Screening *Prunus* Species to Find Sources of Resistance to *Armillaria* Root Rot

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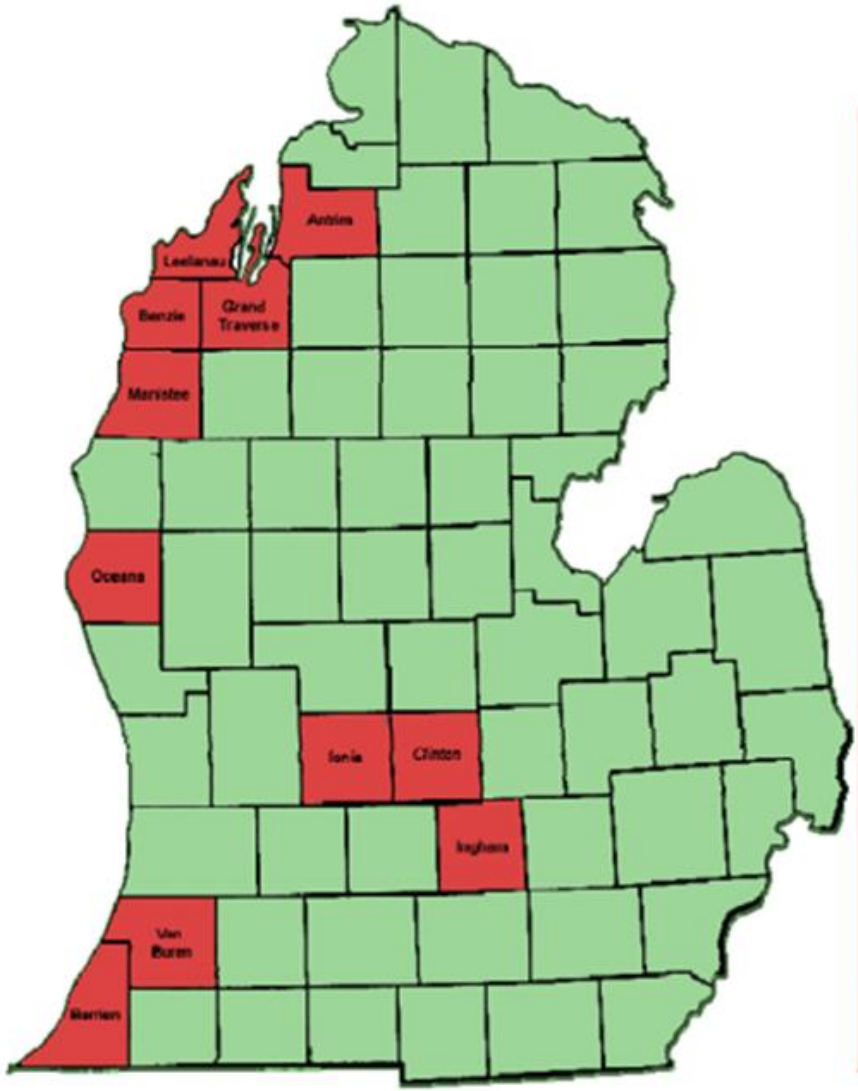
Armillaria Root Rot

- Shoestring root rot, mushroom root rot, toadstool disease.
- *A. solidipes*, *A. mellea*, & *A. tabescens.*
- Majority of the US and worldwide.
- Vines, shrubs, shade and forest trees, horticultural crops.
- Maple, oak, white pine, red pine, aspen, peach, cherry and potato -MI.
- *Armillaria solidipes* - most prevalent -MI.

Armillaria root rot and its impact on MI cherry production

- Michigan produces
  ~70% of the national tart cherry
  ~30,800 acres
  ~17% of the national sweet cherry
  ~7,400 acres
- Leelanau County has ~51% of Northwest Michigan's cherry acreage
- Primary impact on tart cherries

Distribution



County	Host	Number of Isolates	Species
Antrim	Tart Cherry	7	*A. ostoyae*
Benzie	Tart Cherry Sweet Cherry Peach	4 1 1	*A. ostoyae* *A. ostoyae* *A. ostoyae*
Berrien	Tart Cherry	2	*A. mellea*
Clinton	Fallen Log	2	*A. calvescens* or *A. gallica*
Grand Traverse	Tart Cherry	1	*A. ostoyae*
Ingham	Fallen Log	6	*A. calvescens* or *A. gallica*
Ionia	Fallen Log	5	*A. calvescens* or *A. gallica*
Leelanau	Tart Cherry Peach	13 1	*A. ostoyae* *A. ostoyae*
Manistee	Sweet Cherry	2	*A. ostoyae*
Oceana	Tart Cherry Tart Cherry Plum	1 1 1	*A. ostoyae* *A. mellea* *A. mellea*
Van Buren	Plum	1	*A. calvescens* or *A. gallica*

Hammerschmidt (2010)

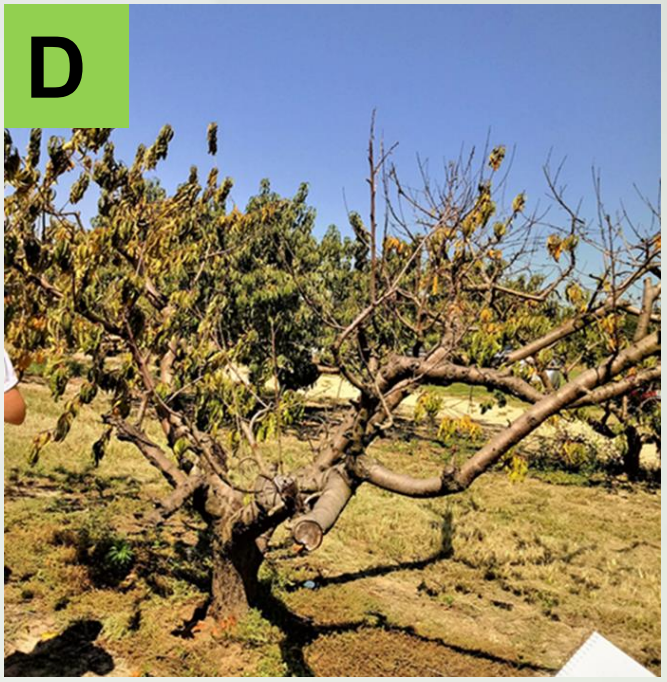
Signs and symptoms

A

B

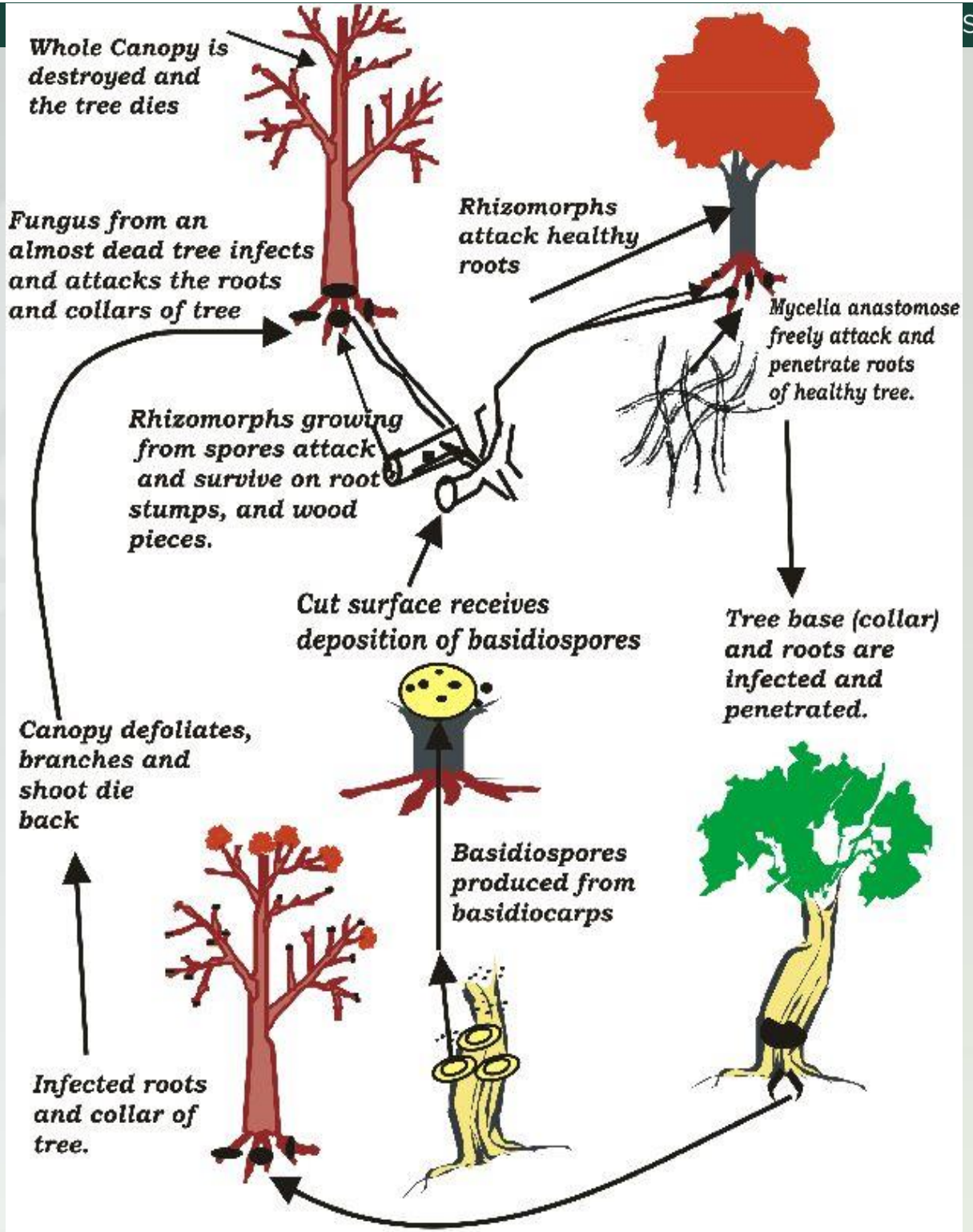
C

D



Disease cycle

- Soil-borne
- Basidiospores Dissemination
- Rhizomorphs
- Root-root attachment



Control of Armillaria root rot

- A number of physical, chemical, and cultural control approaches have been tested with limited success
- No known control
- Planting resistant rootstock is one of the most effective strategy

Overall objective

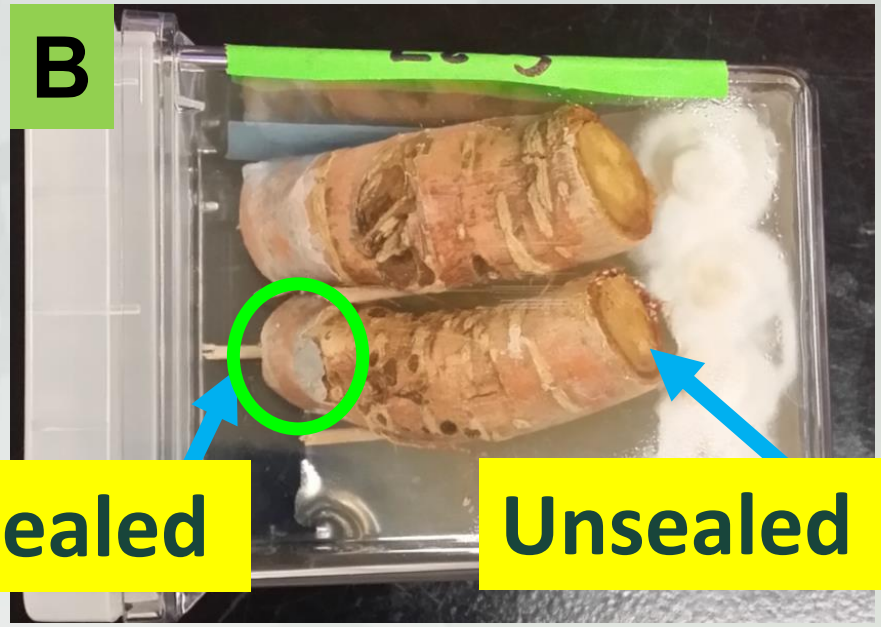
To determine relative tolerance of various *Prunus* germplasms to *Armillaria* spp. and determine mechanisms of fungal tolerance

In-vitro assays - Holistic approach

- 24 *Prunus* germplasms
- Cherry, Peach, Almond, and Plum

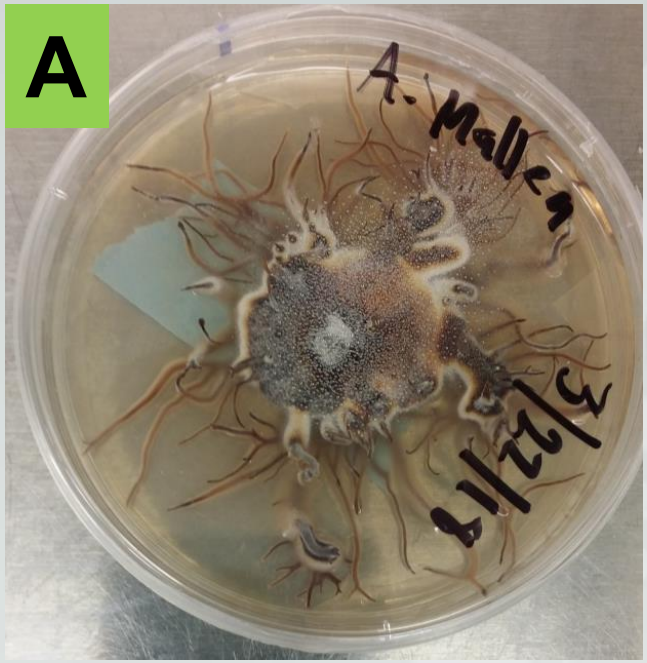
- *A. solidipes*, *A. mellea*, and *A. tabescens*

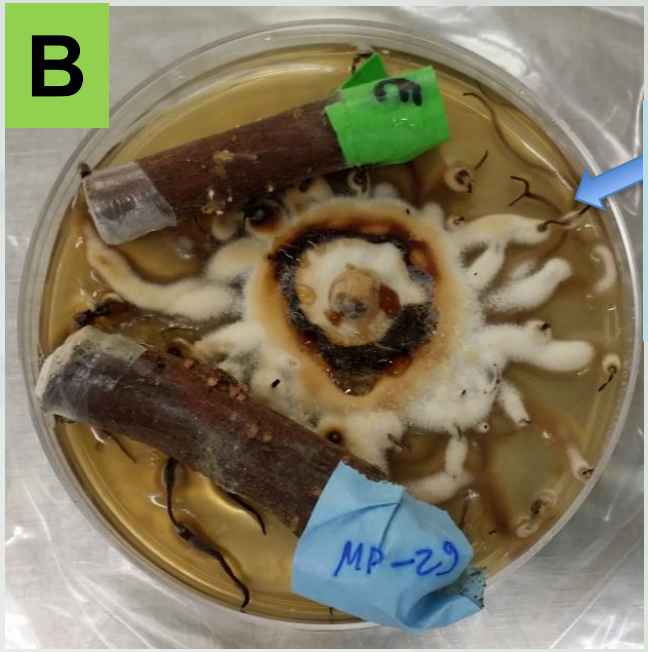
1. Wounded-root inoculation assay



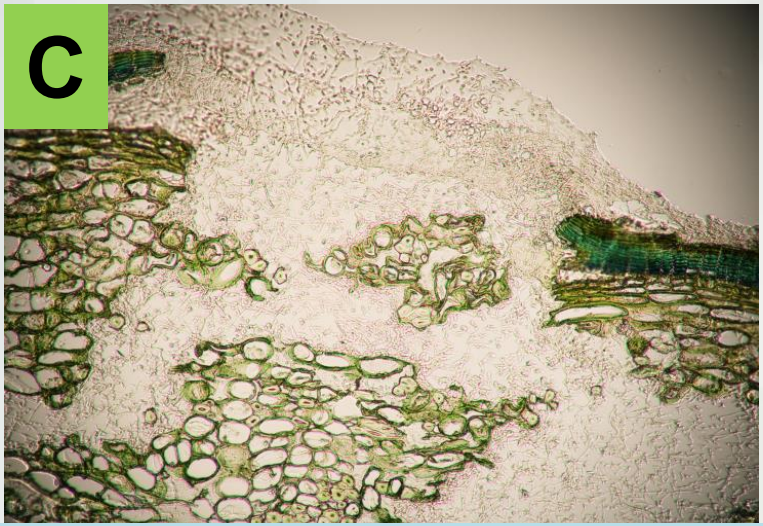
Fungal colonization

2. Intact-bark inoculation assay



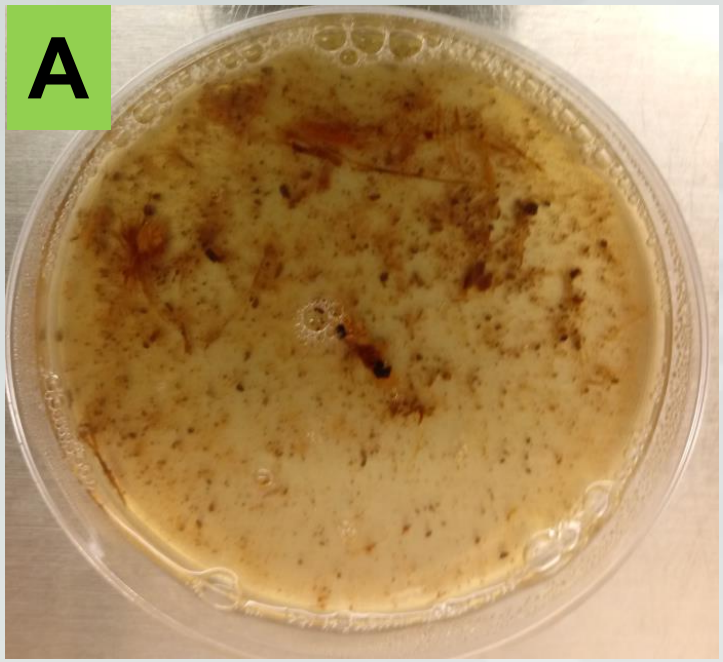


Rhizo morph

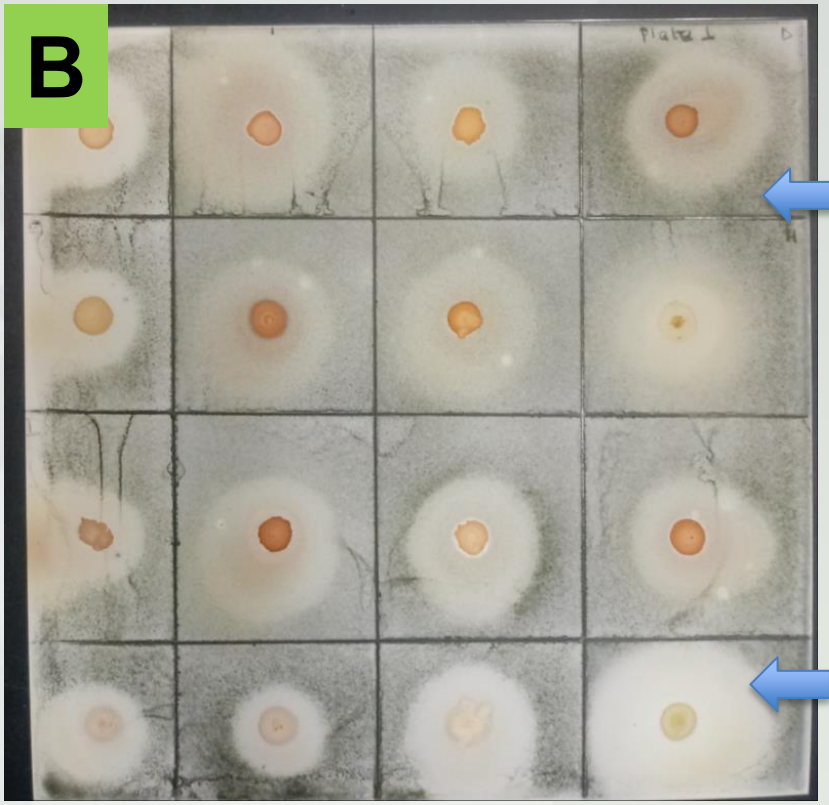


Histological examination

3. Antifungal assays



Periderm amended media



Activity of anti-fungal compounds

Overview of results

Less cambium colonization (Assay 1)

- *P. avium*, *P. maackii*, *P. cerasifera*, *P. mun* 3-4

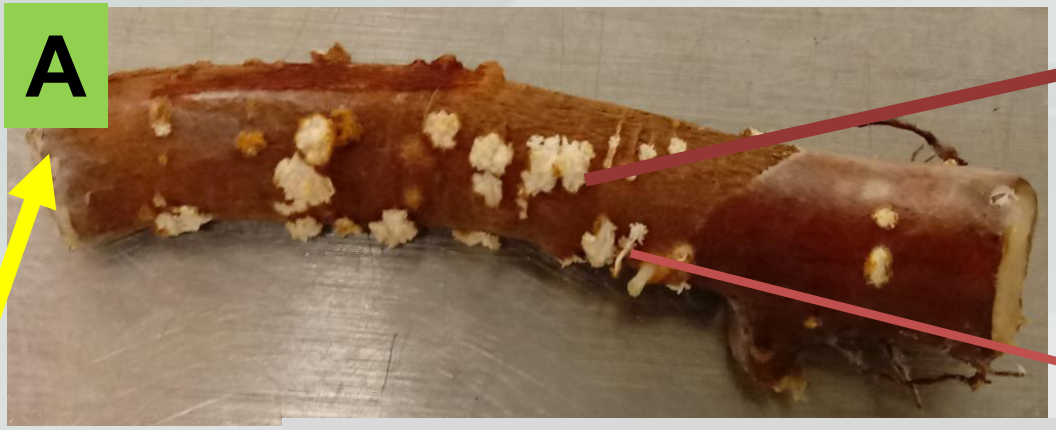
Less bark penetration (Assay 2)

- P mun 1-4, MP-29, *P. avium*, *P. maackii*, *P. cerasifera*, Guardian, Pisa 2, Krymsk#86

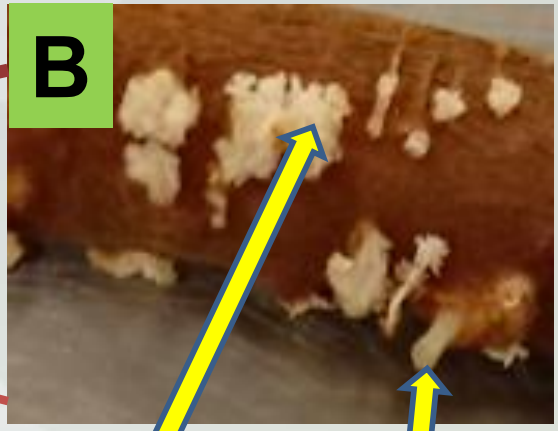
High level of antifungal compounds (Assay 3)

- *P. avium*, *P. maackii*, Pisa 5, Krymsk#86

External callus formation (Assay 1)



P. cerasifera (root)



External callus

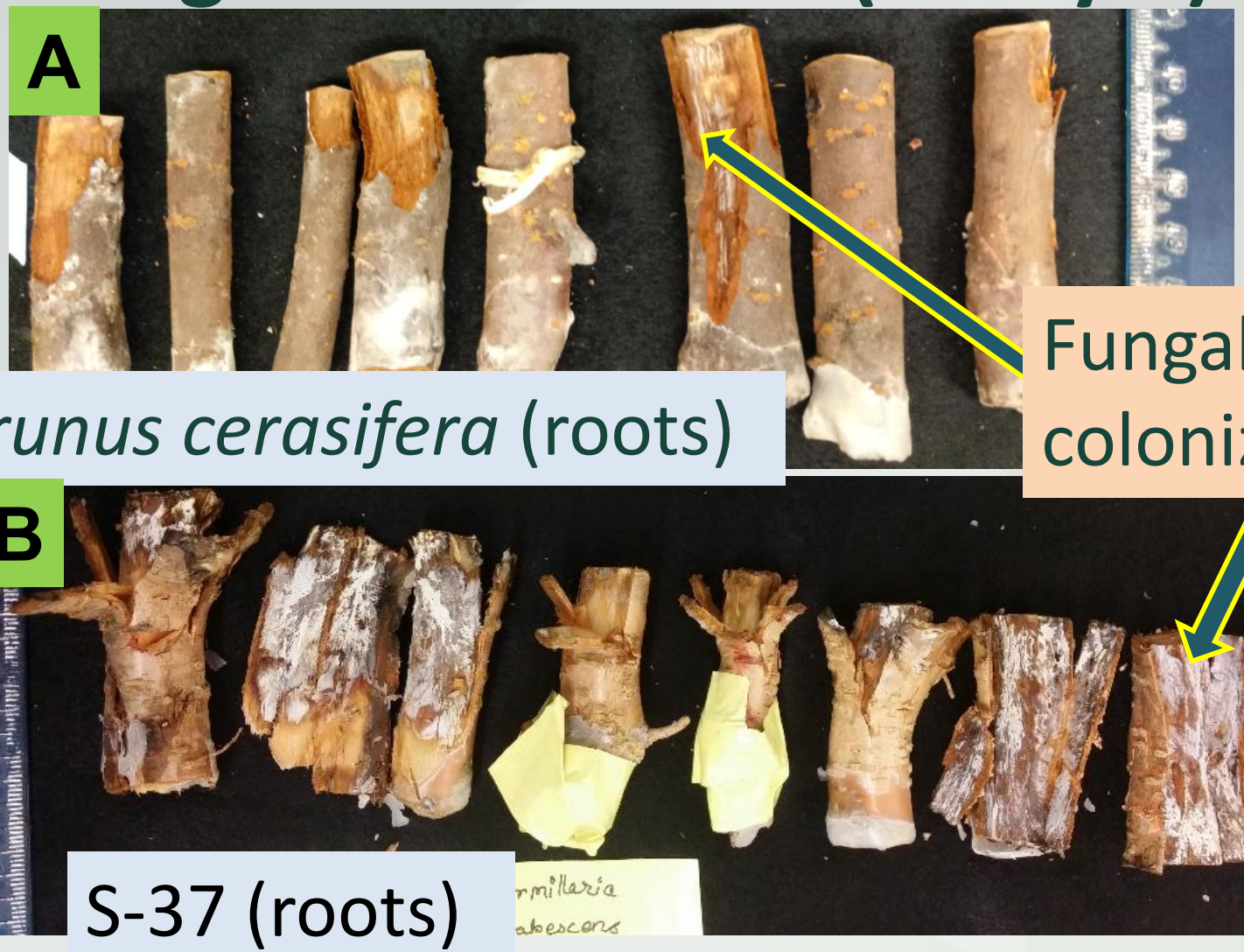
Infection point

Guardian (root)

New root growth from callus

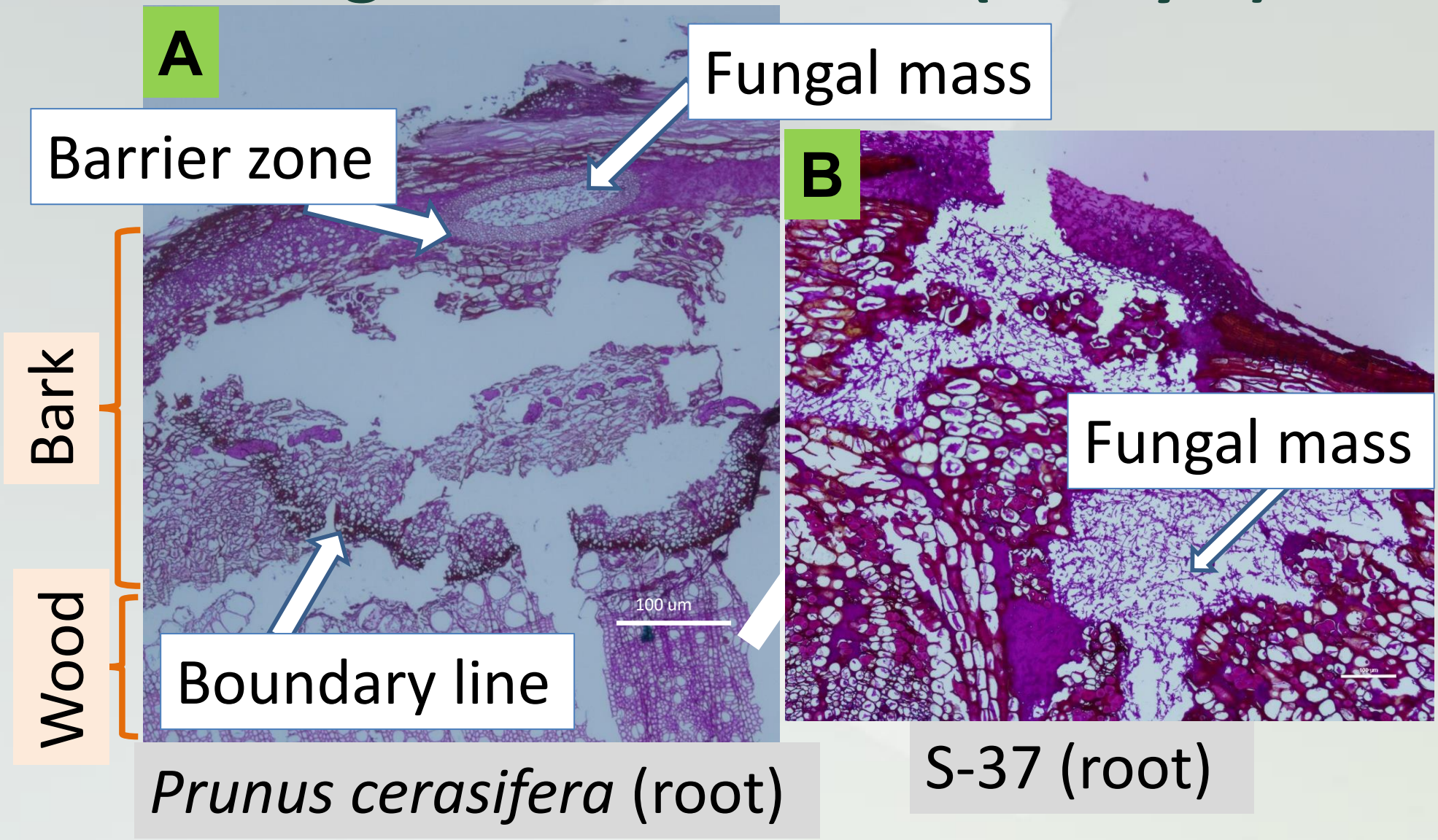
Differential ability of germplasms to form external callus

Fungal colonization (Assay 1)



Differential ability of germplasms to support fungal colonization

Histological examination (Assay 2)



Prunus cerasifera (root)

S-37 (root)

Differential ability of germplasms to wall of fungus

Antifungal assays (Assay 3)

3A

Control

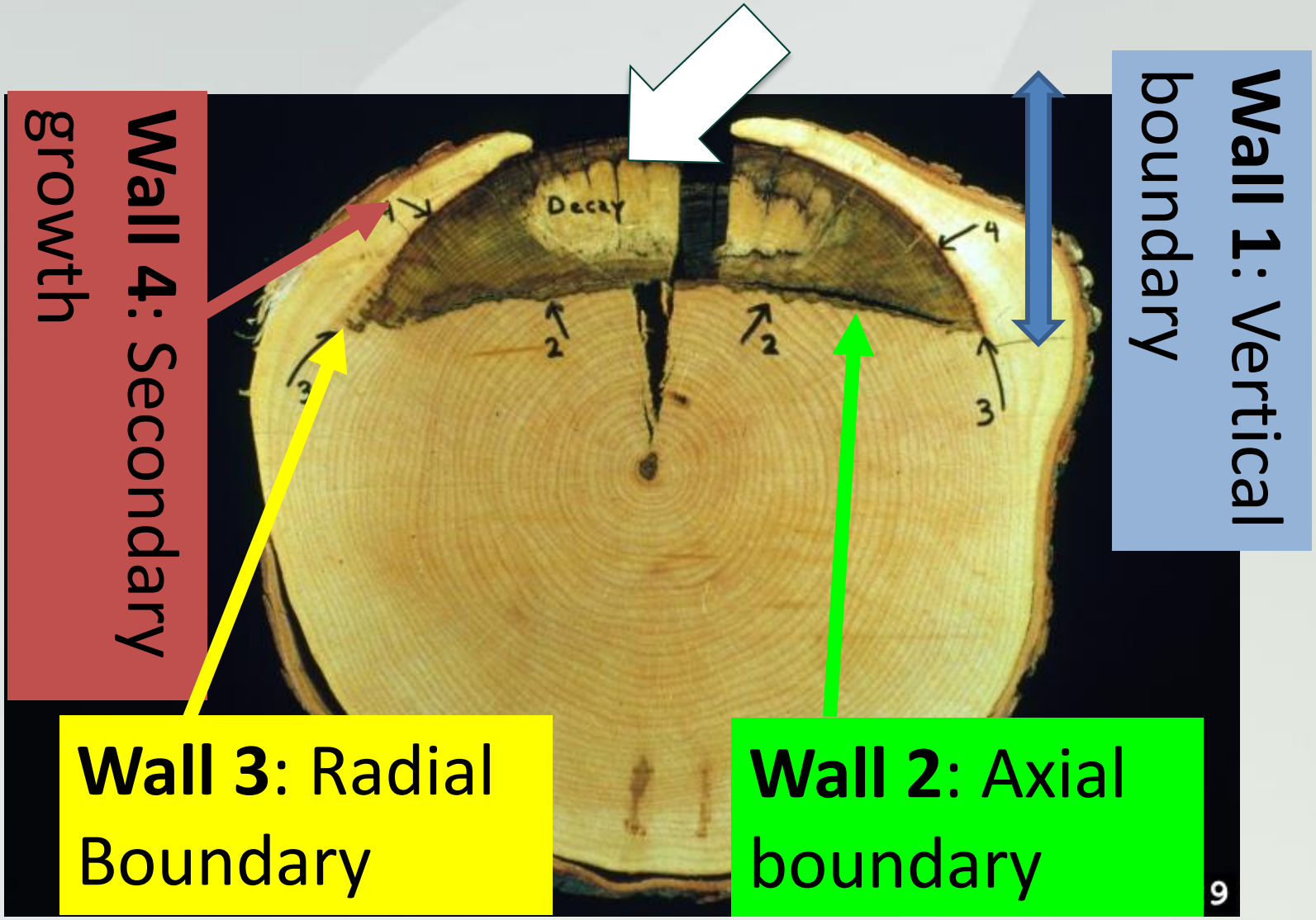
P. avium

S-37 (roots)

3B

Antifungal compounds may differ among germplasm

Compartmentalization of infection



Conclusions

- **Mechanisms of resistance**
  - Antifungal compounds
  - Active defense responses
  - Composition of cell wall components
  - Others

- **Defense responses**
  - Barrier zone formation
  - Callus tissue formation
  - New periderm formation

New strategies (To be tested)

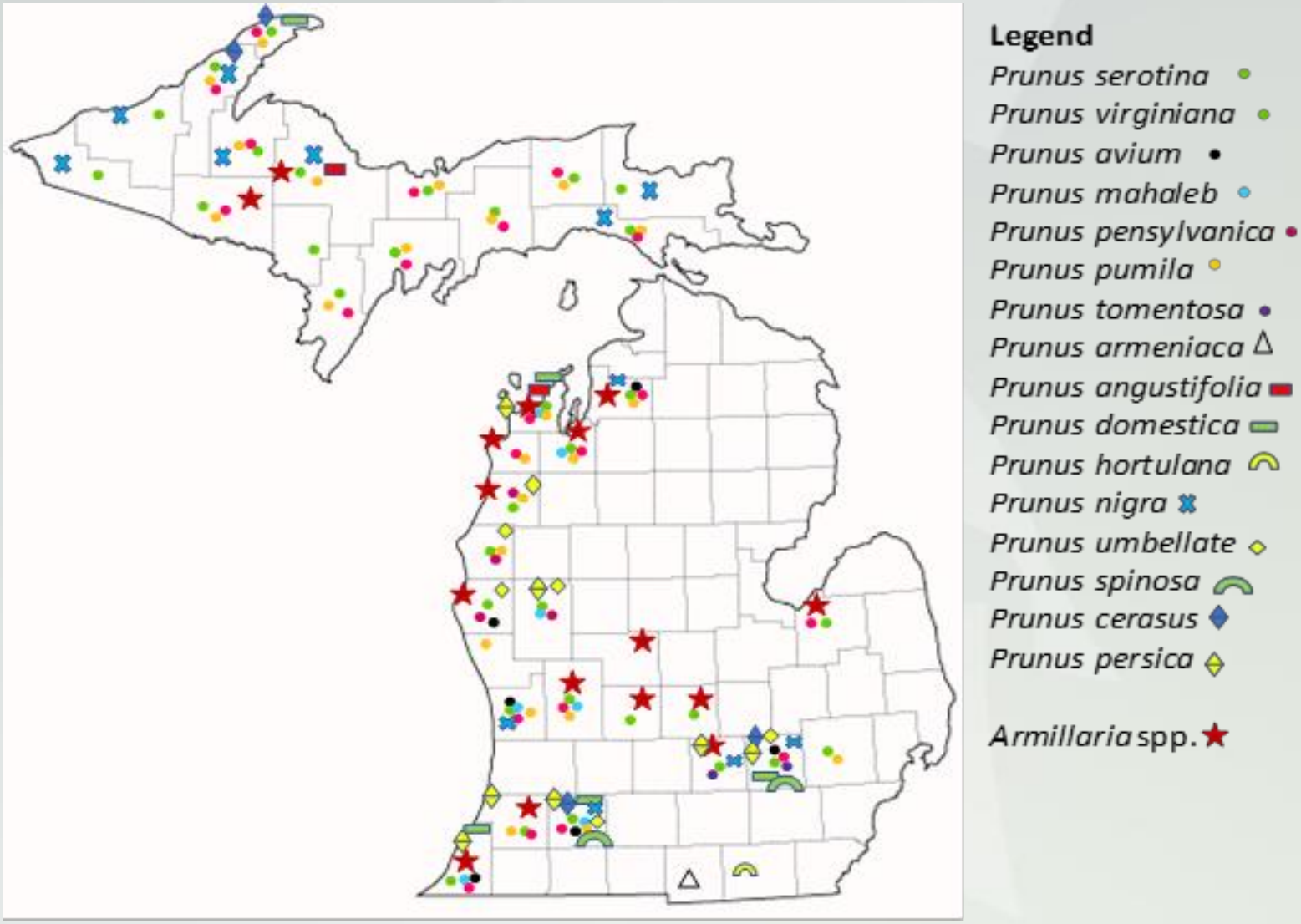
- Planting with graft-union above soil line
- Berm planting and root collar excavation
  Some success in extending tree life in peach orchards
- Finding tolerant rootstocks

"Planting resistant rootstock is one of the most effective techniques for avoiding tree decline and death due to root diseases in susceptible stone fruit crop species."

Search for disease resistant species or individuals

- For sweet and tart cherry there are no known graft compatible ARR resistant rootstocks.
- It may be possible to find resistance to ARR in wild *Prunus* species.
- These species would be more likely to show graft compatibility with the commercially grown cherries.

Possible regions to find resistant individuals



★ Indicates *Armillaria* spp. detected counties

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