WET STEM SCARS AND POSTHARVEST DECAY IN TOMATOES

Jerry Bartz, UF/IFAS, Plant Pathology

Why are postharvest decays so prevalent when fields are wet at the time of harvest?

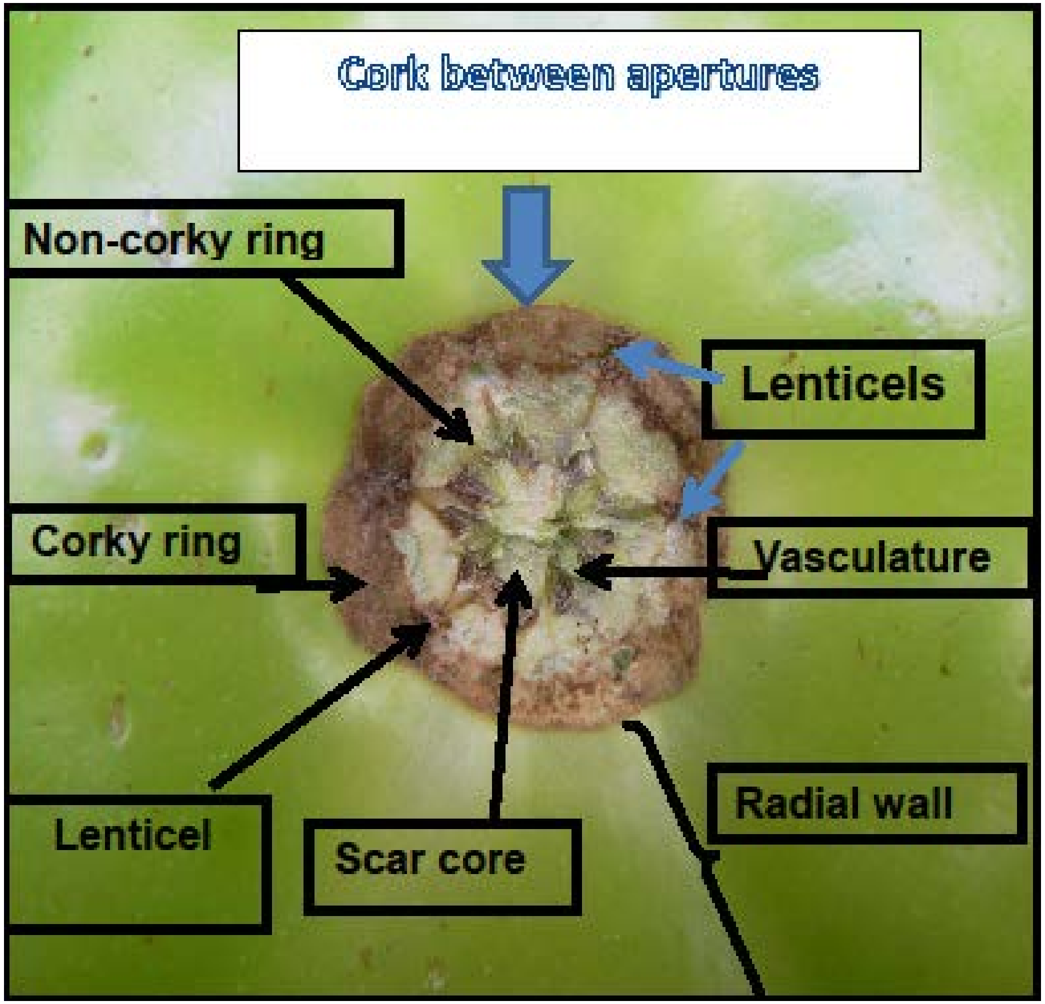
- More importantly, what can be done to successfully market such fruit?
- Approach:
  - Determine likely infection sites in wet fruit—do they differ from vulnerable areas on dry fruit?
  - Create wet fruit in the laboratory and experiment with potential control measures.

Focusing on infection courts

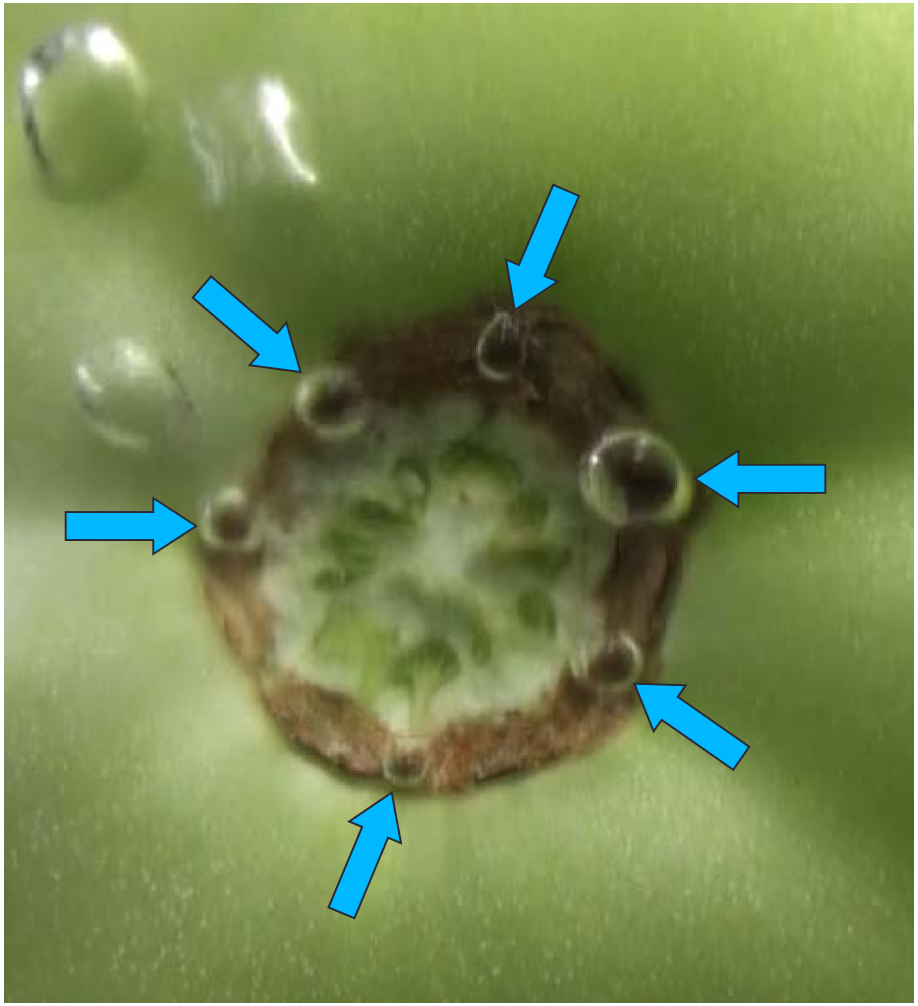
- Where do fruit become infected (pathogen begins attack on tissues)?
  - Cannot infect directly through surface, which has coating of wax as well as cuticle
  - Openings in the surface barriers
    - Wounds
      - Developmental
      - Harvest and handling related
    - Naturally occurring openings—internal cells are living and must have access to oxygen as well as a way to dispose of excess carbon dioxide

Detail of tomato stem scars:

From: **Visual Assessment of Gas-Exchange Sites in Harvested Tomato Fruit—Stahl et al. 2015**



Gas bubble streams mark location of lenticels and their connection with internal air spaces



Even prior to harvest, lenticels are involved with gas exchange

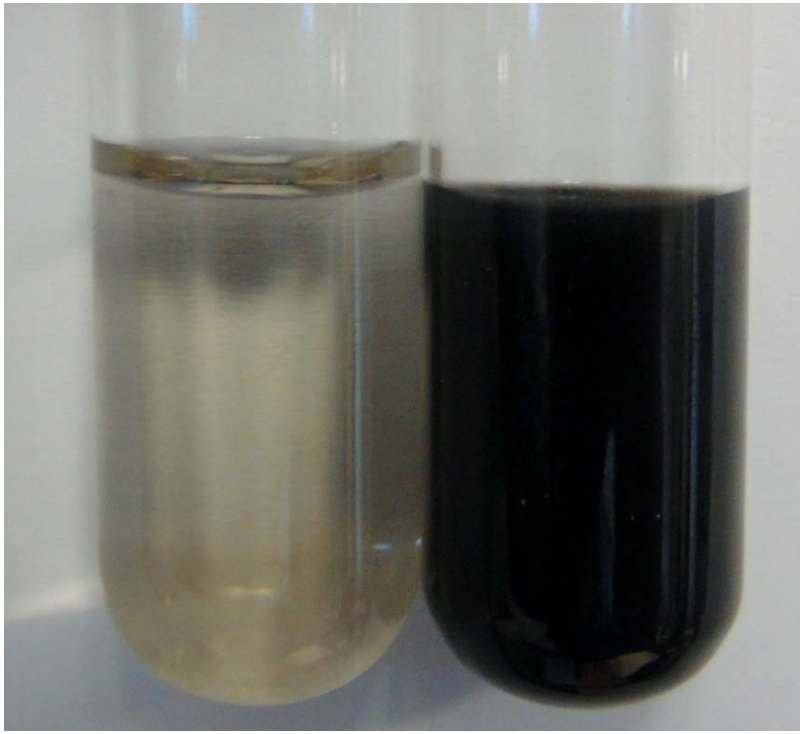
Gas egress and bacterial internalization

- Egress shows openings
- Treatment with dye solutions shows connection between egress and internal tissues
- Treatment with India Ink, a suspension of carbon particles shows likely pathways for internalization of bacteria

Create wet stem scar (water congested) and expose it to India Ink.

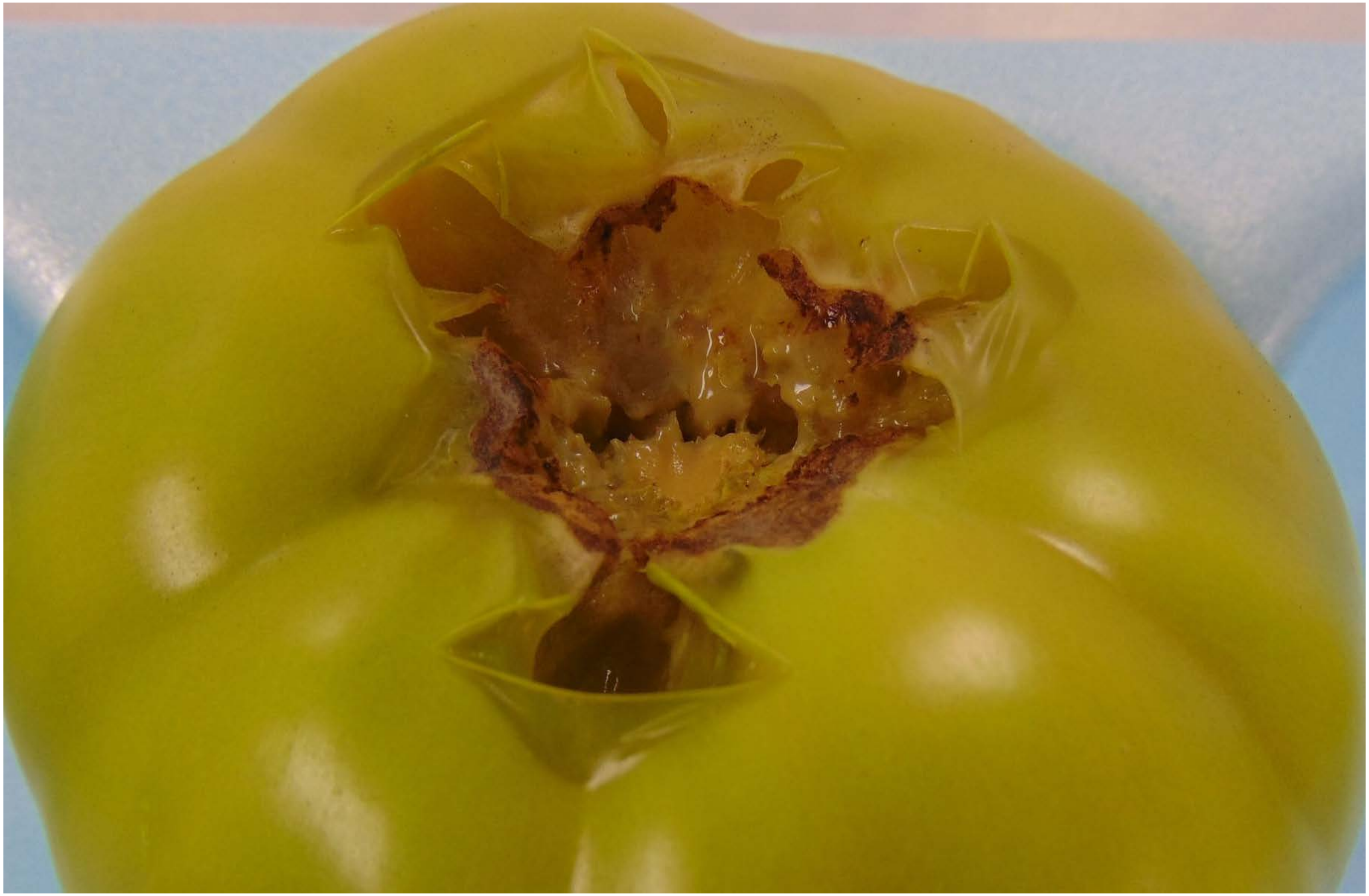
India Ink does not pass through bacterial proof filters

- India Ink is a suspension of carbon particles that are about the same size as gram negative bacteria, such as *Pectobacterium*, cause of bacterial soft rot.



Cross section of fruit treated as shown in previous slide—clearly the lenticel openings do not filter out ink particles

If a suspension of soft rot bacteria is applied instead of India Ink, a soft rot lesion develops under the stem scar.



Experimental protocol.

- Immerse fruit fully in an aqueous cell suspension of *P. carotovorum* for 5 sec.
- Remove and drain for 10 min or not depending on experiment.
- Place fruit on foam depression trays that rested over wet paper towels in a plastic snap lid container.
- Close container and incubate at 20^{o}C(68^{o}F)or 25^{o}C (77^{o}F) for up to 2 wks.
- Periodically remove decaying fruit to avoid fruit to fruit spread.
- Humidity is high within container but experiments with and without wet towels did not support that wet towels are important.

Fruit on trays

How rapidly does inoculum penetrate stem scar structures? Wash for 1 min in 200 ppm free chlorine at pH 6.5.

Exp. No.	# 1	# 2	#3	#4	Avg.
Control	100	100	100	100	100 a[2]
5 seconds	0	0	0	0	0.0 c
10 seconds	0	0	7	0	1.7 c
120 seconds	0	13	7	0	5.0 c
60 min	100	100	47	47	73.3 b

Wiping the suspension from stem scar tissues also reduces decay

Exp. No.	# 1	# 2	Avg.
control	100	100	100 a
5 sec	13	0	6.7 d
10 sec	0	0	0.0 d
120 sec	27	13	20.0 c
60 min	53	80	66.7 b

Simulate packinghouse treatment of freshly harvested tomatoes. Wash in 150 ppm chlorine (pH 6.5) for 1 min.

Exp. No.	# 1	# 2	#3	Avg.
Control	67	73	80	73.3 a
1 hr	47	27	47	40.0 c
4 hr	47	27	47	42.2 bc
18 hr	80	33	40	62.2 ab

Dry wet fruit rapidly

Dry rapidly—minutes far superior to hours—here exposed to air blast for 30 min, water disappears within 20 min.

Exp. No.	#1	# 2	#3	Avg.
Control	67	53	73	64.4a
18 h	87	20	47	51.1ab
4 h	33	20	47	33.3bc
1 h	33	20	40	31c

Does not appear effective for controlling Rhizopus rot or sour rot.

Volatile oxidizers

- Chlorine dioxide has promise if we can determine how best to apply it.
- It is soluble in moisture which coats microorganism structures
- We've applied it by off-gassing from an aqueous solution and by mixing two dry ingredients.   We've had our best results with the off-gassing procedure.

Treat with ClO_2 gas from aqueous solution.

Exp no.	#1	#2	#3	Avg.
Control	46.7	66.7	33.3	48.9a
18 hr	20	0	0	6.7b
4 hr	6.7	0	0	2.2b

Dose = 1 mg ClO_2 / kg fruit
Stored for 5-7 days at 25^{o} C.
In preliminary experiments, dry in-box packets were as effective for controlling primarily Rhizopus rot as room treatment of boxed fruit.

Controlling Rhizopus rot

Each fruit was wounded 4 wounds each wound was inoculate with 10 µl of 10^6 spore/ml. All fruit stored at 20 C for 4 hours before treatment with Chairman or just water in case of control then fruits move to Ethylene chamber for 4 days.

Control (Just inoculated) After 4 days

Chairman® Low dose (430 ppm active ingredient)
After 14 days

Chairman® High dose (860 ppm active ingredient)
After 14 days

Controlling sour rot

- In previous experiments, Mentor (part of the Chairman formula) controlled sour rot.
- We applied these fungicides as an aqueous suspension at the rate specified in Syngenta’s supplemental label and we did find that the a.i. in Mentor was stable in chlorine solutions as would be used in the packinghouse.

Summary:

- The stem scar area of tomato fruit can be infected by bacterial soft rot through lenticels that are part of the gas exchange mechanism. These same lenticels function prior to harvest and can be breached during storms, etc.
- Internalization of bacteria occurs rapidly (within minutes of contact) even if stem scars are not water-soaked
- Washing fruit in chlorine solutions as occurs in packinghouses reduces but does not prevent decay development
- Drying structures within stem scar reduces subsequent decay development, but drying must be rapid
- Drying fruit has not been effective in reducing sour rot or Rhizopus rot
- Holding wet fruit overnight (18 h) prior to packing is not recommended
- Chlorine dioxide applied as a gas shows promise as a way to control bacterial soft rot and Rhizopus rot infections of lenticels and shallow wounds.
- A Syngenta fungicide called Chairman appears highly effective for controlling Rhizopus rot and likely sour rot. It is unlikely to control bacterial soft rot and its efficacy under extreme field conditions such as occurred in South Florida this past winter is unknown.

Questions