Overview and Update of Major Small Fruit Diseases

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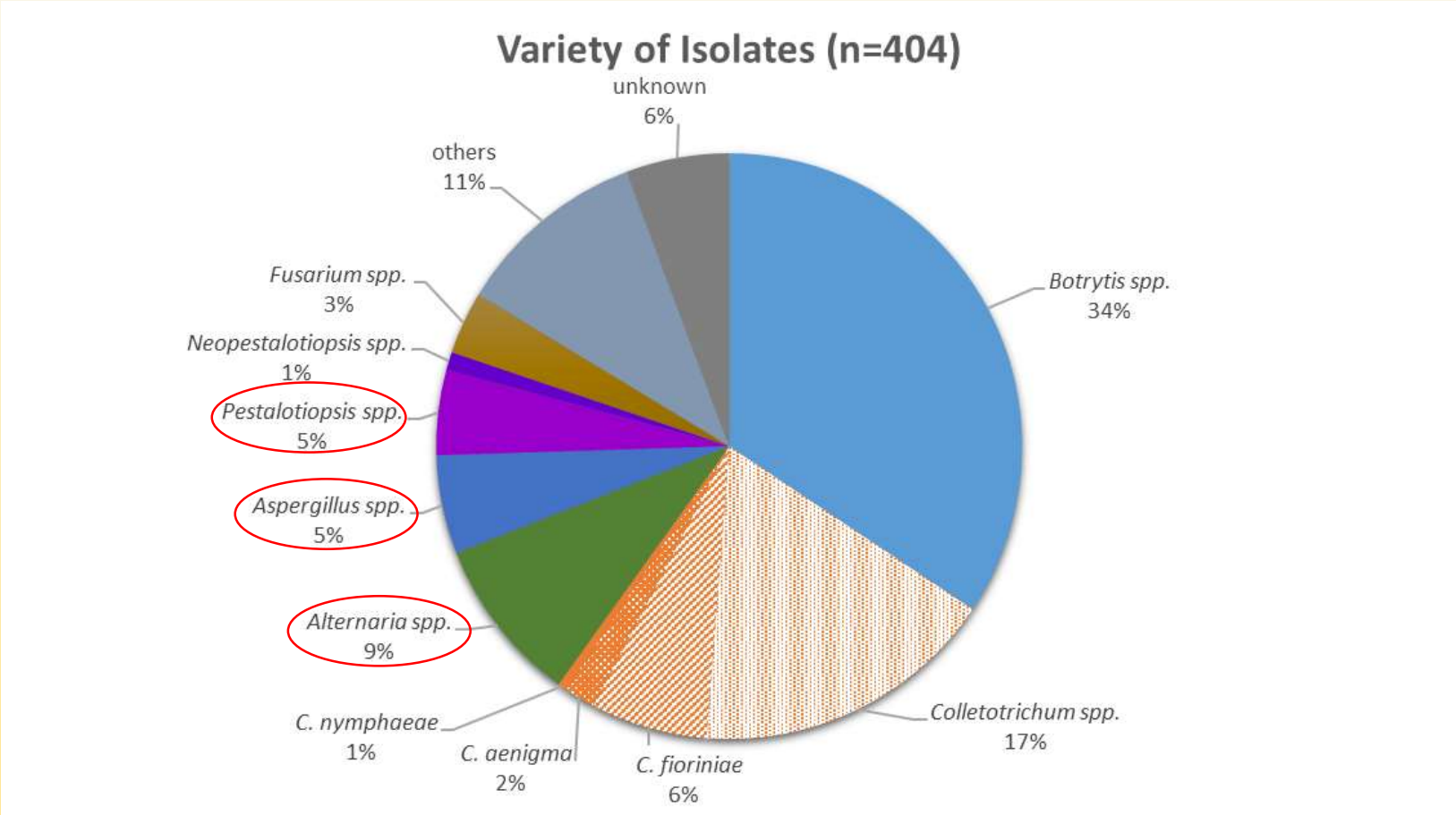
Major Grape Diseases in the Mid-Atlantic

- **Downy Mildew (oomycete)**
- **Powdery Mildew (fungal disease)**
- **Phomopsis (fungal disease)**
- **Black Rot (fungal disease)**
- **Late Season Bunch Rots * (mainly caused by fungi)**

*** A variety of bunch rots caused by multiple pathogens**

Late-season rots: A major threat in Delmarva vineyards

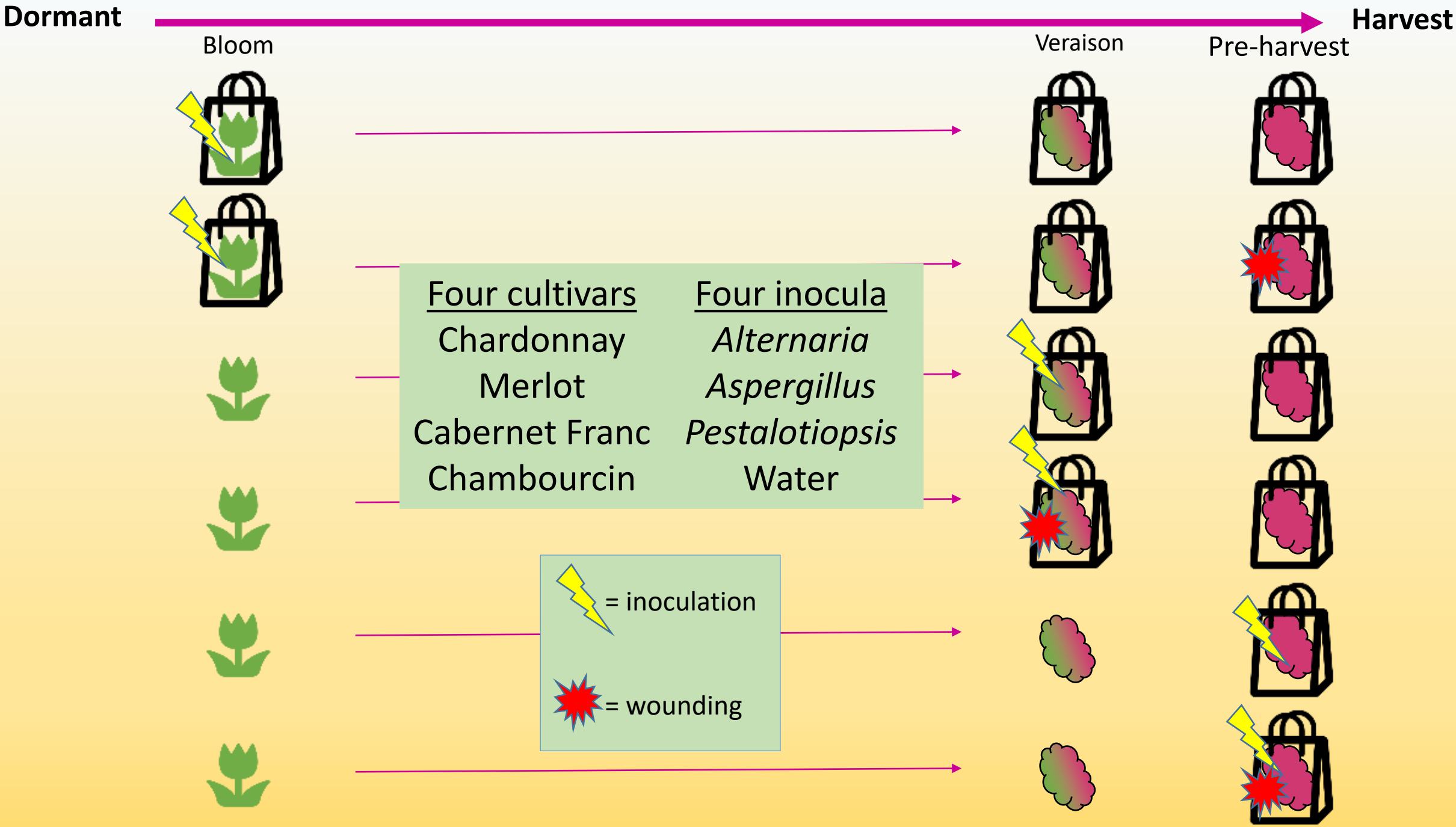
Fungal species associated with LSBR

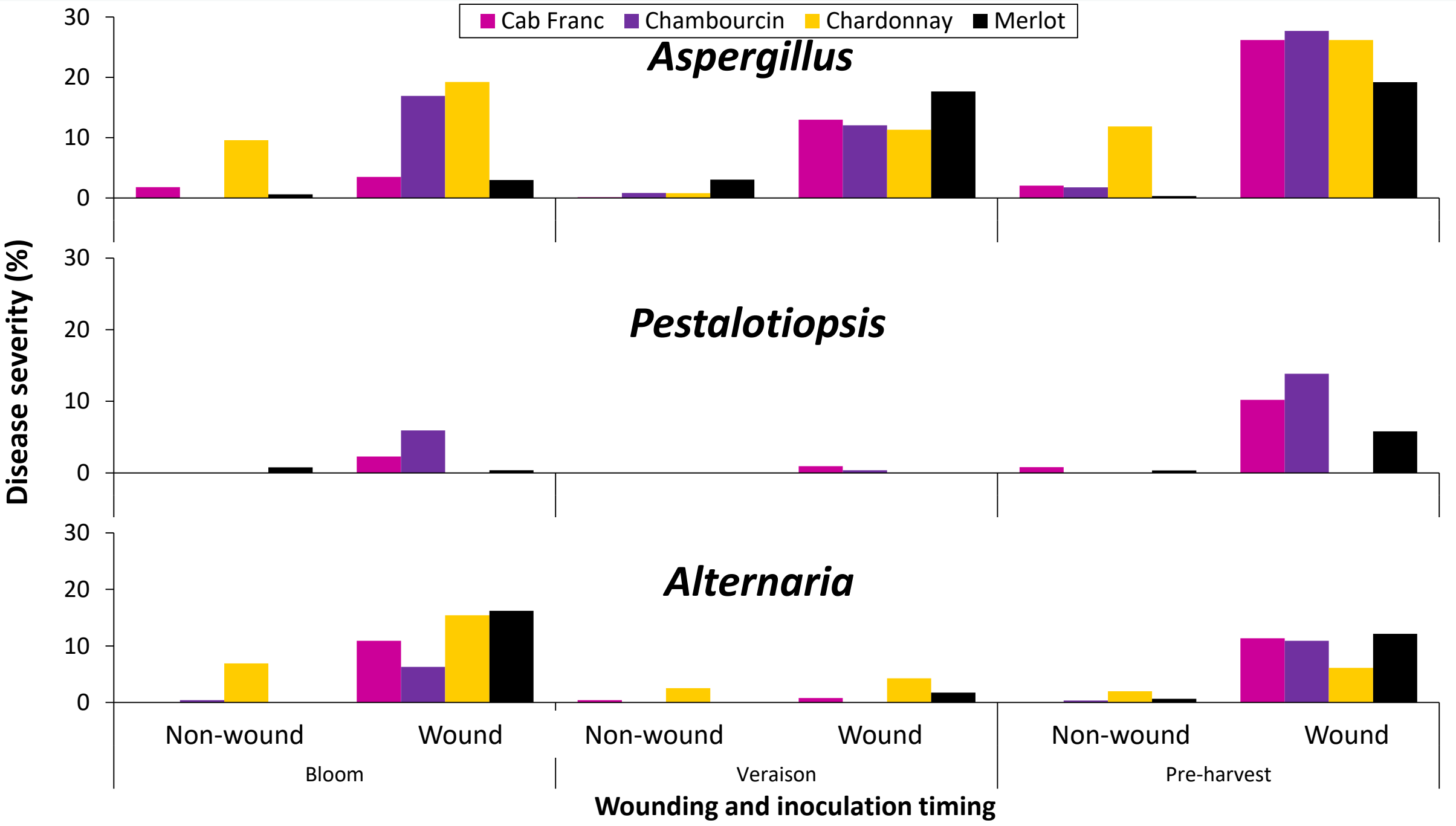


Pathogenicity behaviors of major “secondary invaders” isolated from LSBR

- **Primary objective: Determine pathogenicity of *Alternaria,* *Aspergillus,* and *Pestalotiopsis* <u>under field conditions</u>**
  - Is there differences in cultivar susceptibility?
  - Does pathogenicity vary at different grape growth stages?
  - Is wounding necessary for disease?

Spring ‘19 Field Experiment – Pathogenicity evaluation


Dormant
Harvest
Bloom
Veraison
Pre-harvest
Four cultivars
Chardonnay
Merlot
Cabernet Franc
Chambourcin
Four inocula
Alternaria
Aspergillus
Pestalotiopsis
Water
= inoculation
= wounding

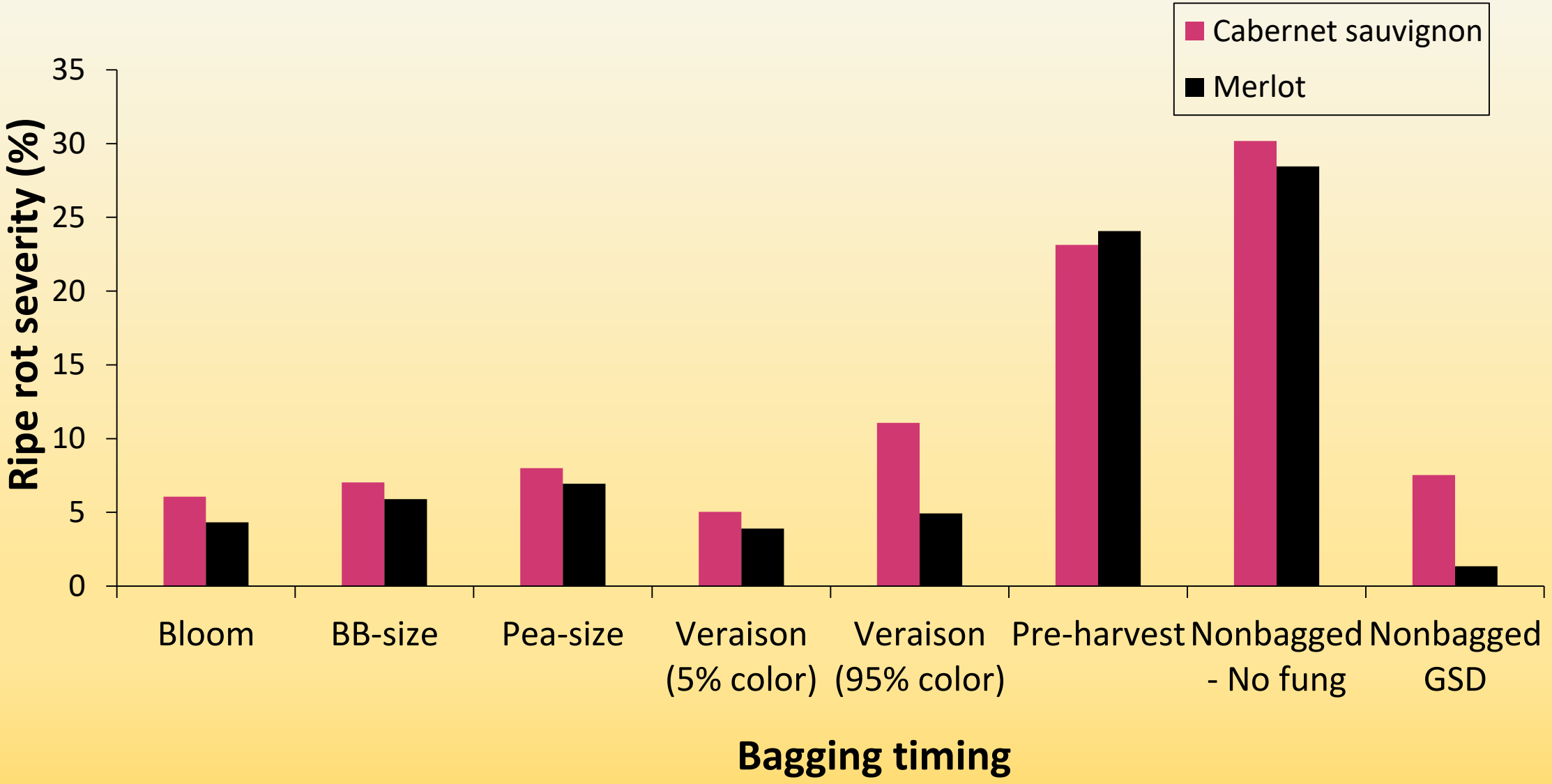

Cab Franc
Chambourcin
Chardonnay
Merlot
Aspergillus
Pestalotiopsis
Alternaria
Disease severity (%)
30
20
10
0
Non-wound
Wound
Bloom
Veraison
Pre-harvest
Wounding and inoculation timing

Spring ‘19 Field Experiment – *Colletotrichum* infection timing

Assess disease severity →

Species correlate to spore traps

Highest severity at pre-harvest and non-bagged timing



Conclusions

- *Alternaria*, *Aspergillus*, and *Pestalotiopsis* are all pathogenic when wounding occurs
- *Wounding occurred at veraison resulted in the few infection of Alternaria and Pestalotiopsis*
- *Aspergillus* is the most pathogenic of the three fungi
  - Highest overall disease
  - Much higher disease at veraison than the other two
- Chardonnay was the most susceptible cultivar to *Alternaria* and *Aspergillus*
- *Our preliminary data suggests the infection may rather occur later in the season (veraison and after)*
- Fungicide sprays for LSBR between BB size to veraison MAY not be necessary

Strawberry anthracnose in the field

Attacking mature & immature fruit

Photo: Tim Elkner

Photo: David Liker

Photo: Meng-Jun Hu

Anthracnose crown rot

Photo: Frank Louws

Flower infection

Photo: Tim Elkner

Characteristic sunken lesion on the fruit

Where does it come from and how it spreads?

Dispersal

Conidia of *C. acutatum* spp. are usually produced in acervuli on host tissue and are typically **rain-splash dispersed**; On low-growing crops such as strawberry, conidia are **spread over short distances** (Peres et al. 2005).

Possible source of infection

- **Nursery transplants**
  - **Facts:** *Colletotrichum* specie have both biotrophic and necrotrophic stages. Symptoms may not develop for some time due to the biotrophic phase that typically occurs early in the infection process (Curry et al. 2002)
  - Soon after planting in fruiting fields, conidiation can occur on the surface of vegetative tissues when weather conditions are favorable, and this can serve to augment inoculum levels to infect flowers and fruit (Leandro et al. 2003)
  - **However,** infected transplants do not always result in the disease.

Possible source of infection (continued)

- **Weeds**
  - **Facts:** the fungi seem to live on weeds as an endophyte or remain quiescent, which unlikely produce acervuli or conidia needed for dispersal
  - Even conidia are available from other hosts, they are limited in distances that they can spread as a rain- or water-splashing pathogen
- **Survivals in the soil**
  - **Facts:** not a typical soil-borne pathogen, but can survive in the soil for up to 12 months under dry conditions. Survival of conidia and sclerotia declined rapidly under moist conditions (Norman and Strandberg 1997).
  - At 11% soil moisture content, the time required for 95% loss of viability was 70 to 75 days. In soil at field capacity (22% moisture), a 95% reduction in population recorded within 4 to 10 days (Freeman et al. 2002)

Control of strawberry anthracnose

- **Chemical control**

- A major pillar in the IPM of strawberry anthracnose
- Strobilurin fungicides (QoIs; FRAC 11) are the most effective but **resistance** has been reported in the Southeast (Forcelini 2016, 2018).
- MBCs (FRAC 1) are effective against *C. gloeosporioides* only.
- Other fungicides such as captan and switch are effective to some extent.

- **Cultural-based control methods**

- Sanitation of infected plants/fruit: **may NOT be effective**
- Living mulches (such as wheat, rye, or rye grass) or organic mulches (wheat straw): **likely effective**
- Increasing plant density: **maybe effective**
- Anthracnose was found less severe when water is supplied to plants using drip irrigation rather than overhead irrigation (Madden, 1992; Smith and Spiers, 1986)

Any new or existing fungicides that may offer some efficacy?

Colletotrichum spp. affecting strawberries

- ***Colletotrichum acutatum*** [a, b]

  -C. nymphaeae

  Resistant to FRAC 11

  -C. fioriniae

  Resistant to FRAC 11

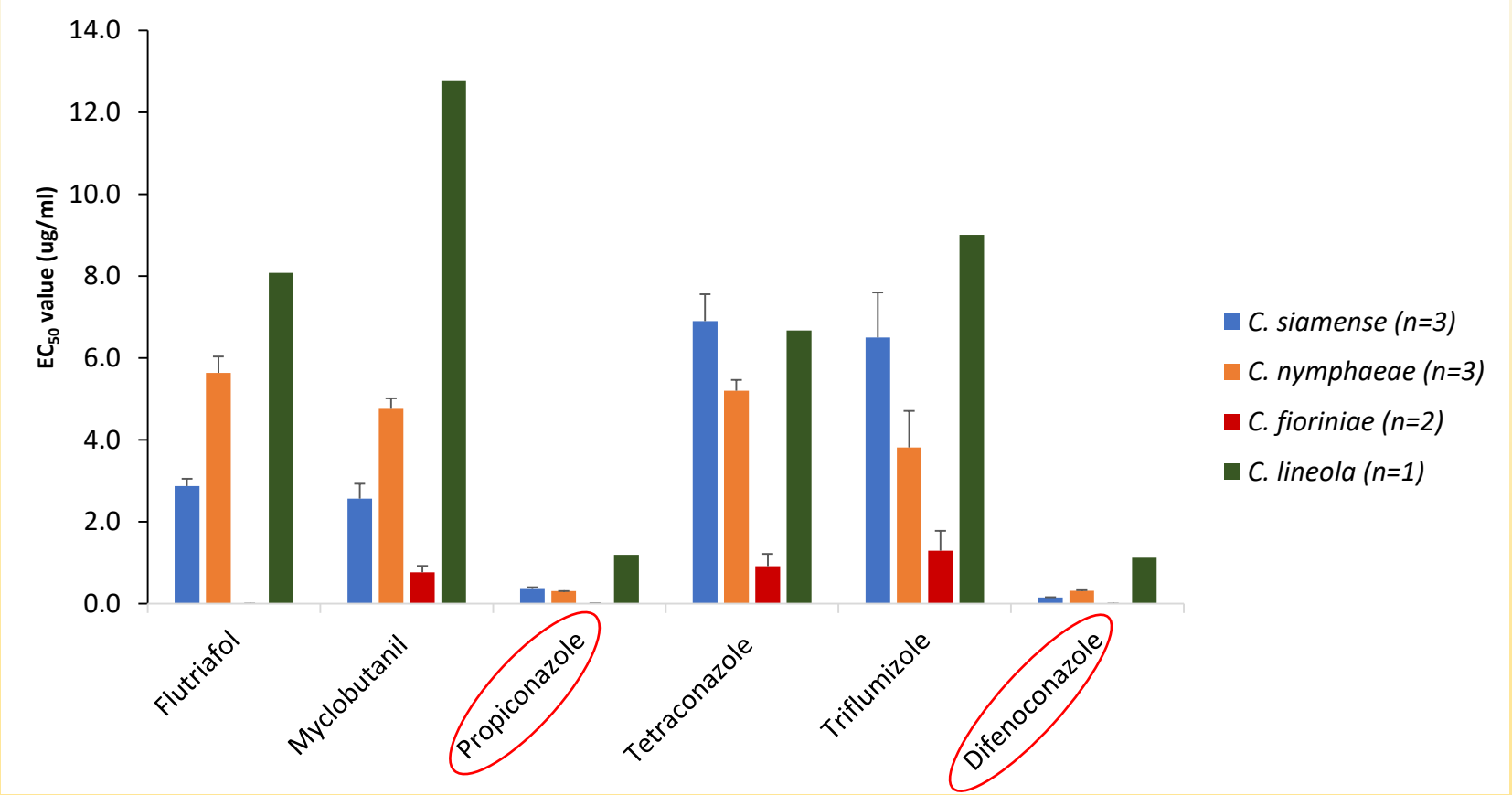
  [a] Inherently resistant to FRAC 1

- ***Colletotrichum gloeosporioides*** [b]

  -C. siamense

  Resistant to FRAC 1 & FRAC 11

Sensitivity of Colletotrichum Species to FRAC 3 Fungicides



Anita and Hu (unpublished data)

Any new or existing fungicides that may offer some efficacy?

Sensitivity of *Colletotrichum* isolates to FRAC 7 (SDHI) fungicides (mycelial growth)

Species and isolates	EC_{50} (µg mL^{-1}) of fungicide:				
	Bos-	**Fluxapy-**	**Penthio-**	**Fluopy-**	**Benzovin-**
C. gloeosporioides					
Niitaka 3	>100	>100	2.6	>100	0.2
5-2-1	>100	>100	1.9	>100	<0.1
5-2-2	>100	>100	1.8	>100	<0.1
Nagasaki 1	>100	>100	0.8	>100	<0.1
Nagasaki 2	>100	>100	0.7	>100	<0.1
19002	>100	>100	1.6	>100	<0.1
Cg_RR12-1	>100	>100	1.2	>100	<0.1
Cg_SE12-2	>100	>100	1.1	>100	<0.1
Cg_EY12-2	>100	>100	2.6	>100	<0.1
Cg_RR12-4	>100	>100	1.1	>100	<0.1
Ca_EY12-1	>100	>100	2.0	>100	<0.1
C. acutatum					
GC2-1	>100	>100	0.3	>100	<0.1
AAU811-3	>100	>100	0.5	>100	<0.1
CO4-35	>100	>100	1.2	>100	<0.1

- Bos: Pristine
- Fluxapy: Merivon
- Penthio: Fontelis
- Fluopy: Luna series
- Benzovin: Aprovia (not labeled on strawberry)

Ishii et al., 2016
(Pest Manag. Sci.)

Take-Home Message

- Resistance to QoI (FRAC 11) or MBC (FRAC 1) is common, use of these two fungicide classes may no longer be effective
- Captan should be included in every sprays during fruit ripening
- Certain DMIs (i.e. Tilt and Quadris Top) and Fontelis may be useful, but their efficacy need to be validated under field conditions.
- Avoid growing highly susceptible cultivars in open-field condition.
- Any practices that keep water/rain off the plant WILL be of great benefit
- Do not keep strawberries in the “permanent” crop areas, especially when soils are on dry side.

A REVIEW of BRAMBLE Diseases and their management

Fruit rots

Foliar diseases

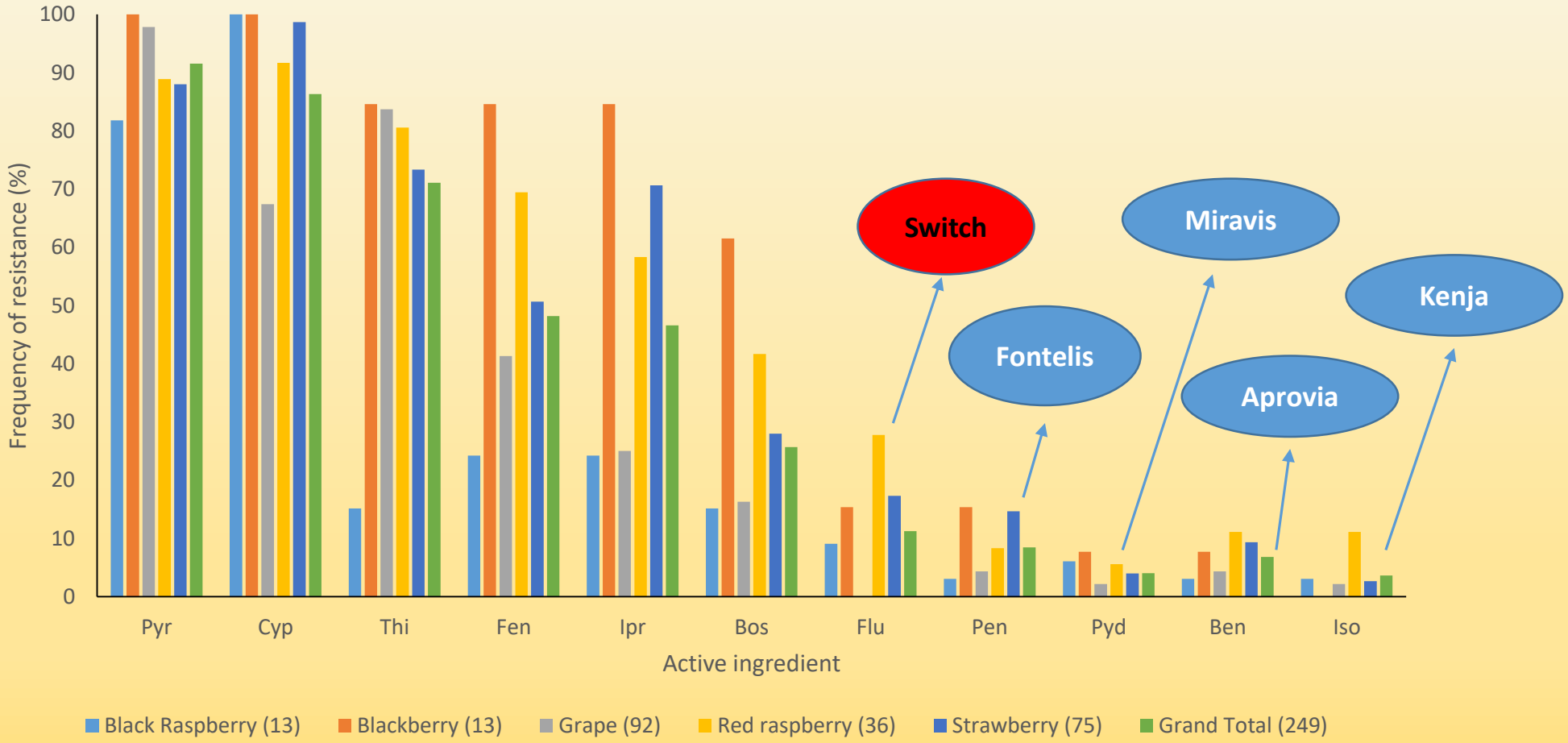
Cane and crown diseases

Root rots

Viruses

Botrytis – light spores on gray stalks

Fungicide resistance in Botrytis cinerea from small fruits in the Mid-Atlantic



Late leaf rust

- Not systemic
- Affects fruit and leaves
- Certain spruce are alternate host, but can persist without them
- More common on fall raspberries (red and *black*)
- Can cause premature defoliation, unmarketable fruit

Late leaf rust

- Cultural controls
  - Don’t pull plants out!
  - Improve air flow
  - In tunnels, remove floricanes (i.e., only fall crop?)
  - Avoid planting near white spruce
- Chemical controls
  - Not *usually* needed
  - Category 3 and 11 fungicides, include copper for resistance management

Viruses

- 160 samples in a PA survey in 2018
  - 54 tested positive for a virus (many were wild)
  - 9 positive for more than one virus = symptoms

- In order of frequency:
  - Blackberry chlorotic ringspot virus (42)
  - Black raspberry necrosis virus (11)
  - New one, not yet named (5)
  - Raspberry bushy dwarf virus (2)
  - Tomato ringspot virus (1)
  - Apple mosaic virus (1)
  - Tomato black ring virus (1)

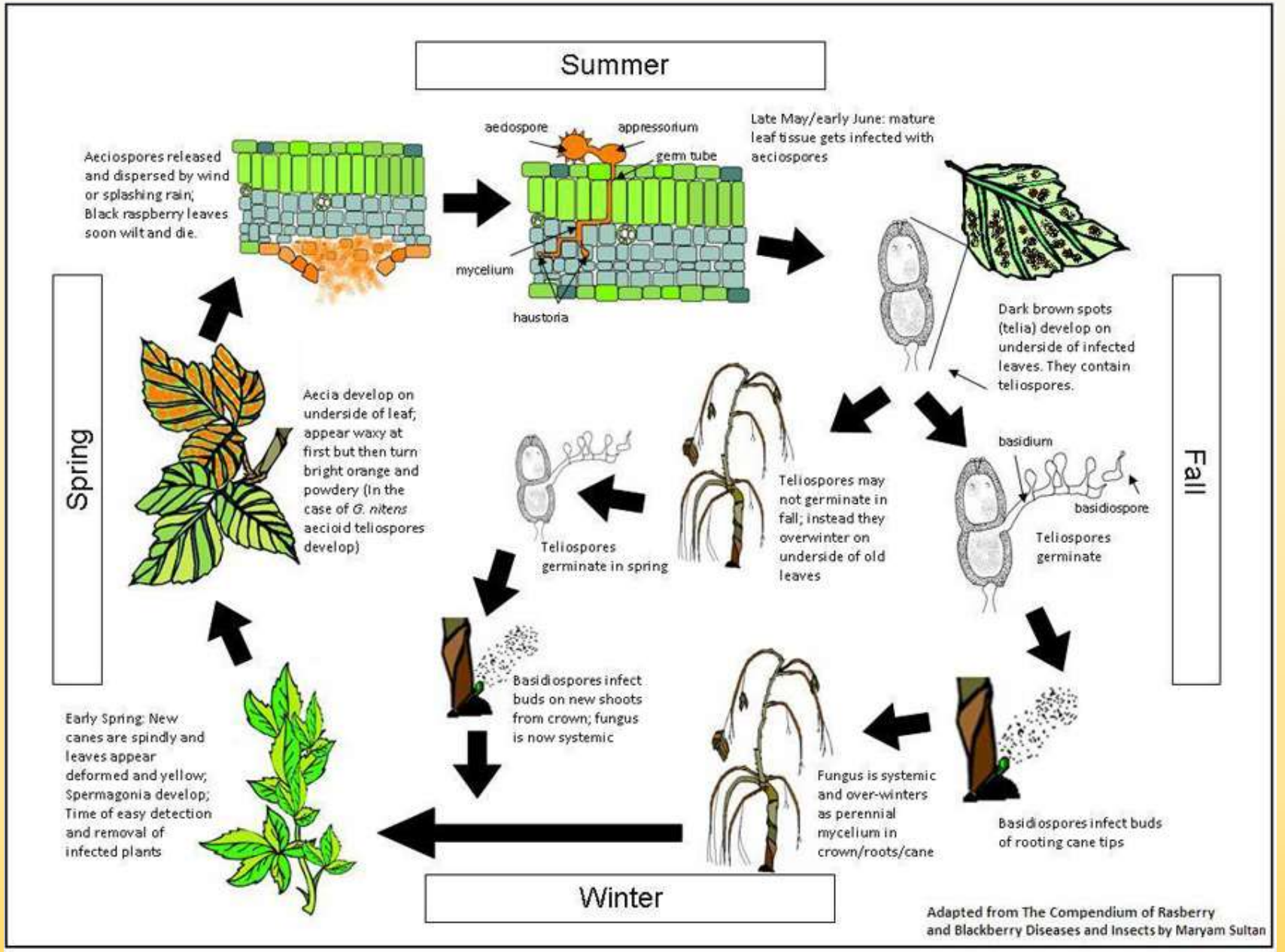
Virus Management

- Maximize distance from wild brambles or old plantings – can’t control all vectors
- Control known vectors (aphids in particular, thrips)
- Watch for symptoms -remove plants

Orange Rust

- Only a problem for black/purple raspberries, blackberries
- Systemic
- Bright orange spores in late spring
- Complex life cycle
  - Two spore types at different times of year

Life cycle of bramble orange rust



Orange rust management

Scouting

- After leaves have just emerged in early spring, check new primocane growth for deformed, yellow leaves. Look for spindly, clustered new shoots that develop from the crown. Infected canes will have few if any spines.

- Search the underside of leaves for waxy, blister-like pustules. Towards the end of May, search the underside of leaves for powdery, bright orange blisters.

- During the summer, check the underside of mature leaves for dark brown spots, especially in the lower canopy and toward the middle of the trellis.

Orange rust management

Cultivar

Red raspberries are all resistant. **All purple and black raspberries are susceptible to orange rust.** The level of resistance in blackberries appears to be dependent on the region. Maximize distance from wild brambles when planting

Chemical control

FRAC 3 and 11, including Abound, Cabrio, Tilt, and Rally

- Around the time of leave emergence in early spring
- About 3-6 weeks in the fall: extended moisture (> 6 hrs) and temp between 45 to 70 F
- Spray every 14 to 20 days

Summary

- Scouting is CRITICAL for orange rust management
- The disease is favored by cool temperature and prolonged moisture
- Use of fungicides may NOT be sustainable, due to limited chemical options and relatively intensive sprays. Perhaps no need to spray IF no sign of disease.