Late Season Fungal & Bacterial Diseases of Onion

Lindsey du Toit
Washington State University

2023 Pacific Northwest Vegetable Association Annual Convention & Trade Show
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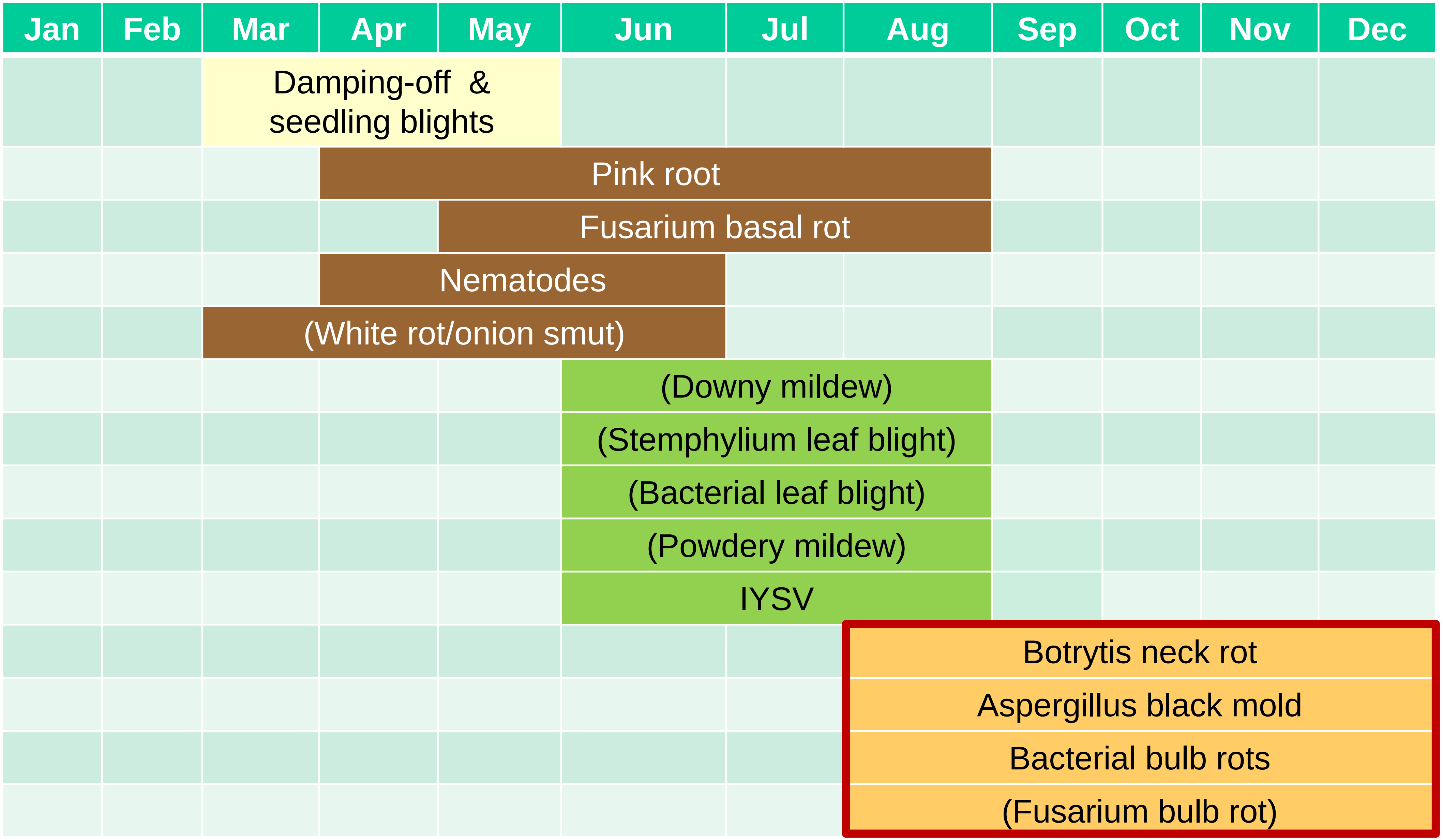
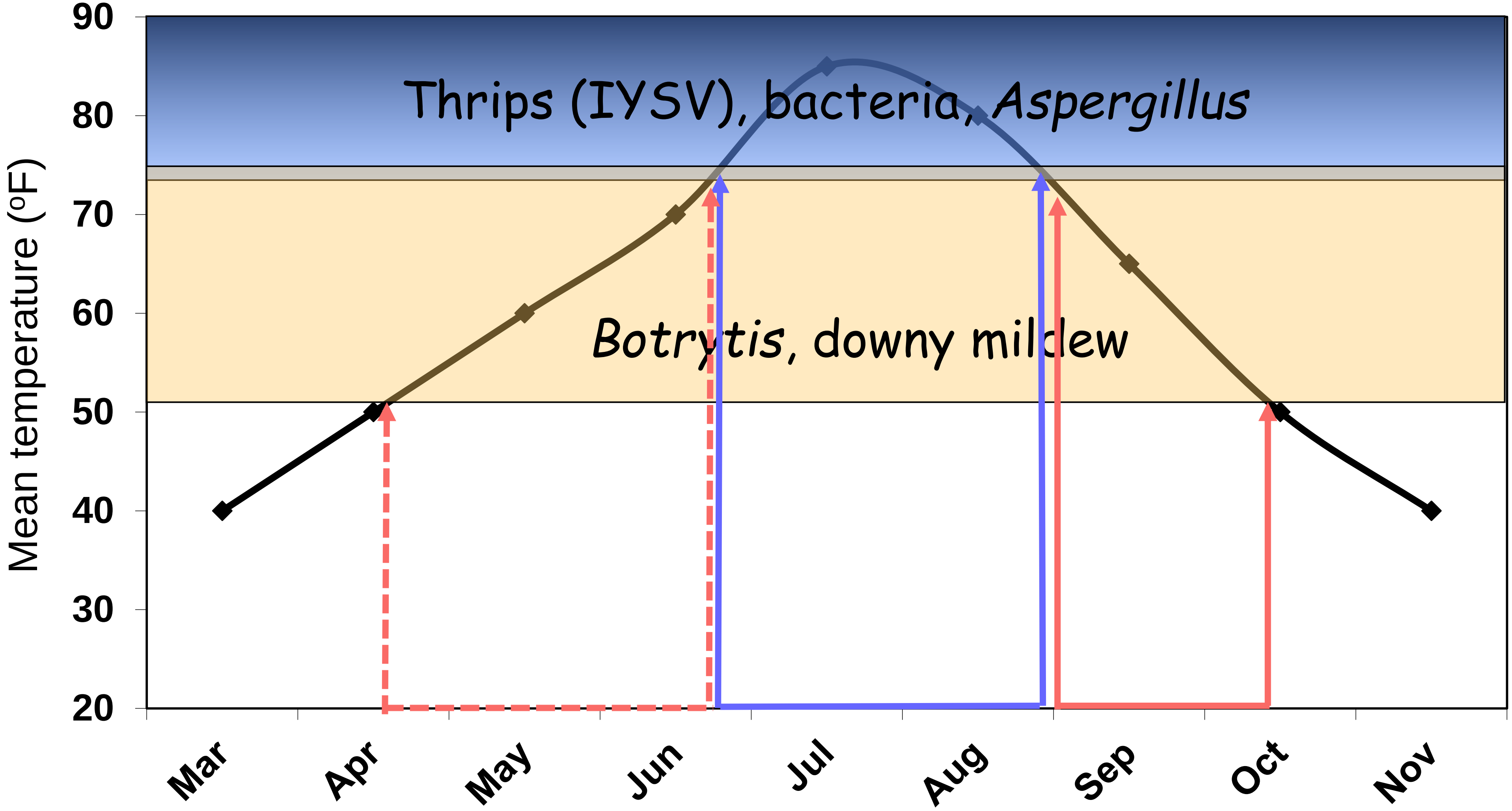
Diseases of onion bulb crops in the Columbia Basin



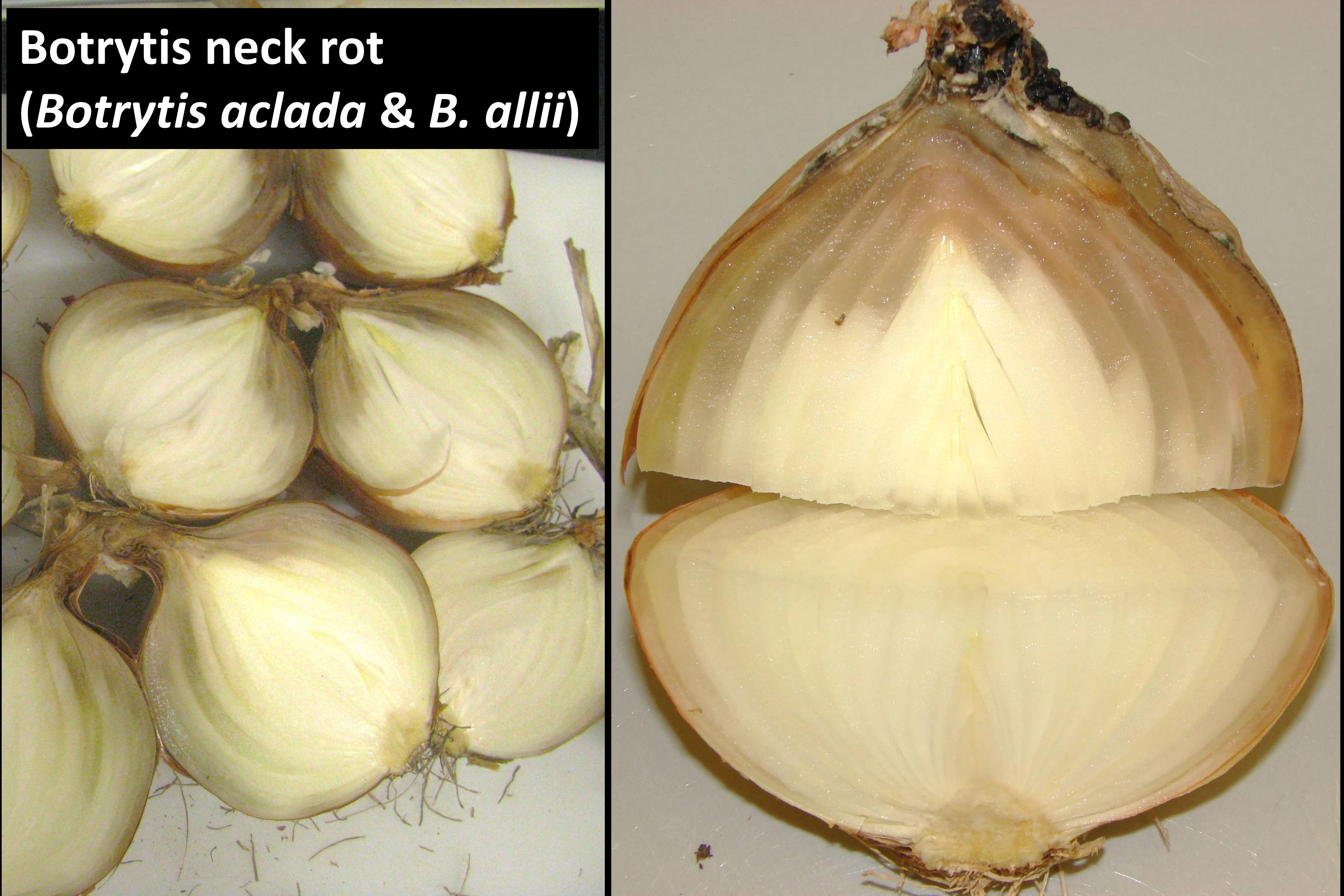
Temperature effects on diseases and pests of onion bulb crops in the Basin



What is “neck rot”?

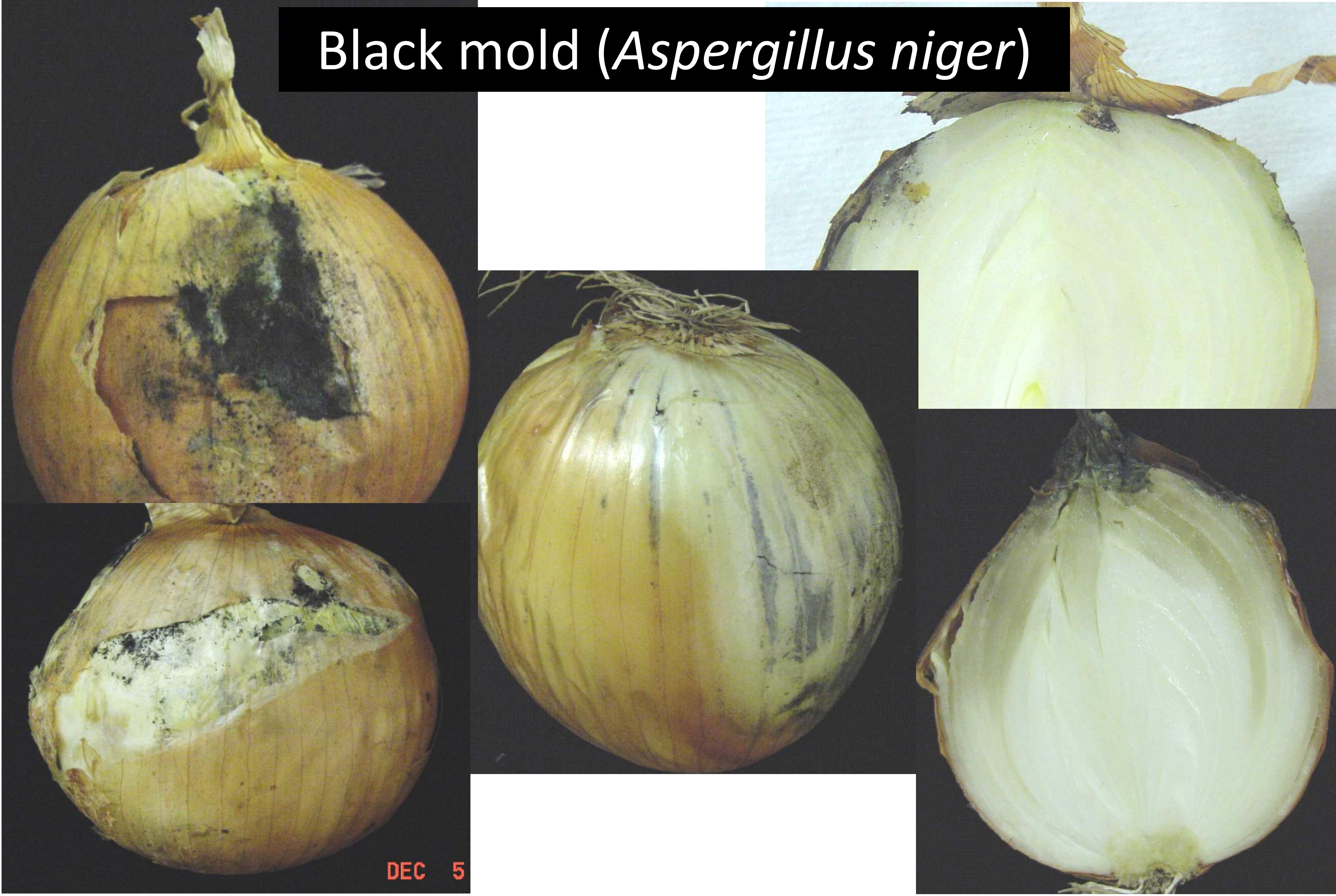
Onion “neck rots”

Botrytis neck rot
(*Botrytis aclada & B. allii*)




New Zealand
South Africa

Black mold (*Aspergillus niger*)



Bacterial leaf blight/bulb rots



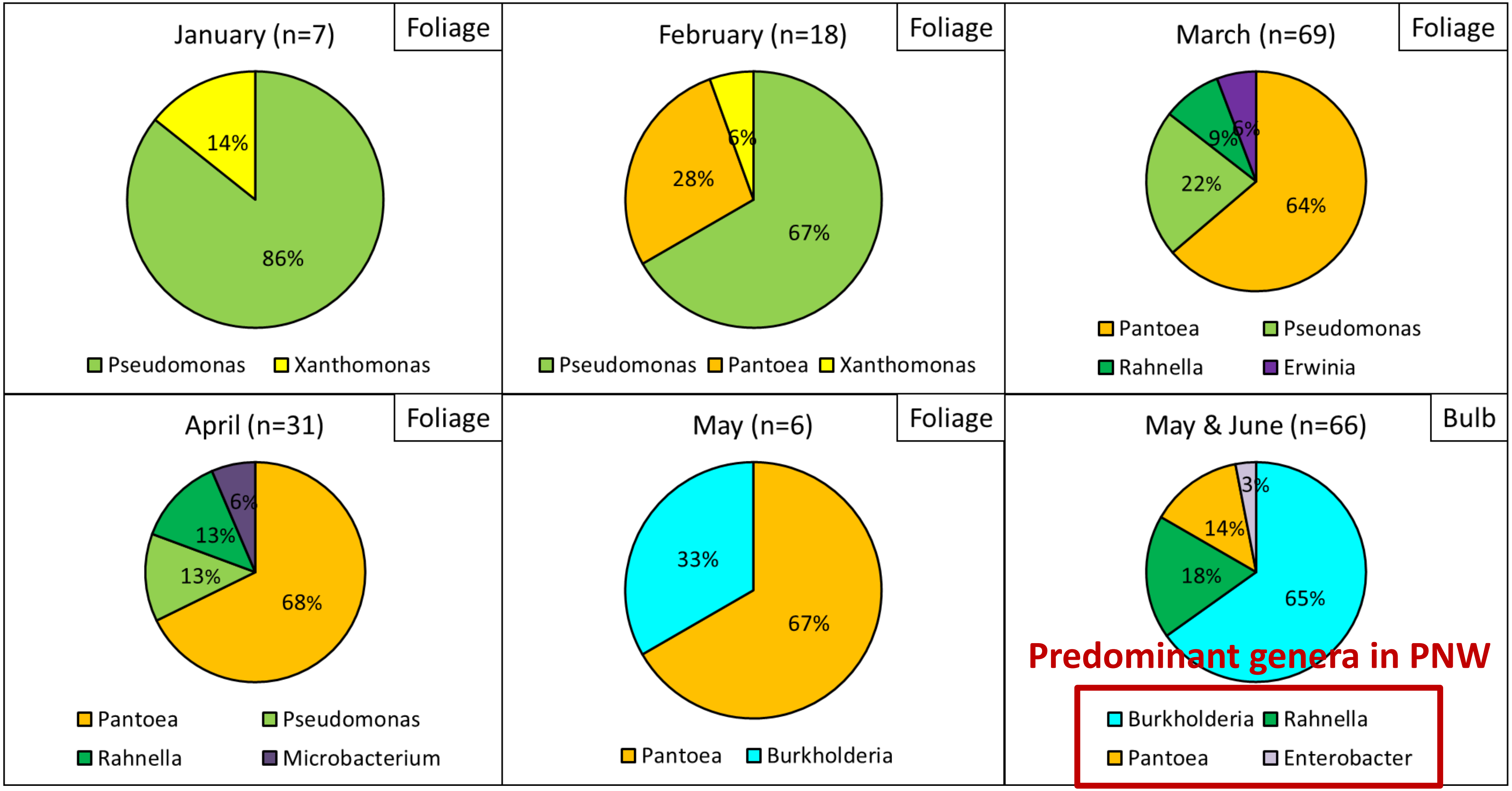
2
1
CM

Infection of onion plants by bacteria, *Botrytis*, and *Aspergillus*

- All three are ubiquitous in onion production areas
- All three are favored by moisture in onion necks/foliage
- Bacteria and fungal spores are splashed from soil & colonize plants
- Primary pathogens and opportunistic pathogens:
  - Latent infections in healthy onion tissue only become active when:
    1. Dead/injured host tissue
       – natural senescence (e.g., 'tops down'), injured (e.g., hailstorms)
    2. Moisture
       – rain, irrigation, dew; moisture in/on senescing tissue
- *Botrytis*: 55-75^{o}F vs. *Aspergillus* & most bacteria: 80-100^{o}F
- **Rot race!** Avoid excess fertility & irrigation, late termination of irrigation
  - Avoid bull necks & slow field curing
  - Focus on late-season practices that speed field curing

Temporal progression of bacteria isolated from January to June 2020 from symptomatic leaves & bulbs in Vidalia onion crops, GA

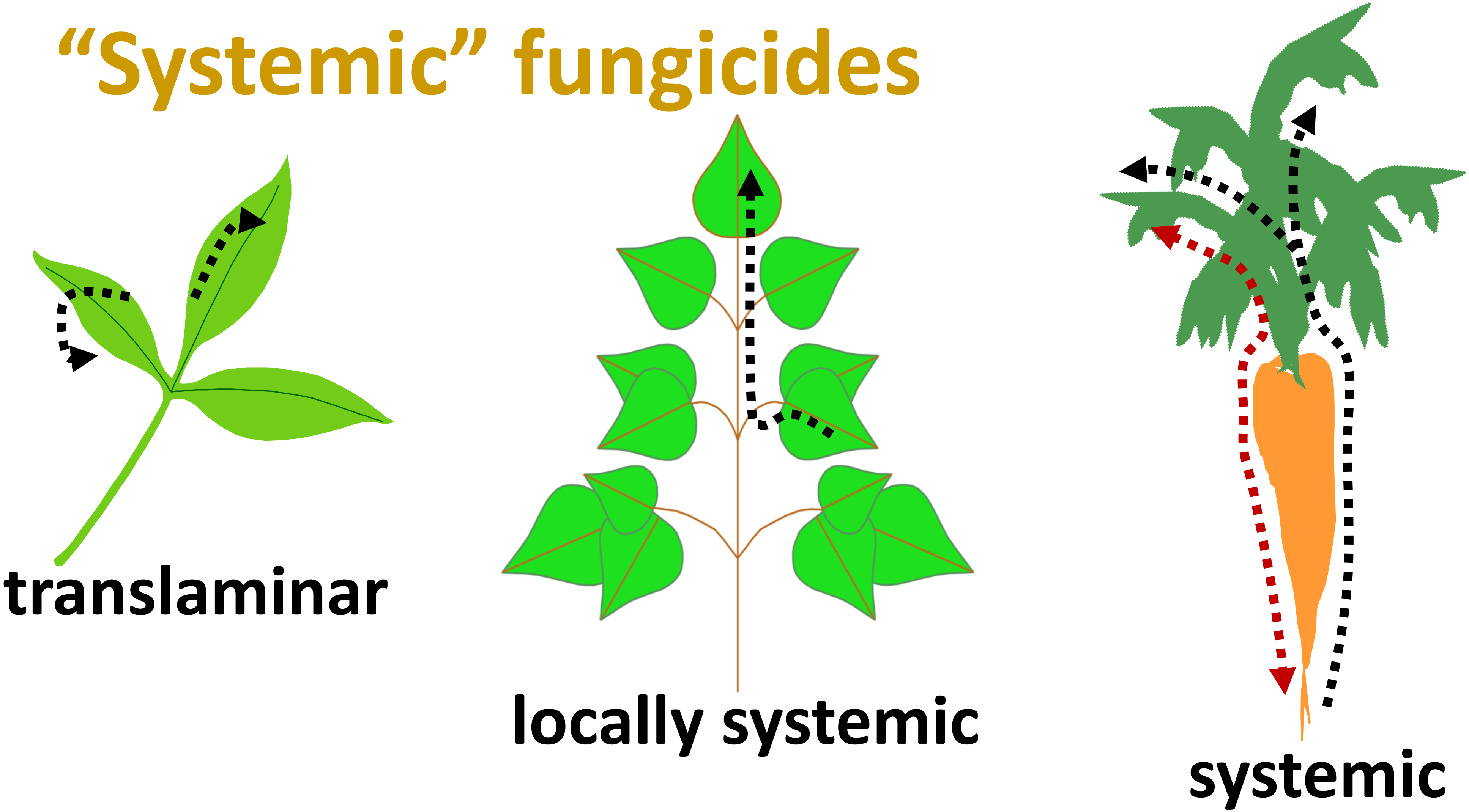
(B. Dutta and M. Zhao, UGA)



When to apply fungicides for Botrytis neck rot and black mold in onion bulb crops

- Periods of natural senescence:
  - tops down = 3-4 weeks before harvest
  - moisture in necks + senescence = high risk
  - 'bull necks' = high risk
  - cool & moist field curing conditions = high risk for *Botrytis*, warm & moist = high risk for *Aspergillus*
- Immediately after injury:
  - transplanting, 'cultivator blight', hail, …
- Fungicide spray program:
  - 10- to 14-day interval **late season = high risk** period
  - **1st application:** necks still green (alive) to facilitate locally systemic movement of fungicide into necks, and upright (coverage)
  - mix or alternate fungicide modes of action

"Systemic" fungicides



Apoplastic = moves in xylem = UP the plant (e.g., Ridomil, FRAC Grp 4)

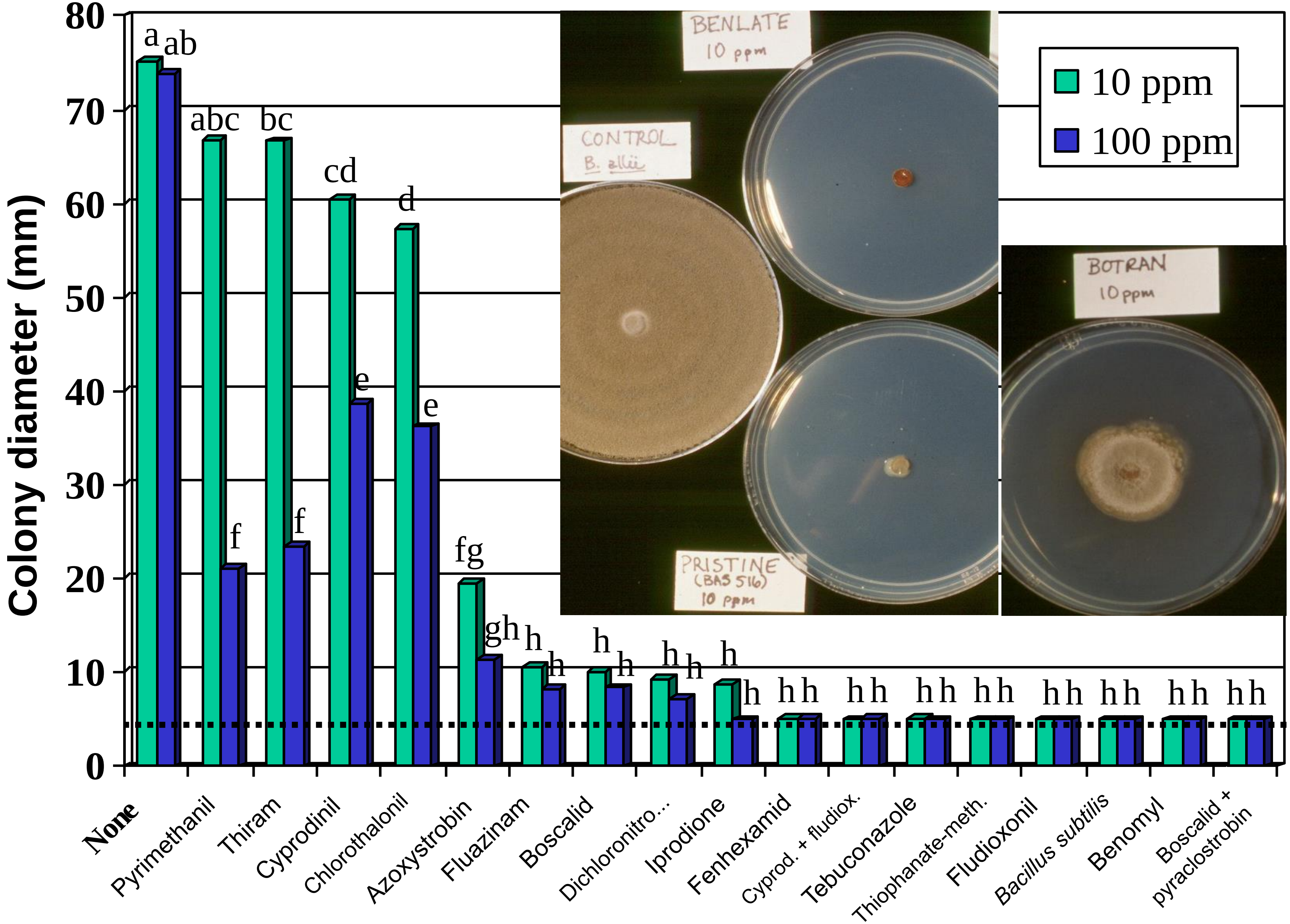
Symplastic = moves in phloem = UP & DOWN (e.g., Aliette, FRAC Grp 33)

All forms of systemic movement require live plant tissue to move the fungicide

https://pnwhandbooks.org/plantdisease/pesticide-articles

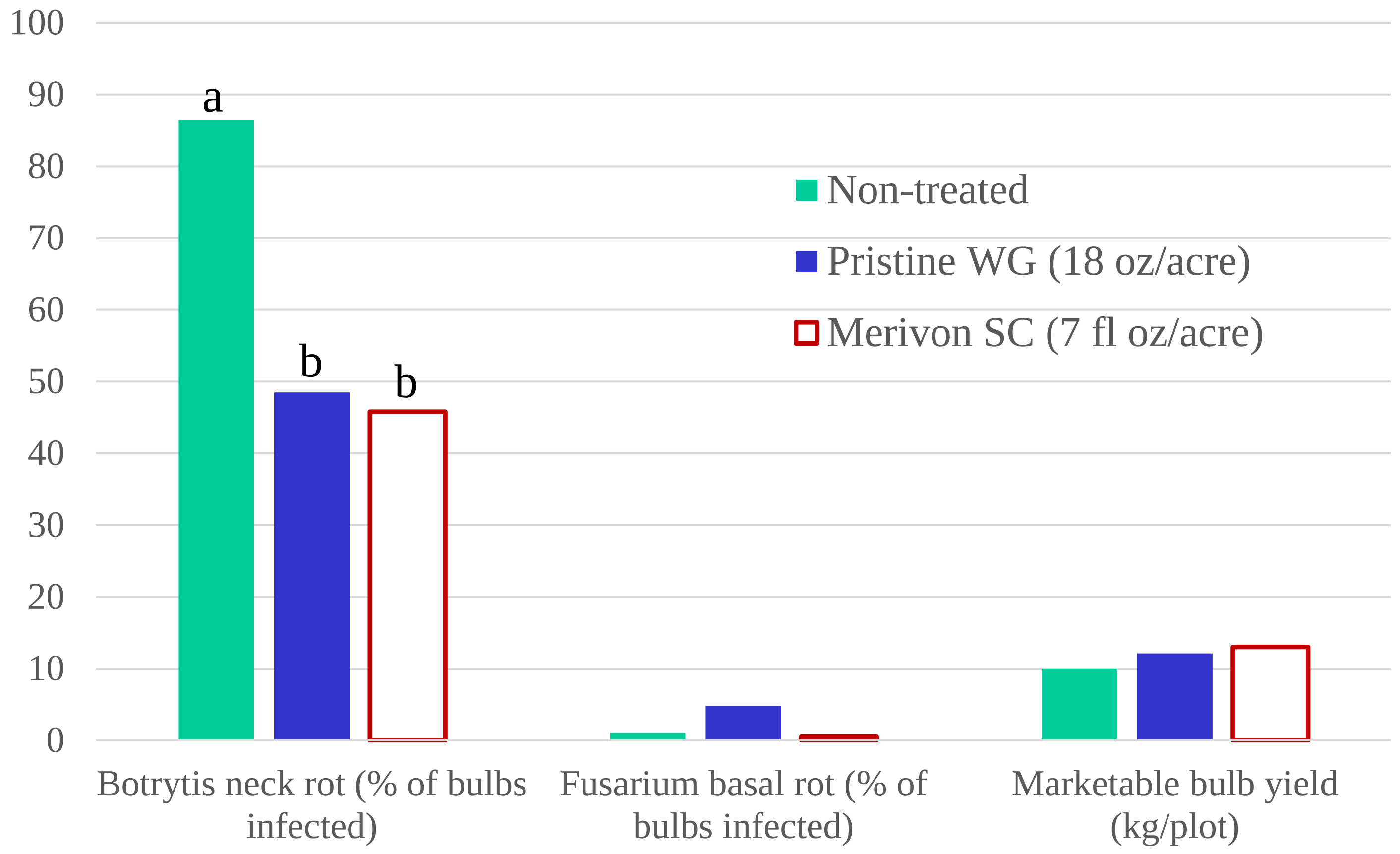
Efficacy of fungicides for *Botrytis aclada* & *B. allii*

(6 days on fungicide-amended agar)



Pristine and Merivon fungicide evaluation for control of Botrytis neck rot of onion

2020 Field Trial – Tim Waters, WSU Pasco Vegetable Farm



- RCBD with 4 reps
- Onion cv. Calibra
- Fungicides applied with backpack sprayer (30 gpa, 30 psi) on 7/29 and 8/12/2020
- Inoculated with *B. aclada* & *B. allii* (inoculum supplied by L. du Toit) after fungicide application
- Bulb rot rated in storage on 2/11/2021

Fungicide mobility in plants

Strobilurins (= QoI fungicides) = FRAC group 11

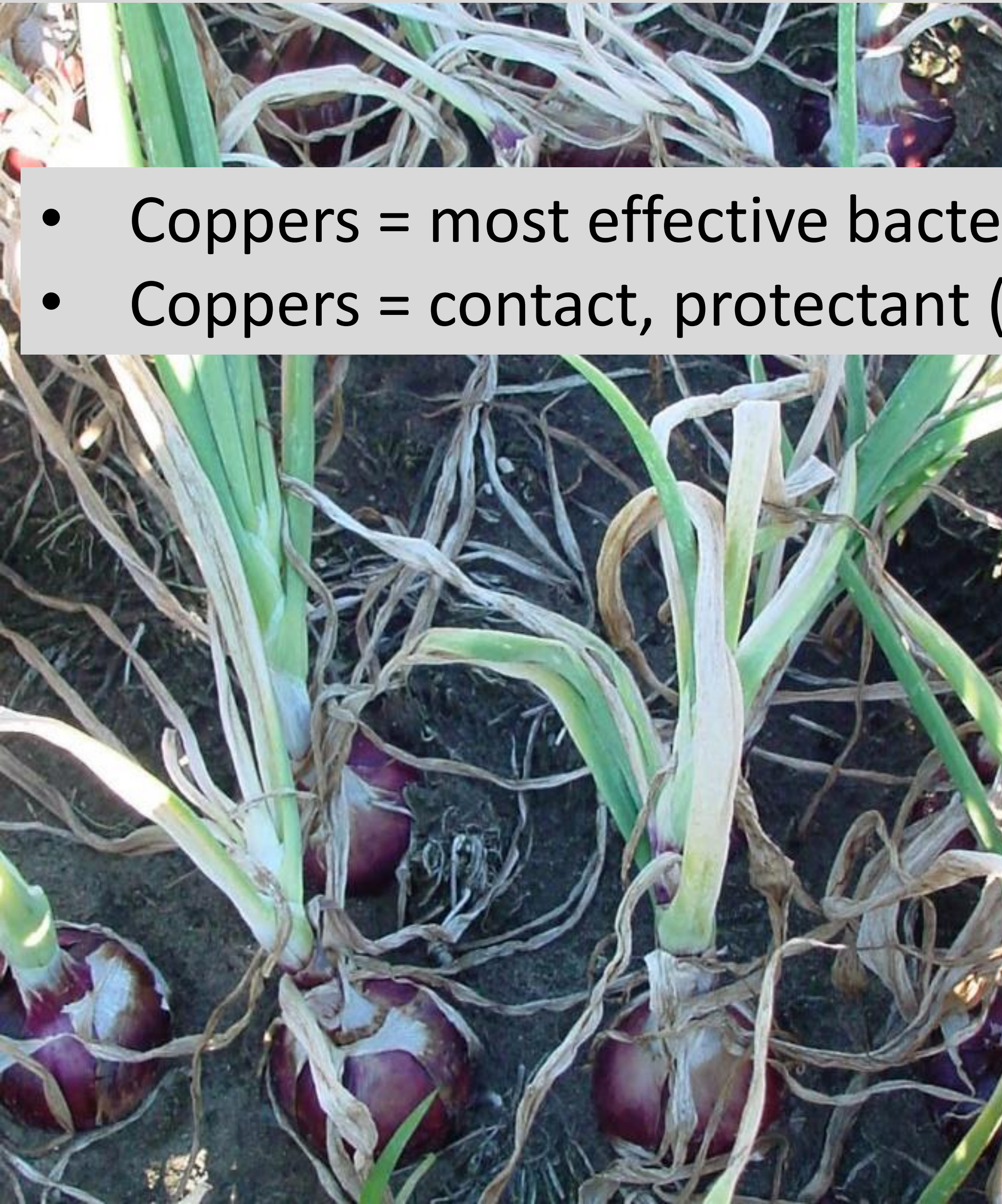
- Inhibit respiration of fungi
- Common MoA but differences in family

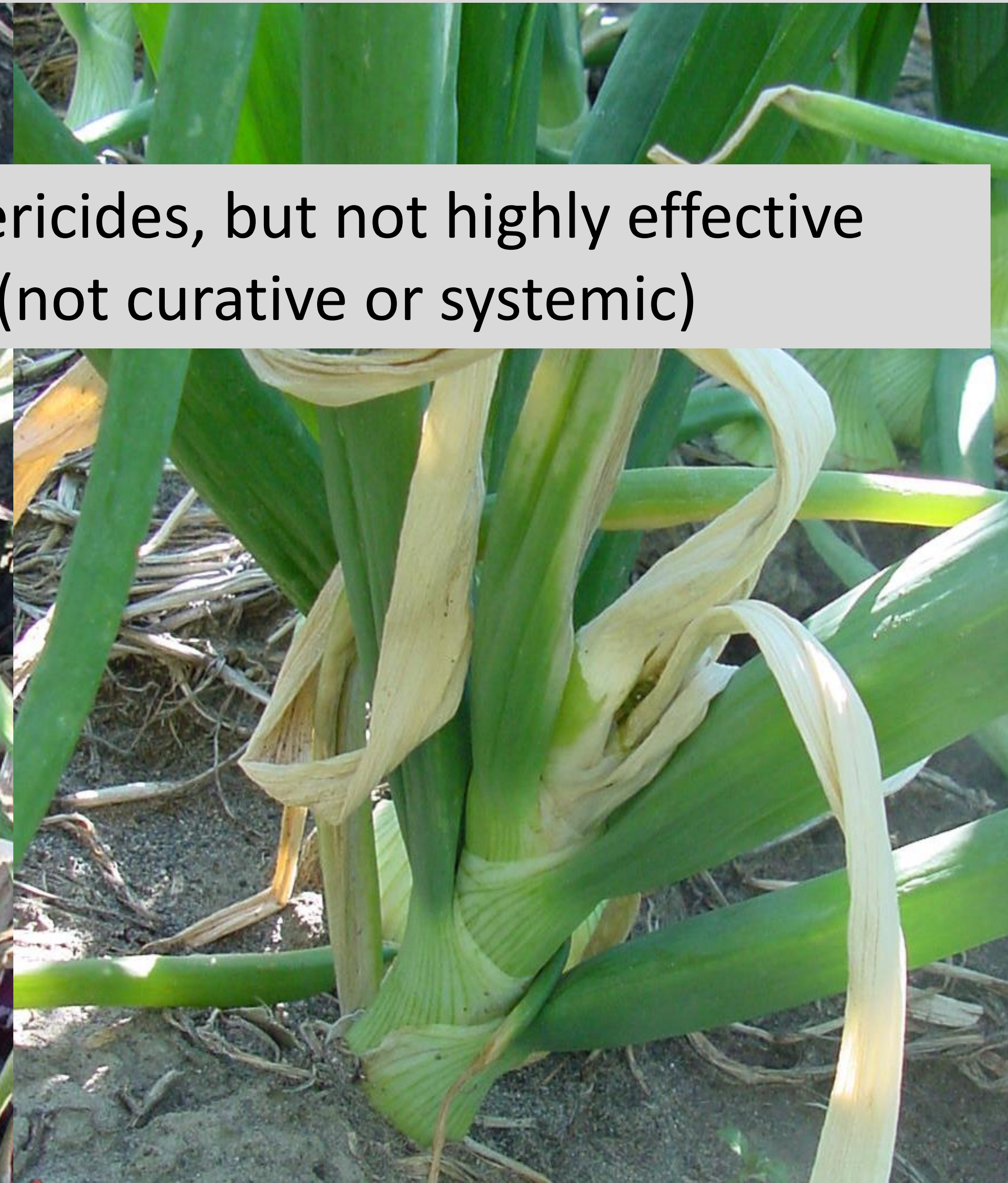
	azoxystrobin e.g. Quadris ®	pyraclostrobin e.g. Headline ®	trifloxystrobin e.g. in Stratego ®
Uptake into leaf	low	very low	very low
Metabolic stability within leaf	yes	yes	yes
Translaminar movement	yes	low	low
Xylem systemic	limited	no	no
Phloem mobile	no	no	no

Bartlett et al. 2002

Chemical control of onion bacterial diseases

- Coppers = most effective bactericides, but not highly effective
- Coppers = contact, protectant (not curative or systemic)





Bactericide Efficacy & Phytotoxicity Trials

Bactericide Trial

Battling Onion Bacterial Diseases with Bactericides

By Lindsey du Toit, Tim Waters, Michael Derie and Jennifer Darner, Washington State University

Onions are a hardy species. However, like most living things, onions can become infected by a diversity of pathogens, including fungi, bacteria, viruses, nematodes, phytoplasmas, parasitic plants and others. About 20 species of bacteria alone can cause diseases of onion plants and bulbs. Some of these bacteria cause distinct lesions on onion leaves that reduce photosynthesis. Others cause the foliage to die back into the necks, leading to soft rot of bulbs in the field. (Fig. 1)

Some bacteria infect onion plants and bulbs in the field without causing visible symptoms. These latent infections can, insidiously, start to rot the bulbs after harvest, in storage or when the bulbs are shipped to markets, after all production and packing costs have been incurred. These bacterial diseases have been estimated to cause $60 million in losses annually in the United States alone. Losses can vary widely among regions, seasons and fields, depending on

Favorable Conditions for Bacterial Diseases

Bacterial diseases of onion are favored by moisture, whether from irrigation, rain or dew. The bacteria are spread by splashing water. Storms are particularly conducive to bacterial diseases because of the combination of moisture and physical damage to the crop from wind, hail and even sandblasting. Frost, feeding injury from pests such as thrips and mechanical practices that cause wounding when the plants are still green can all predispose onion plants to infection by bacteria. Overhead irrigation, rains, irrigating excessively late in the season when bulbs should be field curing, excessive nitrogen fertility (particularly after bulb initiation) and dense plant stands that increase relative humidity in the canopy by limiting air movement all create favorable conditions for bacterial diseases of onion.

Many of these bacteria are common in soil and surface water, a few can be

Management Tools

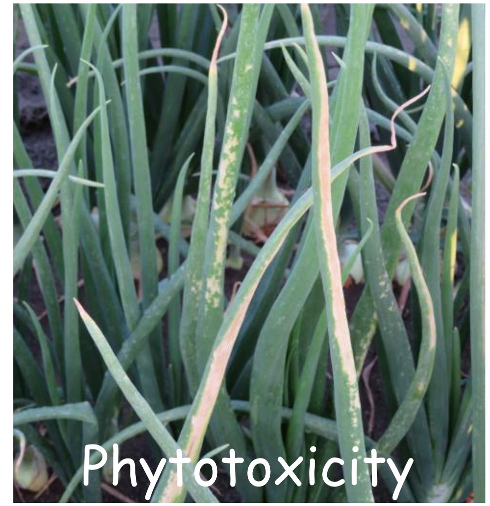
Managing bacterial diseases of onion effectively requires a comprehensive box of management tools, even in semi-arid regions of production where the amount of water used to grow an onion crop typically can be managed more readily than in regions with high rainfall and humidity.

Management tools include purchasing high quality seed or transplants, using good sanitation practices such as removing culled onions and onion volunteers that can harbor inoculum, taking precautions to minimize wounding of plants and bulbs, avoiding excessive irrigation and fertility (particularly in the latter part of the season), applying pesticides that have efficacy against bacteria, using cultural practices that speed up field curing (e.g. undercutting and timely tapering of irrigation) and

Figure 1. *Bacterial pathogens of onion can cause a wide range in symptoms, including leaf yellowing or chlorosis (A), water-soaked lesions on leaves (B), severe leaf dieback (C) and soft rot in the field (D), and bulb rot at harvest or in storage (E).*

Further complicating the choices growers face in selecting relevant

population of 164,000 seeds per acre at the WSU Pasco Extension Farm in



Plant Disease Management Reports, e.g., Dutta et al. 2021. UGA

Treatment and rate of product per acre	Application No. ^{z}	Initial disease severity (%) on 25 Mar	Final disease severity (%) on 28 Apr^{y}	AUDPC^{x}	Center rot incidence in bulb (%)^{w}
Mankocide 2.5 lb	1-6	10.7 b^{x}	43.8 c	358.8 c	9.1 c^{v}
Kocide 3000 1.5 lb	1-6	28.9 ab	50.0 bc	540.7 bc	29.8 bc
Champ 1.5 lb	1-6	15.1 ab	51.3 b	464.8 bc	18.0 c
Oxidate 5.0 32 fl oz per 100 gal	1-6	40.0 a	71.3 a	791.2 ab	55.2 a
Agrititan 800 ppm	1-6	29.4 ab	58.8 b	602.8 bc	19.5 c
LifeGuard 2 fl oz	1-6	22.7 ab	48.8 bc	469.2 bc	26.8 bc
Nordox 1 lb	1-6	18.0 ab	53.8 b	502.4 bc	17.2 c
Non-treated check	**-**	**44.9 a**	**87.5 a**	**1012.2 a**	**74.8 a**

Evidence of widespread copper tolerance in onion bacterial pathogens in Columbia Basin, and poor efficacy of copper bactericides

Non-chemical options to manage late-season onion bacterial and fungal diseases:
Irrigation methods

- Drip irrigation significantly reduced bacterial bulb rot in CA, but results were mixed in GA (humid climate)

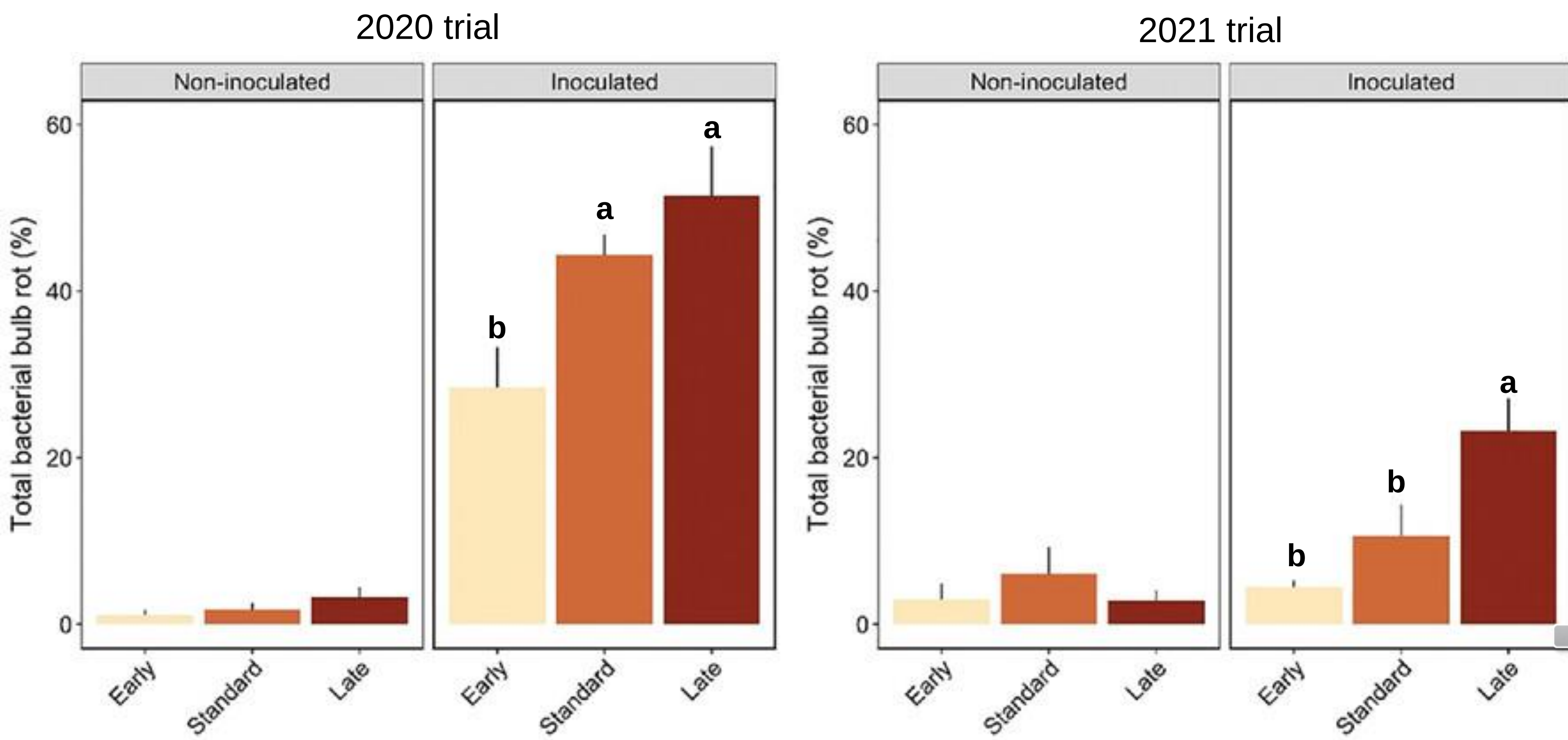
2021 California irrigation trial: Drip vs. solid-set irrigation

Treatment	Foliar bacterial disease incidence AUDPC*	Foliar bacterial disease severity AUDPC	Total bulb yield (t/A)	Average bulb size (oz)	Bacterial bulb rot incidence (% by weight)	Onion stand at harvest (# / bed-ft)
Solid-set irrigation	339 a**	269 a	48.5 b	9.5 b	22.25 a	11.3 a
Drip irrigation	96 b	24 b	59.1 a	11.1 a	0.67 b	11.8 a

Wilson et al. 2022. Plant Disease Management Reports 16:V154.

Late termination of sprinkler irrigation increased bacterial bulb rot. Irrigation frequency did not affect bacterial bulb rot

Belo et al. 2023. Ag Water Management 288:108476



Onion bulb harvest methods for control of bacterial bulb rot

	Incidence (%) of bulbs with internal bacterial rot		
Method of digging onion bulbs	**2020**	**2021**	**2022**
Chain digger (TopAir)	**3.5 b**	**9.0 b**	**1.3 b**
Straight-blade undercutter (TopAir)	**10.2 a**	**20.5 a**	**10.7 a**
P value	**<0.001**	**<0.001**	**<0.0001**

Dutta and Tyson. 2020. Plant Disease Management Reports 15:V025.

Mechanical vs. manual harvest	**2020**	**2021**	**2022**
Mechanical harvest (TopAir)	**2.2 b**	**4.5 b**	**3.0 b**
Manual harvest	**10.5 a**	**14.5 a**	**12.5 a**
P-value	**0.024**	**0.031**	**<0.0001**

Dutta and Tyson. 2020. Plant Disease Management Reports 15:V026.

Length of necks after topping bulbs, if necks are still green/moist when topped

2021 trial on length of neck after topping	Internal bacterial bulb rot incidence (%)
12.5 cm	4.5 y
7.5 cm	4.0 y
2.5 cm	19.0 z

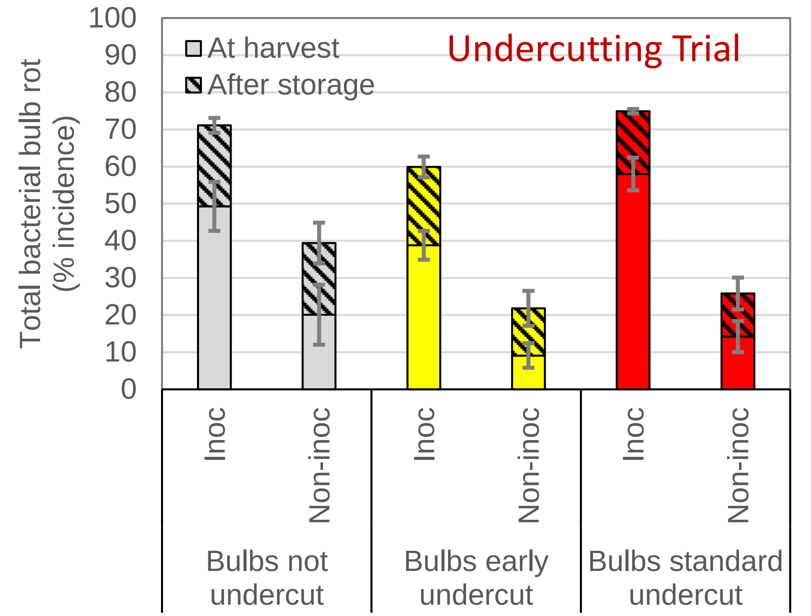
Dutta et al. 2022. Plant Disease Management Reports 16:V107.

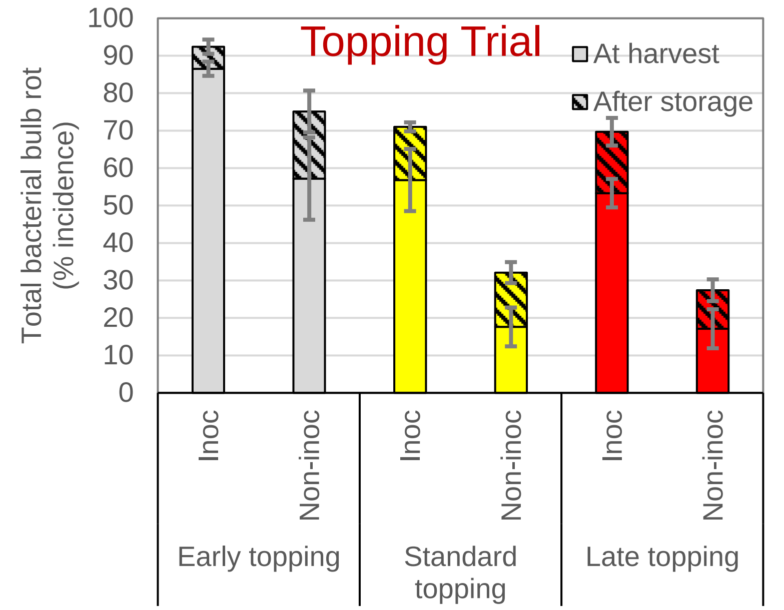
2022 trial	Internal bacterial rot incidence (%)7.5
7.5 cm	10.0 b
5.0 cm	11.5 b
2.5 cm	18.0 a
0 cm	19.5 a

Dutta et al. 2023. Plant Disease Management Reports 17:V008.

Other late-season cultural practices to manage bacterial and fungal bulb rots

- Undercutting bulbs:
  - Early undercutting (50% tops down) increased yield and reduced bacterial bulb rot compared to undercutting at 100% tops down or not undercutting
- Timing of topping bulbs:
  - Early topping (~50% tops down) reduced bulb yield by 54% because of increasing bacterial bulb rot (84% vs. 49-52% when bulbs were topped late)
- Rolling tops:
  - Rolling tops at the onset of tops down did not affect bacterial leaf blight, bulb yield, or bacterial bulb rot



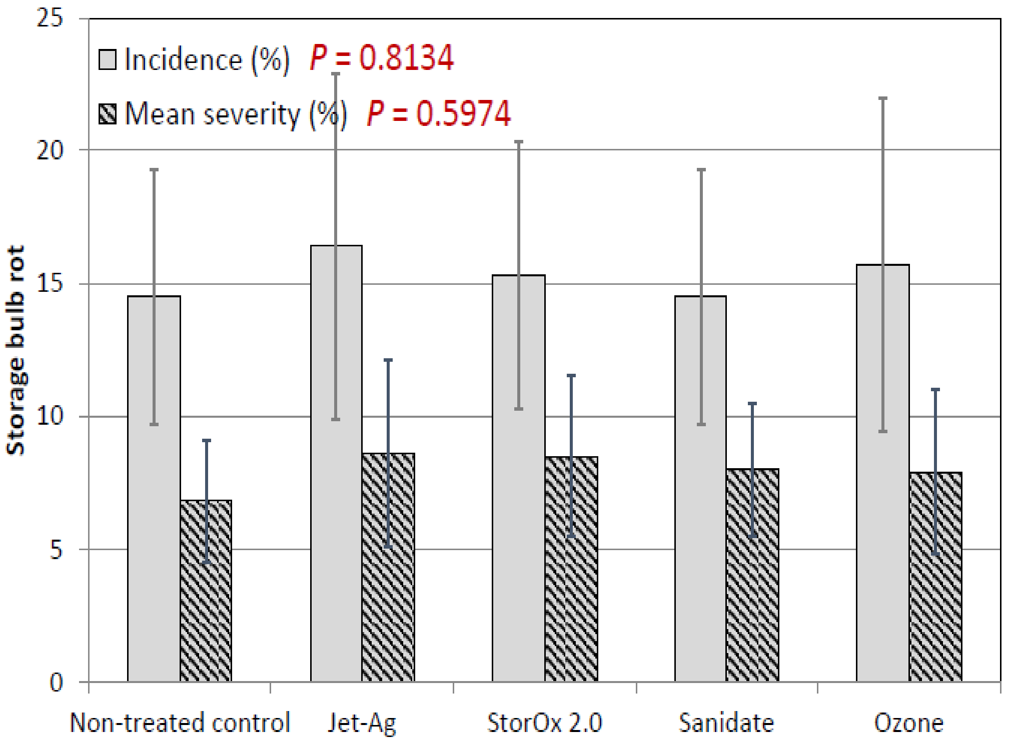


du Toit et al. 2023. Plant Disease Management Reports 17:V125, V128, V129.

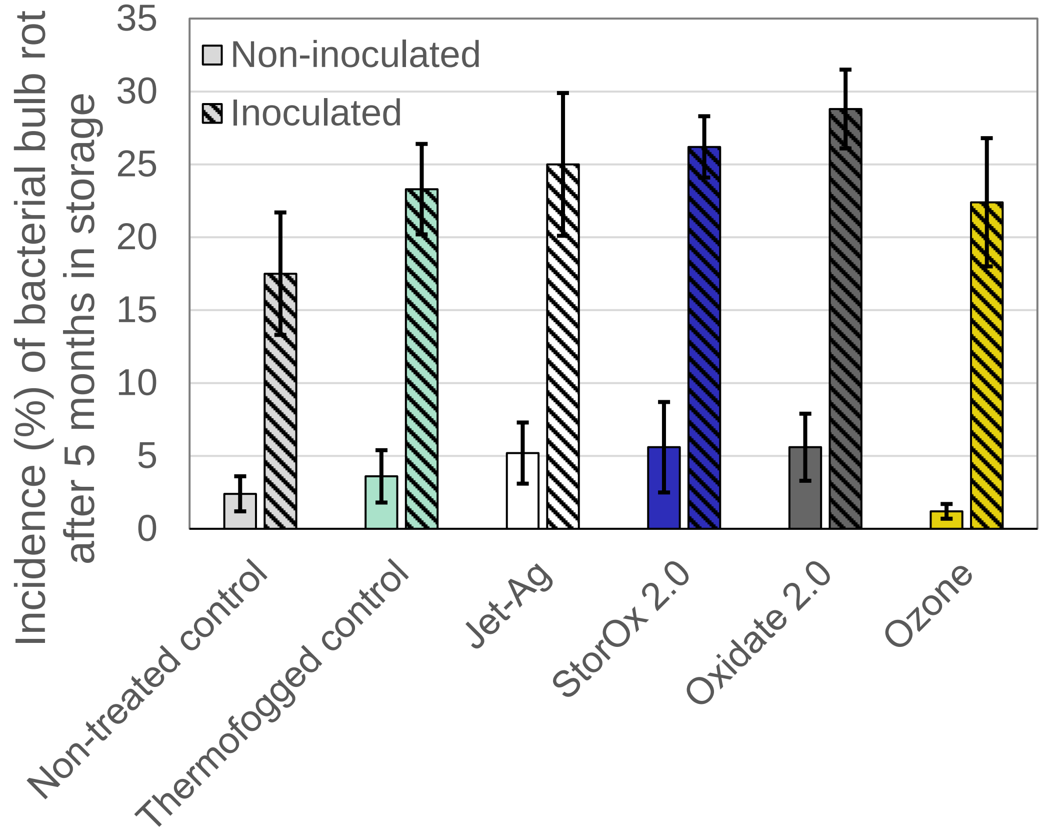
Postharvest applications of disinfectants do not control bacterial or fungal bulb rots in storage:

No penetration into bulb/neck where infections reside

2020-21 trial: Incidence (%) of bacterial rot



2021-22 trial: Incidence (%) of bacterial rot



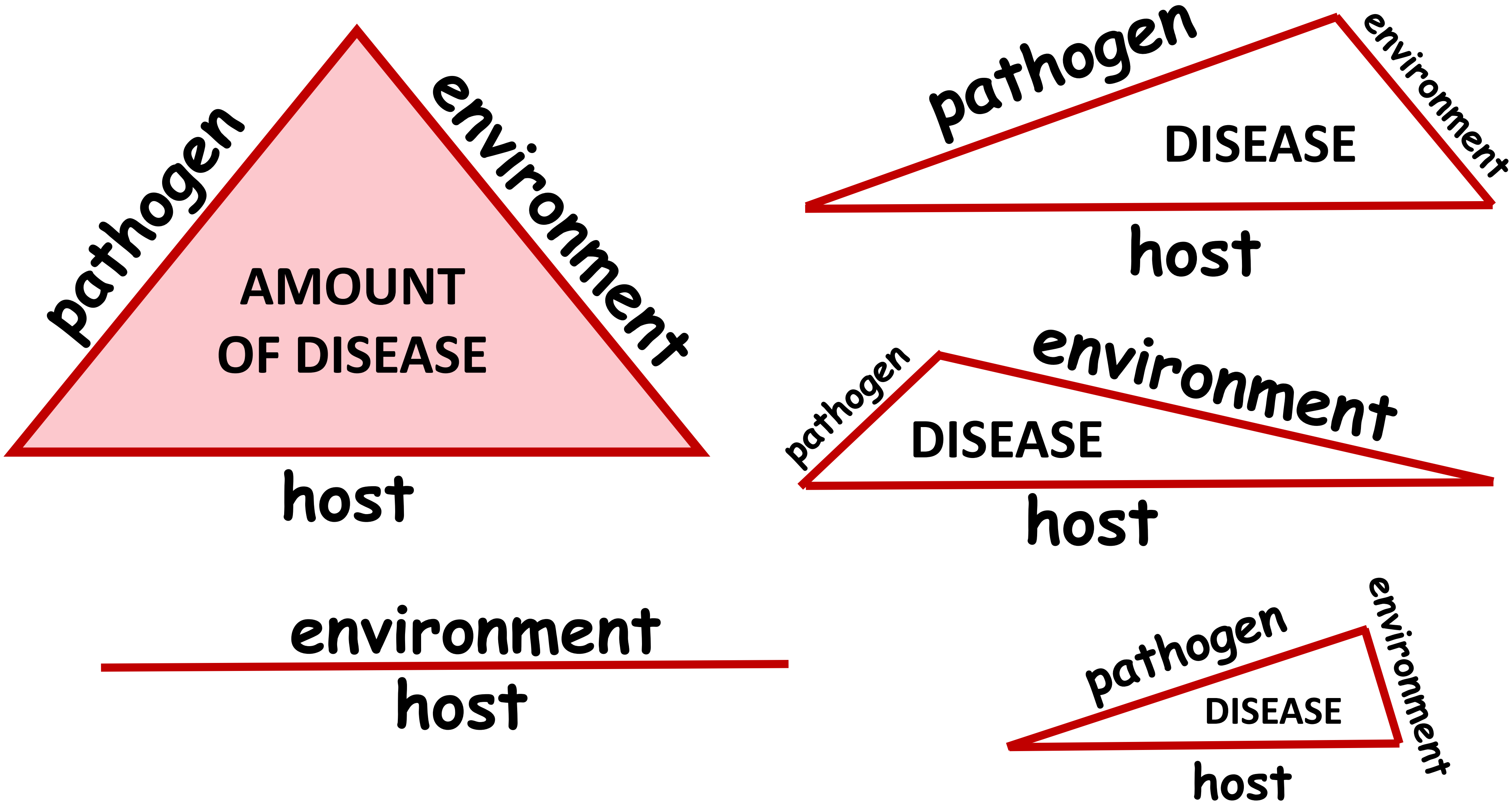
du Toit et al. 2021. Plant Dis. Management Reports 15:V102.
du Toit and Waters. 2021. Onion World, July/August 2021:6-9.

du Toit et al. 2022. Plant Disease Management Reports 16:V148.


2021 Heat stress

What Can you Control?

Know what conditions favor the disease



Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties.

In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action.

It is your responsibility to check the label before using any product to ensure lawful use, and obtain all necessary permits in advance.