicides are not known to affect this disease.
- The water used to wash or handle tomatoes should contain a minimum of 150 ppm free chlorine at pH 6.5 to 7.5 and the chlorine and pH should be uniform throughout the water system.
- Packingline equipment and packing containers should be cleaned and sanitized daily.
- Note label on sanitizers as some may require rinse with potable water. Surface sanitizers containing quaternary ammonium compounds must never drain into or otherwise contact chlorinated water as an exothermic (gives off heat) reaction will occur that generates hazardous fumes.
- Chemicals used to clean surfaces may not always kill microbes attached to those surfaces. However, relatively concentrated solutions of bleach (diluted to 0.5 to 1% NaOCl) will both clean (good for removal of fatty or proteinaceous soils) and sanitize if the bleach is allowed to stand on the treated surface for several minutes. However, bleach will remove lignin from wood surfaces and will cause corrosion on metal surfaces (not as likely on stainless steel).

RESISTANT CULTIVARS:

Resistance to Rhizopus rot is unknown, but cultivars yielding fruit that resist cracking, roughness or water uptake are less likely to become infected.

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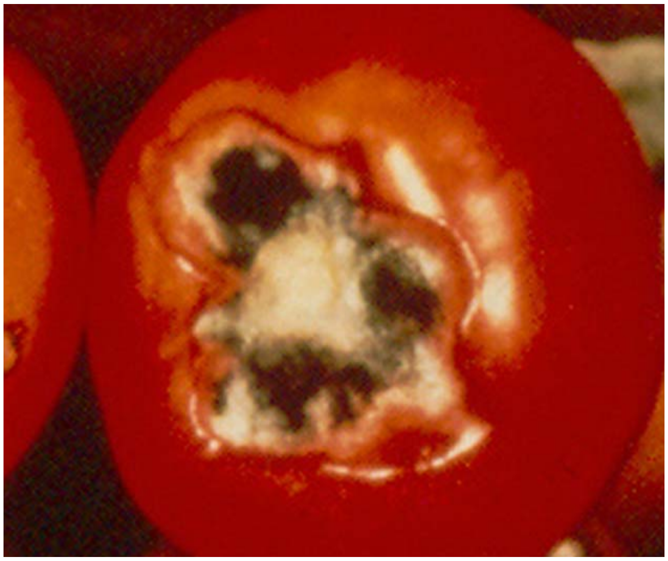

SIGNS & SYMPTOMS:

Black mold rots on fruit can be caused by several different pathogens including *Alternaria alternata*, *Stemphylium botryosum*, *Pleospora lycopersici* and *S. consortiale*. Early blight caused by *A. solani* and target spot caused by *Corynespora cassicola* may produce similar symptoms. The first four pathogens are all weak, opportunists that attack weak tissues. None of the six is likely to spread among fruit during storage or marketing. The lesions are usually firm and dark in color with a covering of black mold on their surfaces. However, one or more of these fungi can grow down the stylar pore and may initiate an internal lesion, which appears as a moldy mass in cross-section. Early blight and target spot lesions usually show concentric rings.

DISEASE CYCLE & EPIDEMIOLOGY:

A. alternata, *S. botryosum, P. lycopersici* and *S. consortiale* are common saprophytes and are found in plant debris or on damaged plant tissues. Radial or concentric cracking, blossom end rot, sun scald, heat or field chilling injuries provide infection courts on fruit. Infection of senescing flowers may lead to colonization of the style and internal pockets of decay. Persistently wet areas (from condensation) in ripening rooms may promote growth of these pathogens on walls or other surfaces leading to high levels of inocula. Fruit stored under such conditions for several days are likely to develop mold growth on stem scars, with or without penetration into the fruit flesh. Chilling injury during storage will promote fruit infections.

FIELD SIGNATURE:

Blackened firm lesions often near the stem attachment, particularly if radial or concentric cracks have formed. Internal lesions may first draw attention by dark areas appearing on the fruit surface. When the fruit is sliced open, an internal area of blackened necrosis will be observed as the reason for surface symptom. The necrosis is often linked to the stylar pore, which will appear as a blackened stripe from the blossom scar to the lesion. Early blight lesions often appear to have originated on or beneath the calyx and can become quite large with zonate rings. Target spot lesions can range in size from small freckles to large zonate rings located anywhere on the fruit. Typically, the small lesions enlarge during storage.

PHOTOS:

Figure 1. Typical black rot lesions around stem scar caused by *Alternaria alternata*. Photograph by: Jerry Bartz.
Figure 2. Three fruit with typical zonate early blight lesions that began at the stem attachment. Photograph by: Jerry Bartz.
Figure 3. Fruit with target spot lesion; these lesions may also appear zonate. Photograph by: Jerry Bartz.

POSTHARVEST DISEASES OF TOMATO:
Black Mold Rots

CULTURAL CONTROLS:

- Avoid growing tomatoes at times when fruit may be chilled just prior to harvest.
- Check recommendations to avoid blossom end rot, sunscald, or fruit cracking as these factors predispose fruit to attack by the black mold rot pathogens.
- Do not store green tomatoes below about 15°C.
- Check recommendations for controlling early blight and target spot.

Figure 4. A fruit with a fingernail wound (arrow) that later developed into black mold rot. Photograph by: Michael Mahovic.

CHEMICAL CONTROL:

- Fungicide recommendations for controlling early blight and target spot in the field will reduce postharvest losses to these pathogens.
- Fungicides are not recommended for controlling the weak black mold rot pathogens.

RESISTANT CULTIVARS:

Select cultivars that are considered resistant to cracking.

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SIGNS & SYMPTOMS:

Sporadically develops on tomato fruit in warm wet weather that have been exposed in the field to standing water, direct contact with the soil or late blight. Buckeye rot is caused in fruit by *Phytophthora capsici* or *P. parasitica*. Neither of these attack the plant. Late blight caused by *P. infestans* may also appear as similar symptoms in the fruit, which may be confused with buckeye. Buckeye may spread from fruit to fruit in humid storage conditions.

DISEASE CYCLE & EPIDEMIOLOGY:

The causal organisms for buckeye rot live in the soil, but require warm wet conditions to infect the fruit. Standing water is most conducive to infection. Fruit in contact with the soil or water are most likely to be infected; however, rain splash also can move zoospores in the standing water up onto fruit surfaces. Storage temperatures below 60°F slow the development of disease, whereas about 80°F is ideal for infection. Signs (diffuse mycelium) are not likely to appear on the surface of lesions unless the humidity is very high or the lesion has advanced to cover most of the fruit. Late blight is a severe above ground disease that is often harbored in volunteer tomato plants or, in some cases, in volunteer or nearby potato crops (see late blight for more information). Late blight is unlikely to spread from fruit to fruit in storage.

FIELD SIGNATURE:

Small olive-green to light brown spots appear on green tomato fruit, usually on areas in contact with the soil or facing the soil. The spots have diffuse edges, are usually not sunken, remain firm and can enlarge rapidly. The spots often appear water soaked and darken in color. Large dark brown bands may appear in the lesion. The lesion surface is usually smooth for buckeye and roughened for late blight. A diffuse fungal growth may develop over the lesion surfaces under humid conditions.

PHOTOS:

Figure 1. Relatively small buckeye lesion with smooth surface. Photograph by: Jerry Bartz.

Figure 2. Late buckeye lesion with sparse mycelium and roughened surface. Photograph by: Jerry Bartz.

Figure 3. Late blight lesion showing roughened surface. Photograph by: Jerry Bartz.

Prepared by: Dr. Jerry Bartz

CULTURAL CONTROLS:

At least a three-year rotation recommended for buckeye. Avoid planting tomatoes after peppers or eggplant. Make sure field is well-drained and does not have areas prone to accumulate standing water. Grow tomatoes in dry climates or during drier times of the year.

CHEMICAL CONTROL:

Spray applications that are effective for controlling late blight should also be effective for controlling buckeye rot. Make sure label on any fungicide applied has instructions for application to tomatoes.

RESISTANT CULTIVARS:

None reported although certain cultivars are more prone to become infected.

Figure 4. Late blight of tomato. Photograph by: Jerry Bartz.

Figure 5. Cross-section of late blight of tomato. Photograph by: Jerry Bartz.

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Botrytis cinerea

SIGNS & SYMPTOMS:

This is often the most important postharvest disease in fruit produced in cool moist climates (particularly coastal growing areas) although it can be found in the late spring season in Florida after the second or third harvests when plant canopy injuries have accumulated. Formerly, it was described as a major problem in south Florida, particularly during cool, wet growing periods. The disease is usually not a problem when crops are produced on high calcium or well-limed soils.

DISEASE CYCLE & EPIDEMIOLOGY:

The causal organism is an excellent saprophyte and grows on a wide range of hosts. The organism grows best at 75-79°F, whereas disease progress is most rapid at 64-75°F. Tomatoes exposed to chilling temperatures in the field or in storage become quite susceptible to infection. Germinated spores may directly penetrate the fruit surface, but if temperatures warm much above the ideal range, the infections are aborted. These arrested lesions remain white to yellow in fully red fruit giving a halo or "ghost-spot" symptom.

FIELD SIGNATURE:

Gray-green to gray-brown, slightly water-soaked spots often initially appear near the stem-end of the fruit or at the point of contact between a lesion and a healthy fruit. The lesion contents are softened but not mushy. A grayish mold develops at breaks in the tomato skin or sparsely over the surface of older lesions. The mold coating appears velvet-like due to numerous spore clusters that develop like clusters of grapes.

PHOTOS:

Figure 1. Red fruit with large gray mold lesion that is covered by typical mycelium and sporulation. Photograph by: Jerry Bartz.

Figure 2. Early stages of *Botrytis* on a postharvest tomato. Photograph by: Denise Thomas.

Figure 3. Gray mold starting at the fruit calyx from ruptured tissue. Photograph by: UF/IFAS.

POSTHARVEST DISEASES OF TOMATO: Gray Mold Rot (Botrytis Fruit Rot)

CULTURAL CONTROLS:

For management of the disease postharvest:

- Avoid allowing free moisture to develop on packed fruit by maintaining uniform storage temperatures.
- Note recommendations for chlorinating the packinghouse water systems and for minimizing the chances for absorption of water by fruit (prevent infiltration) **(pg. 143)**.

See pgs. 105-106 for cultural controls in the field.

CHEMICAL CONTROL (in the field):

- Chlorothalonil, chlorothalonil plus mefenoxam, pyraclostrobin (suppression only), and boscalid are fungicides labeled for field application of gray mold on tomato.
- Also labeled for use on tomato are Pyrimethanil and *Bacillus subtilis* strain QST 713. Both of these compounds should be applied with an appropriately labeled fungicide.
- On pepper, Pyraclostrobin and *Bacillus subtilis* strain QST 713 are labeled for this disease.

Figure 4. Gray mold in the field typically does not produce harvestable fruit. Photograph by: Phyllis Gilreath.

Figure 5. Close up of *Botrytis* showing grape-like clusters of conidia as seen through a dissecting scope. Photograph by: Jerry Bartz.

References:

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McColloch, L.P., H.T. Cook and W.R. Wright. 1968. Market Diseases of Tomatoes, Peppers, and Eggplants. A.R.S., U.S.D.A., Agric. Handbk No. 28, Washington, D. C.

Stall, R.E. 1991. Gray Mold, pp. 16-17. *In* J. B. Jones, J.P. Jones, R.E. Stall and T.A. Zitter (eds.), Compendium of Tomato Diseases. APS Press. St. Paul, Mn.

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