Bacterial Bad Guys - Improved management of soft rot in the field and post-harvest

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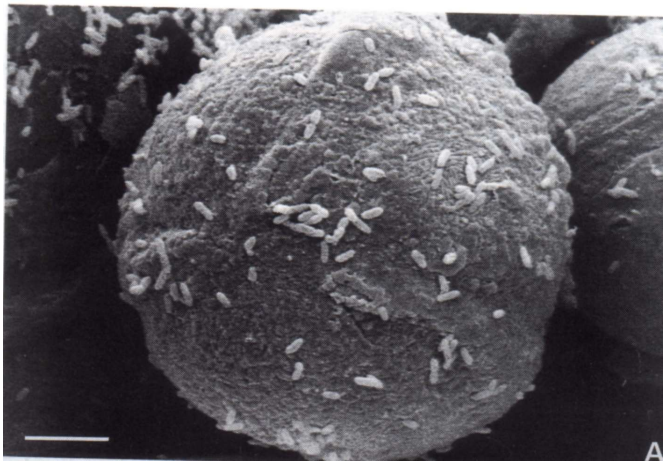
Why focus on soft rot?

- Case Study on Idaho rejection/downgrade notices from large retailer distribution centers
  - August 2018 to August 2021 (2018, 2019 and 2020 fresh and stored crops)

Dickeya spp. and Pectobacterium spp.

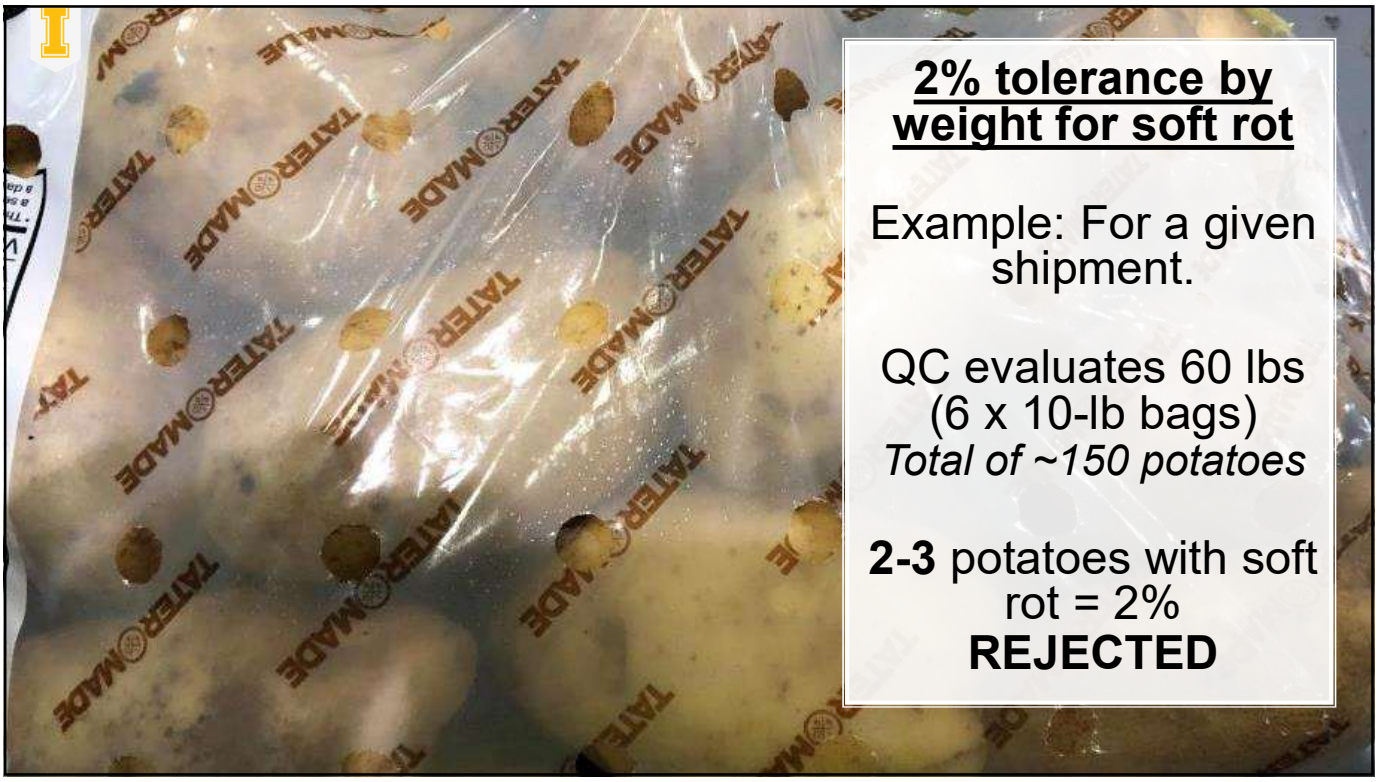
Bacteria on the head of a pin.



Bacteria on a pollen grain.

Top 5 **Main Notice** Reason for Each Year

Top Reason	2018		2019		2020	
1	Sunken Discolored	19%	Wet Rot	24%	Wet Rot	38%
2	Wet Rot	14%	Blackspot Bruise	17%	Blackspot Bruise	22%
3	Dry Rot	12%	Sunken Discolored	15%	Sunken Discolored	9%
4	Shatter Bruise	11%	Shatter Bruise	13%	Pressure Bruise	6%
5	Blackspot Bruise	9%	External Discoloration	10%	Shatter Bruise, Dry Rot, Internal Discoloration	Each 4%



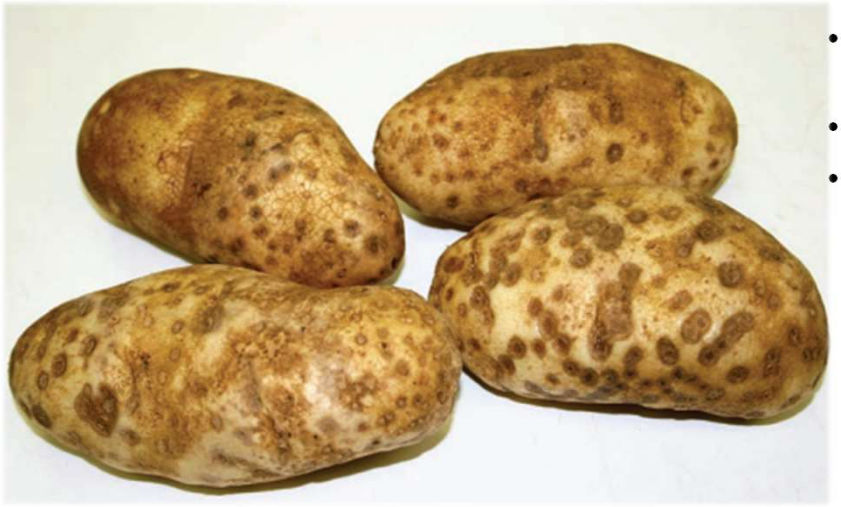
2% tolerance by weight for soft rot

Example: For a given shipment.

QC evaluates 60 lbs (6 x 10-lb bags)
Total of ~150 potatoes

2-3 potatoes with soft rot = 2%
REJECTED

Post-Harvest Lenticel Rot



- *Pectobacterium carotovorum* subsp. *carotovorum*
- Lesions are shallow
- Appear 4-10 days after harvest

From J.J. Farrar, J.J. Nunez, and R.M. Davis
California Agriculture 63(3):127-130

Value of mitigation by quality issue

Assume:
Rejection rates at the retailer are representative for the U.S., with annual average value of $1.24 billion

Rejection issue	Implied rejection rate by issue	Implied value of rejections ($ millions per year)
Sunken discolored areas	0.40%	$4.97
Soft rot (external)	0.83%	$10.3
Internal black spot	0.85%	$10.5
Dry rot (external)	0.45%	$5.52
Wet breakdown (external)	0.33%	$4.04

Note:
- Implied rejection value is an estimate of lost potential income for potato producers
  - Including costs for transportation, labor, etc. would raise these values regarding impact to farm income
- Retailer has increased costs/efficiency losses from finding alternative supplies

Objectives

1. Evaluate efficacy of foliar fungicide/bactericide programs on the potential **to reduce aerial stem rot in the field and bacterial soft rot decay in storage.** **(Field)**
2. Evaluate the effect of handling procedures during transfer of potatoes **from storage to fresh pack** facilities on bruising and soft rot development. **(Storage)**
3. Survey fresh pack operations to evaluate potential **factors that may contribute to soft rot** development. **(Packing)**

- Blackleg
- *P. atrosepticum* and *D. dianthicola*
- Seed piece decay
- Black to brown soft rot of stem
- Plants are stunted and die

- Erwinia early dying
- *Pectobacterium carotovorum* subsp. *carotovorum*
- Defoliate from the ground up
- Outer stem appears healthy
- Vascular tissue is tan to brown

Both are promoted by warm temperatures and moisture.

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Objective 1:
Evaluate efficacy of foliar fungicide/bactericide programs on the potential to reduce aerial stem rot in the field and bacterial soft rot decay in storage

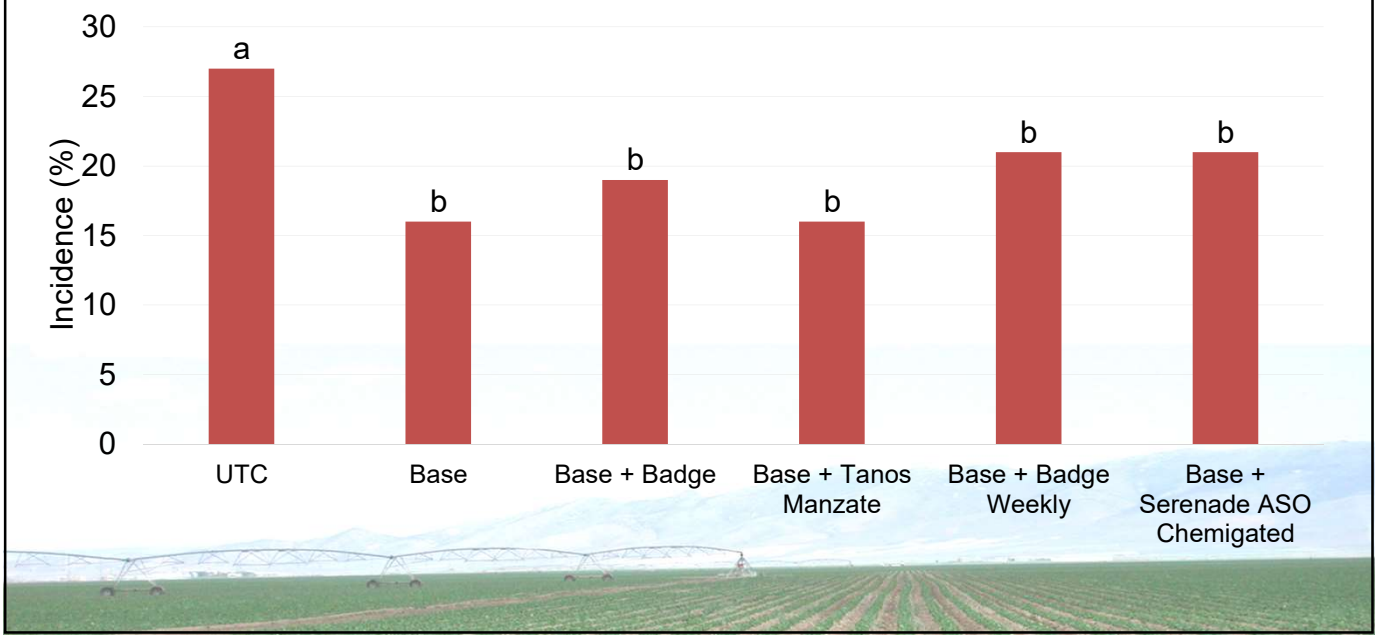
Objective 1

1. Untreated control
2. Standard fungicide program (14-day interval) = base
3. Base + copper
4. Base + famoxadone + mancozeb
5. Base + intensive (weekly) copper applications
6. Base + Serenade ASO (chemigated)

- ***Dakota Russet***

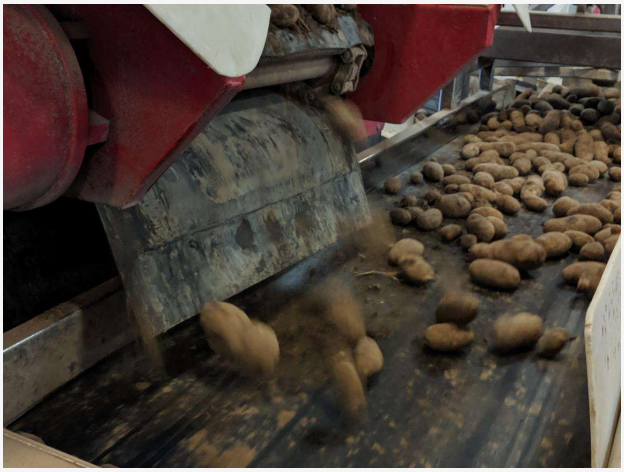
Base Program:
1. Miravis Prime + Bravo WS
2. Miravis Prime + Bravo WS
3. Bravo WS
4. Bravo WS

Aerial Stem Rot Incidence



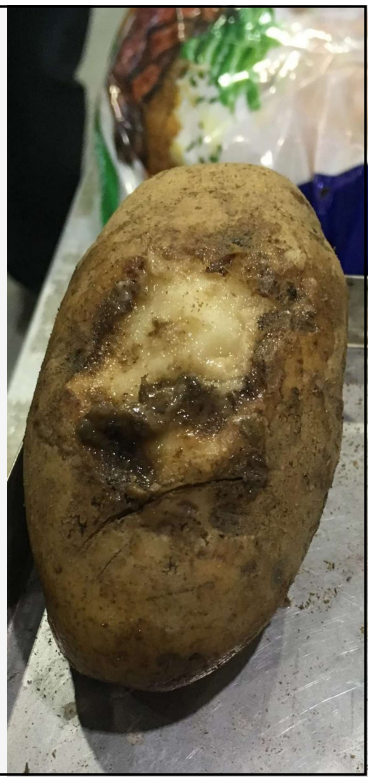
Objective 2:

Evaluate the effect of handling procedures during transfer of potatoes from storage to fresh pack facilities on bruising and soft rot development

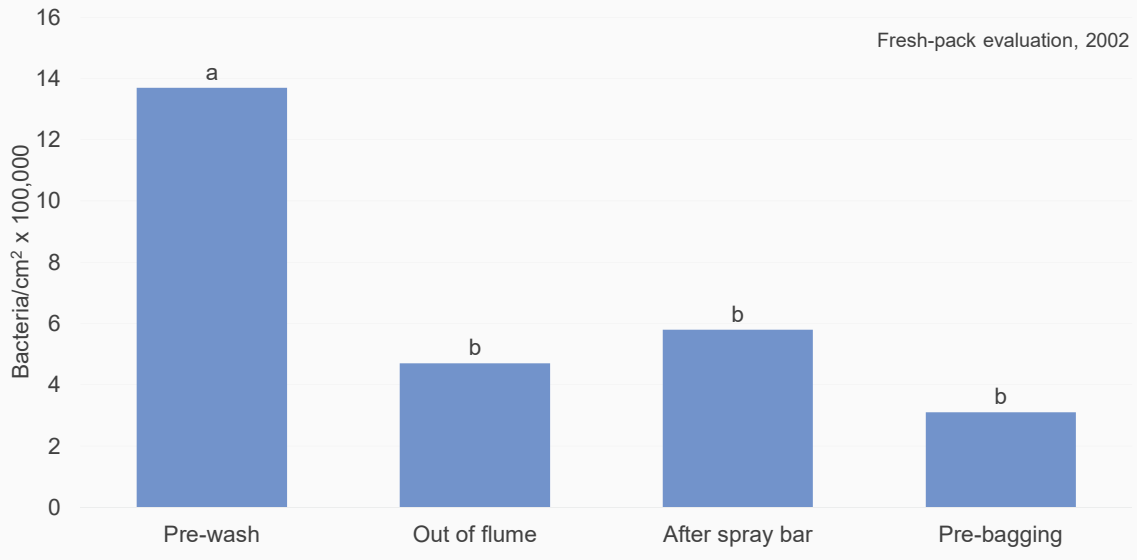


Potential soft rot 'triggers' at the packing shed

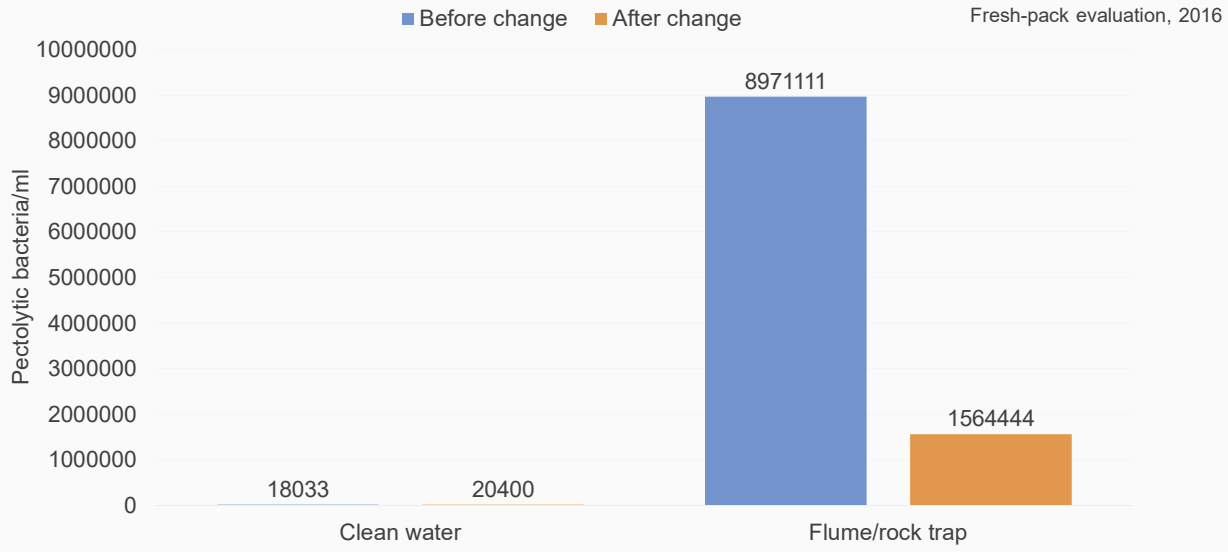
- Wounding
- Water
  - Tuber and wash water temperatures
  - Duration in water
  - Hydrostatic pressure
  - Bacterial load
- Disinfectant & Sanitation
- Drying capabilities
- Packing and palletizing



Soft-Rotting Bacteria – Tuber Surface



Soft-Rotting Bacteria – Water

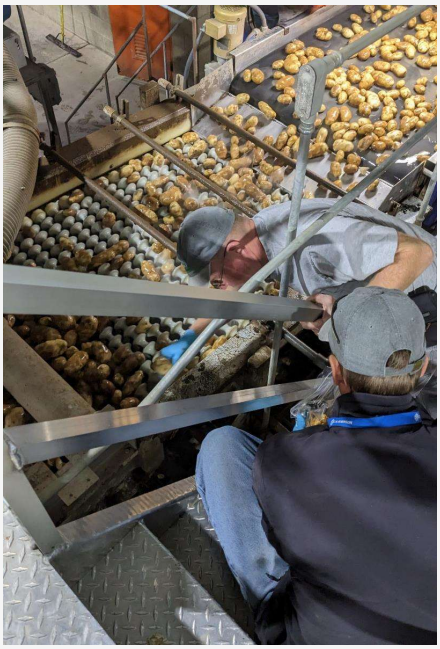


Wounding and shatter bruises

Entry for soft rot – major pathway

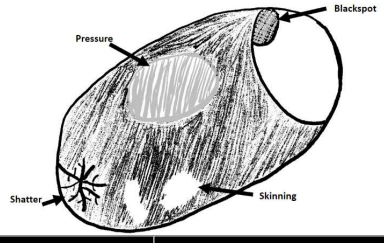
Wounds remain wet longer – favorable for soft rot

Disinfectants not as effective as wound # increases (Bartz and Kelman, 1986)



Packing Shed 1

Average number of bruises per tuber



Type of Bruise	Off truck (average of 3 trucks)	After flume/ before bin	After disinfectant spray bar	After bagging
	48°F	*49°F*	*51°F*	*53°F*
Skinning	1.9	3.7	3.8	3.6
Shatter	0.6	2.3	2.8	2.8
Blackspot	0.7	1.6	2.2	2.7
Soft Rot Decay (%)	1	51	88	93

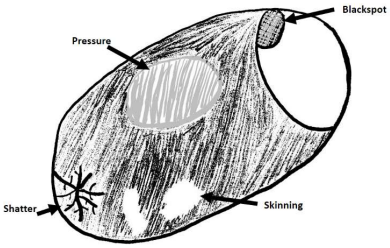
Water Temp: 57°F
Tuber temp: 49°F

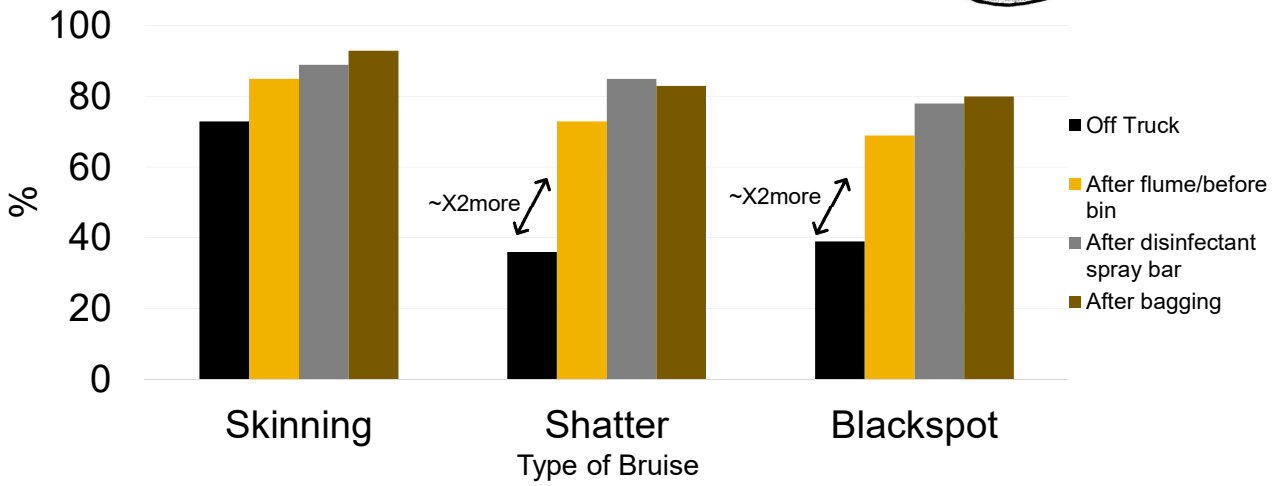
Average of **3 min 14 s** in water flume

0.4% moisture removed from potatoes after drying

Packing Shed 1

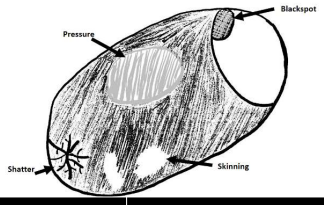
Incidence (%) of bruise





Packing Shed 2

Average number of bruises per tuber



Type of Bruise	Off truck (average of 5 trucks)	After flume/ before bin	After disinfectant spray bar	After Drying	After bagging
	49°F	50°F	50°F	51°F	53°F
Skinning	2.3	1.9	1.5	1.7	3.4
Shatter	1.7	4.3	3.9	3.3	3.1
Blackspot	3.3	1.8	2.4	2.0	3.7
Soft Rot Decay (%)	1	86	86	93	88

Water Temp: 54°F
Tuber temp: 49°F

Average of **27 seconds** in water flume

0.5% moisture removed from potatoes after drying