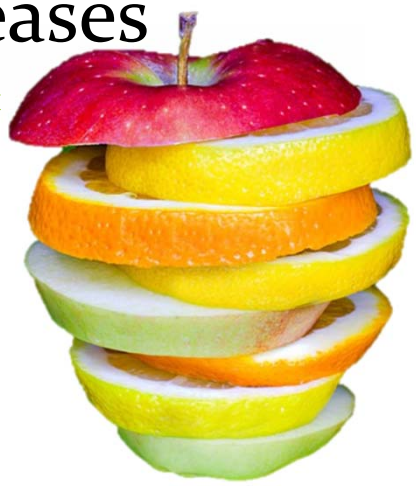
Postharvest Diseases

Jerry Bartz, postharvest pathologist



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Postharvest Diseases

- Plant pathology= diseases of plants
- Plant disease = continuous malfunction caused by infection by a parasitic microbe.
- Continuous malfunction and infection by a microbe differentiate postharvest diseases from defects related to physical injuries, growth abnormalities, injuries caused by harmful environments such as chilling, hypoxia, ethylene insensitivity, sun exposure, etc.
- Postharvest diseases are those that appear and develop after harvest.

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Outcomes of postharvest diseases

- Products with defects are unmarketable leading to increased cost of production and occasionally loss of an entire crop
- Individual "defective fruit" require additional handling (hand culling) and may be threats to entire containers or storage units.
  - Nest production—product to product spread with visible pathogen development
  - Spread of decay within container by fluids produced during disease development
- Volatiles produced during infection lead to off-flavors, undesirable aromas, hypoxia, and even mycotoxins (patulin)

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Concepts important in postharvest "decays"

- Severity=amount of host tissues involved
- Incidence=percentage of product with lesions
- Inoculation=pathogen becomes located in an "infection court," where it can infect plant
- Penetration=actively or passively penetrate outer barriers such as cuticle, bark, etc
- Infection=pathogen begins to colonize living plant tissues
- Latent period=between arrival on plant to shedding of pathogen structures (secondary inoculum)
- Incubation period= inoculation to symptom development
- Quiescent=pathogen initiates infection and then stops development temporarily.
- Latent=infection not visible—most or all infections are initially latent, but pathogen isn't quiescent
- Signs=visible pathogen structures
- Symptoms=visible changes in the plant

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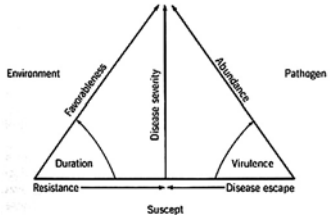
What favors postharvest diseases

- Apply the "disease triangle" to postharvest.



- Arguably if one leg of the "triangle" is absent, disease does not occur.

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Favorable environment

- Wet conditions
  - Canopy is wet
  - Soil or beds may have flooding
  - Dew and guttation are slow to dry in the morning
  - Prolonged periods of wet canopies
- Favorable temperatures—sometimes cool and sometimes warm—depends on crop and pathogen
- Not exposed to UV or desiccation

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Large populations of pathogens

- Freshly harvested fruits and vegetables are not sterile. Much of the naturally occurring biome can produce a decay if the product is abused.
- Debris from previous crops as well as senescing leaves, flower petals
- Runoff from rainfall including temporary flooding
- Cankers, diseased or dead branches, survival structures on or under trees (sclerotia, mummies), pre-harvest diseases on foliage
- Equipment/facilities
  - Dried plant residues in field bins, picking bins,
  - Fungal growth in storage rooms including cooling coils
- Waste disposal sites—cull products dumped near production sites or packinghouses

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Sources of inoculum

- Generally ubiquitous and world-wide in distribution
- Higher populations in plant debris—many are efficient saprophytes and cause disease when the opportunity arises (opportunists)
- Can be associated with weeds, other non-crop plants
- Survival between suscepts
  - Long-lived survival structures (sclerotia, chlamydospores, mummified fruit)
  - Dried deposits of plant debris
  - Infected products (cull piles, etc)
  - Moist conditions may not favor survival—most pathogens do not compete well with free-living or plant associated saprophytes (see biocontrol)

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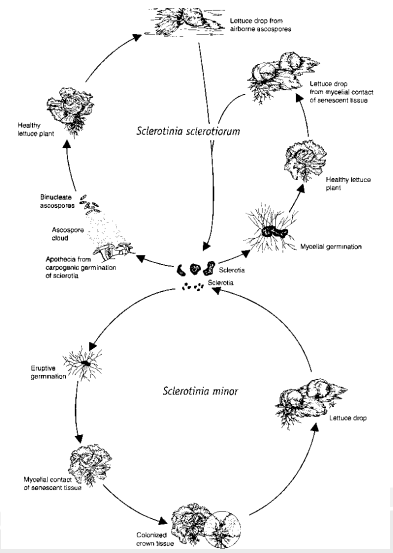
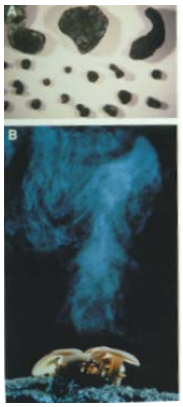
Example of "disease cycle" which includes resting stages of pathogen—here two different *Sclerotinia* spp. causing bottom rot of lettuce in the field.



Survival in sclerotia

- Examples and production of ascospores from apothecia.



Dispersal—from survival structure or during secondary spread in crop

- Light weight or relatively dry spores can be dispersed by wind
- Rainfall disperses heavy and sticky spores
- Bacteria can disperse in storms, aerosols (a 6-mile dispersal was documented during the early phases of the last citrus canker outbreak due to a tropical system)
- Flooding can disperse soil-borne pathogens whose infections can occur post harvest.

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Susceptible plants—the third leg

- Normal susceptibility—certain cultivars may have levels or resistance, others may not—isn't necessarily related to quality (it sometimes seems that way!)
- Physical injury
  - Rough harvest and handling
  - Exposure to harmful temperatures or sunlight
  - Weather events such as wind storms, hail, heavy rainfall
- Physiological injury
  - Nutrient deficiencies
  - Pollination issues
  - Excessive or uneven moisture—from weather or irrigation
- Ripening and senescence

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Types of decays.

- Softened with general breakdown of structure (soft rots)
- Soft and covered with sporulation (gray mold rot, sour rot)
- Soft but with extensive mycelial growth (Rhizopus rot, Mucor rot)
- **NOTE SOFT ROTS ARE OFTEN ACCOMPANIED BY EXTENSIVE FLUID PRODUCTION**
- Firm, necrotic with distinctive sporulation (anthracnose, target spot)
- Firm, necrotic and covered with mold—Alternaria rot, Cladosporium rot.

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Bacterial soft rots.

- Bacteria exist as epiphytes or saprophytes in various niches
- Rainfall, irrigation water, insects, machinery, field operations such as pruning, tying plants to structures, etc. move bacteria to plants
- Bacteria may survive (live) and even multiply on plant surface if fresh wounds, free moisture or biofilms are present
- Bacteria inoculate plant tissues through wounds or natural openings
- Intercellular spaces of plant are ideal moist chambers.
- Cell walls surrounding intercellular spaces are not barriers to attack on cell
- Bacteria produce extracellular enzymes that attack pectolytic compounds that glue cells together or produce lactic acid that kills cells

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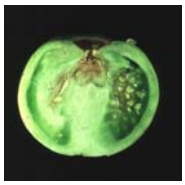
Examples of bacterial soft rots.

- Pectolytic pseudomonads
  - Cool, wet
  - Soil
  - Produce surfactant



- Soft rot erwinia
  - Warm, wet
  - Debris, various sources of water

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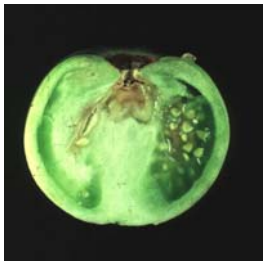
Bacterial soft rot of tomato fruit

- Infection of wounds

- Penetration of lenticels around stem scar



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Internalization of bacteria modeled in experiments with India Ink

- India Ink is a suspension of carbon particles that are of the size of gram negative bacteria
- India Ink has been used to study sutures on cadaver eyes—if the ink particles penetrate so can bacterial pathogens
-) a water-congested stem scar

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Cut the tomato open

- Ink has internalized:

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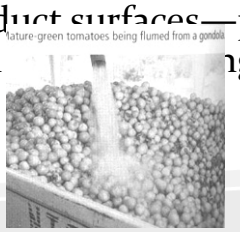
Conditions that lead to internalization

- Temperature decrease in tissues creates vacuums in the intercellular spaces—if water covers pores between fruit surface and external environment, vacuums draw water into pores—note tissue cooling and water uptake is an issue associated with hydrocooling, but if pathogens aren't present, there doesn't appear to be much of a problem.
- Pressure of water on product surfaces—products submerged deeply or hit with stream ng unloads.



Other soft rot diseases

- Sour rot – lesion pH is initially reduced or low and lactic acid aroma is apparent.
  - *Geotricum candidum* – tomatoes, many other crops.

Geotricum citri-auranti – citrus fruit

Soft rots caused by filamentous fungi

- Rhizopus rot – decayed tissues soft but held together by hypha—soft fruits, tomatoes – form nests.
- Brown rot of stone fruits.
- Sclerotinia (white rot)

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- Internal alternaria
- General appearance of several "firm" decays of tomato fruit

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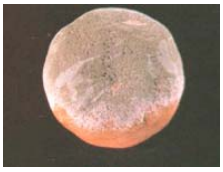
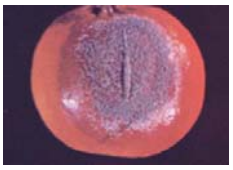
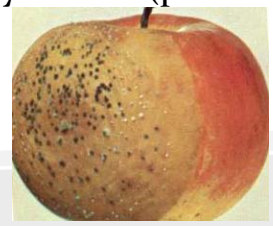
Penicillium molds

- Citrus--green mold and blue mold

- Apples—blue mold, heat stable mycotoxin (patulin) is produced

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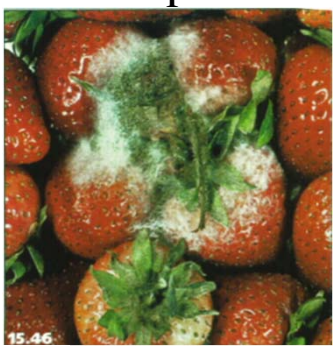
Botrytis fruit rot—major postharvest problem in strawberries

- Nest beginning to form
- Also in apples and tomatoes





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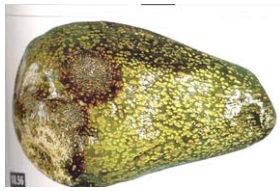
Anthracnose

- Tropical fruit, also in strawberry—causes "rain-stains" on mango and other tropical fruit—dormant in the stain but active when the fruit ripens





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Brown rots of stone fruit

- *Monilina fructicola* and *laxa*
- Infects injuries, senescing flower petals during wet, rainy, moderate temperatures.

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Certain pre-harvest diseases lead to postharvest problems of a non-infectious nature (don't spread postharvest)

- Viral disease not recognized on packingline

- Internal necrosis in tomato (graywall)

- Bacterial blotch of watermelon

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