Managing Botryosphaeria and Phomopsis in Walnut

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U N I V E R S I T Y O F C A L I F O R N I A

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University of California Cooperative Extension

2015 Tehama Walnut Day

Friday, February 6, 2015, Red Bluff, Ca.

HILGARDIA

A Journal of Agricultural Science Published by the California Agricultural Experiment Station

VOLUME 17 AUGUST, 1947 Number 12

1947

CONTENTS

THE BRANCH WILT OF PERSIAN WALNUT TREES AND ITS CAUSE

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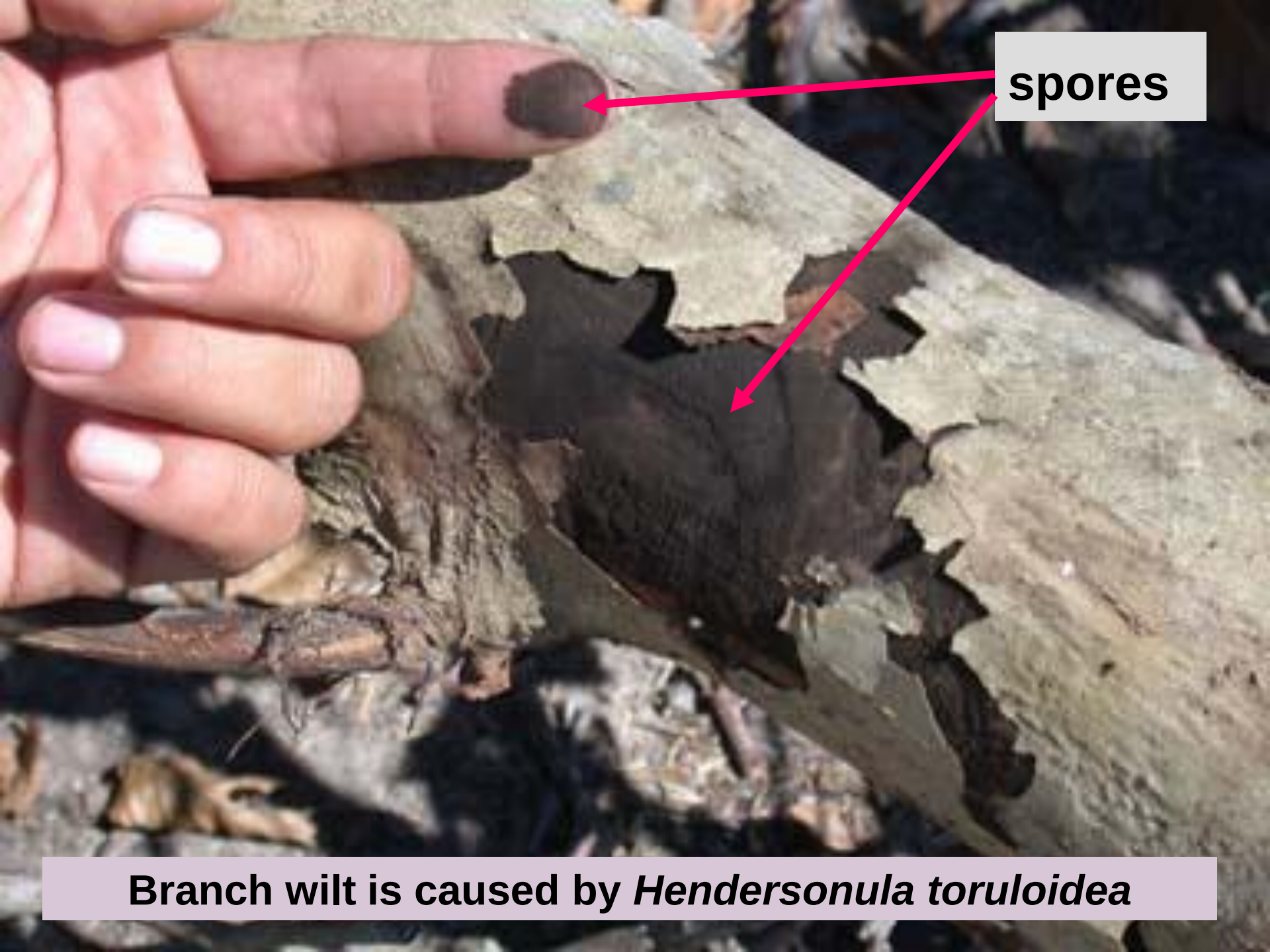
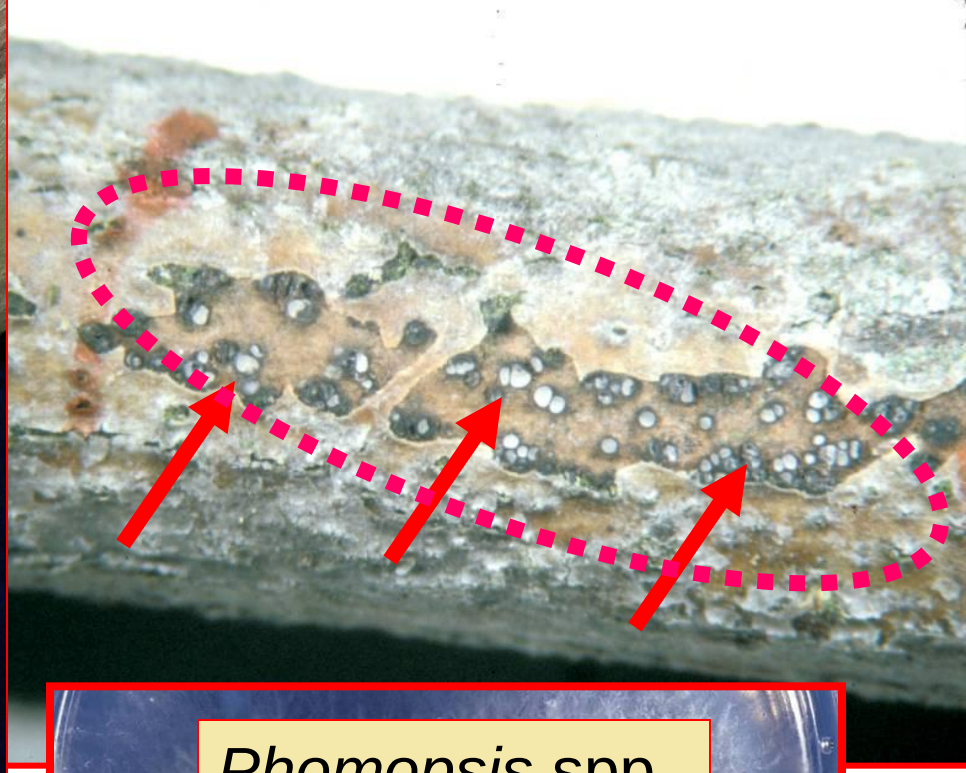
Are all these branch wilt?



Branch wilt is caused by *Hendersonula toruloidea*

Botryosphaeria blight

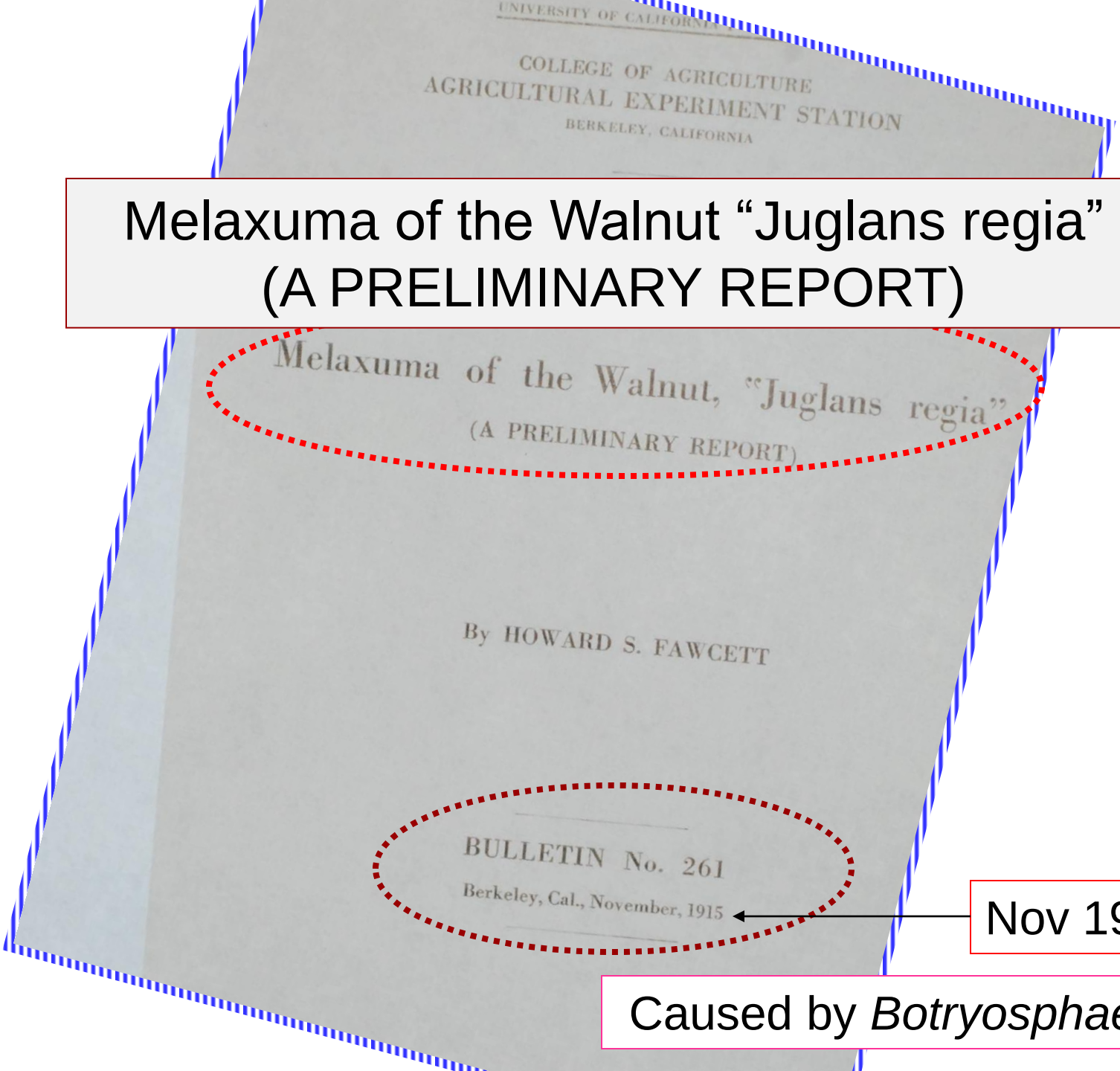


Botryosphaeria

Phomopsis spp.

Cankers, pycnidia, and *Botryosphaeria* & *Phomopsis* in walnut branches

Melaxuma of the Walnut “Juglans regia” (A PRELIMINARY REPORT)



Nov 1915

Caused by *Botryosphaeria ribis*

Smith, C. O. 1934. Inoculations showing the wide host range of *Botryosphaeria ribis. J. of Agric. Research* (Washington D.C.) 49:467-476

Isolates:

B. ribis from walnut

B . ribis from citrus

B. ribis from avocado

} 50 plant species } 34 genera } 20 families

FUNGAL SPECIES

Botryosphaeriaceae

1 *Botryosphaeria dothidea*
2 *Diplodia mutila*
3 *Diplodia seriata*
4 *Dothiorella iberica*
5 *Lasiodiplodia citricola*
6 *Neofusicoccum mediterraneum*
7 *Neofusicoccum nonquaesitum*
8 *Neofusicoccum parvum*
9 *Neofusicoccum vitifusiforme*
10 *Neoscytalidium dimidiatum*

Diaporthe (Phomopsis)

11 *Diaporthe neotheicola*
12 *Diaporthe rhusicola*

(Botryosphaeria)

	COUNTY	SPECIES
A	GLENN	1,6
B	BUTTE	1,6,8
C	COLUSA	6,7
D	SUTTER	6,7
E	YUBA	1,6,7
F	YOLO	2,4,6,8
G	STANISLAUS	5,6,8,11,12
H	MERCED	3,6
I	SAN BENITO	3
J	FRESNO	3,6,9
K	KINGS	3,10,12
L	TULARE	2,3,6
M	VENTURA	2

Distribution of Botryosphaeriaceae in walnuts

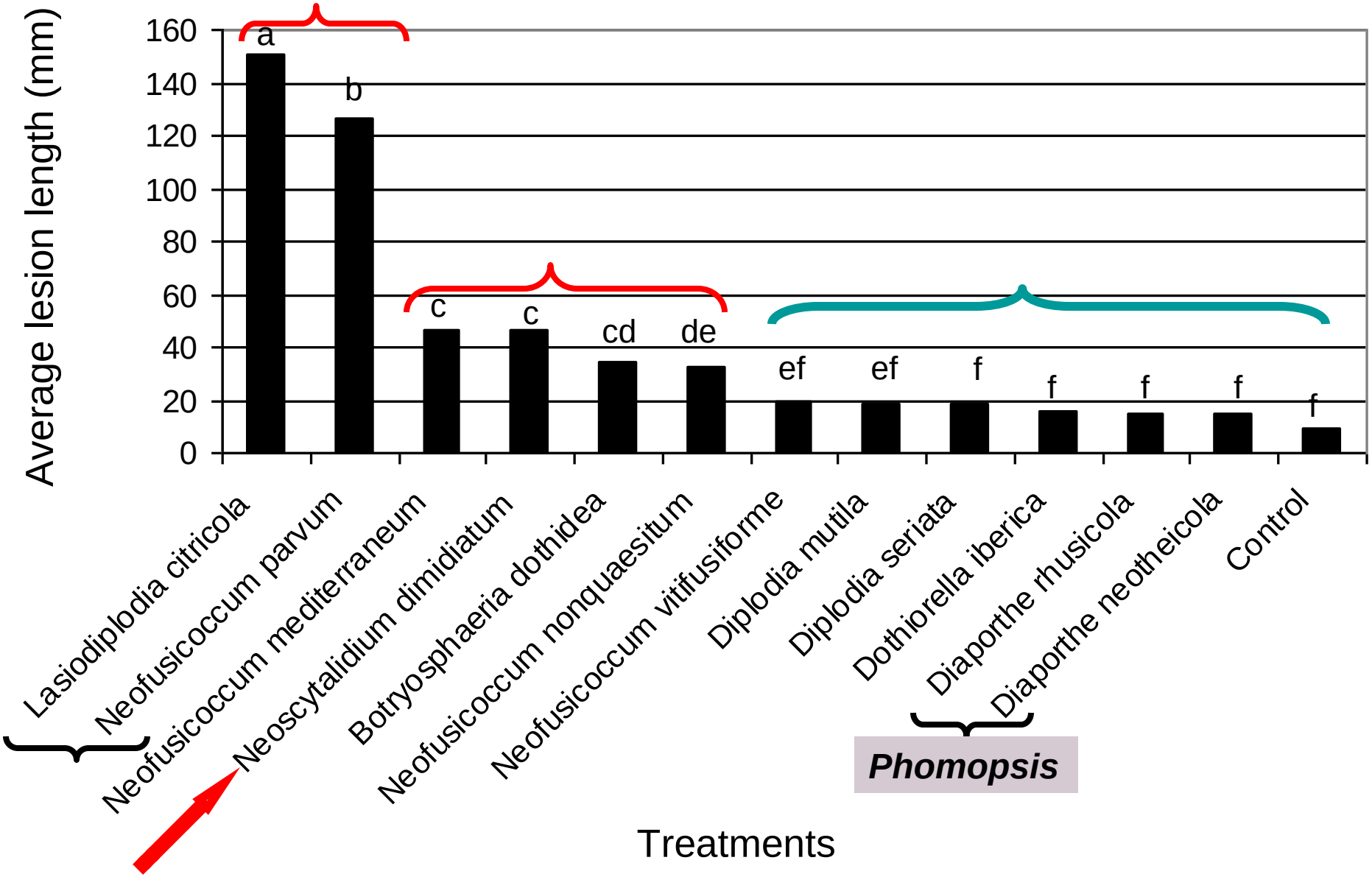
All the commercial walnut cultivars can be infected!

Botryosphaeria dothidea
Neofusicoccum mediterraneum
Neofusicoccum parvum

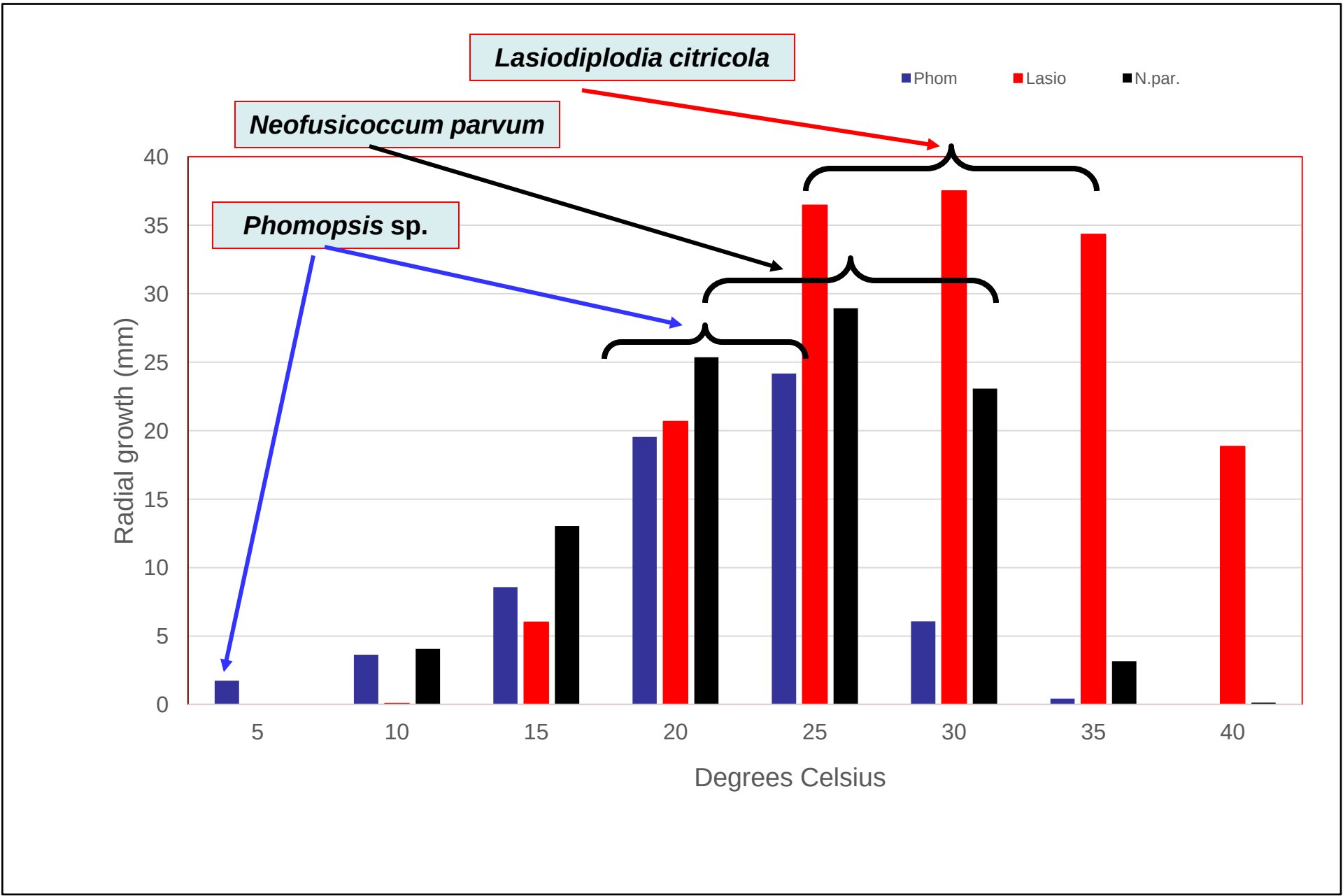
***Lasiodiplodia* spp.**

Diplodia seriata

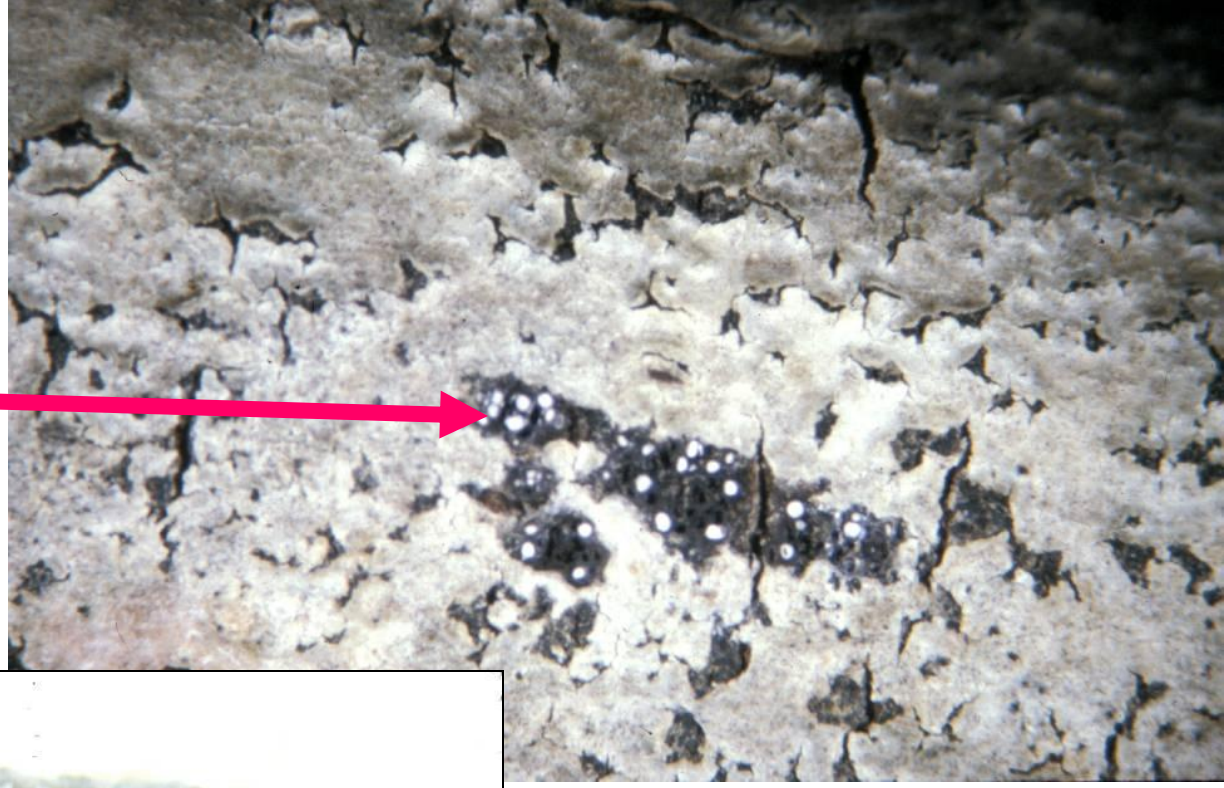
Pathogenicity tests on shoots



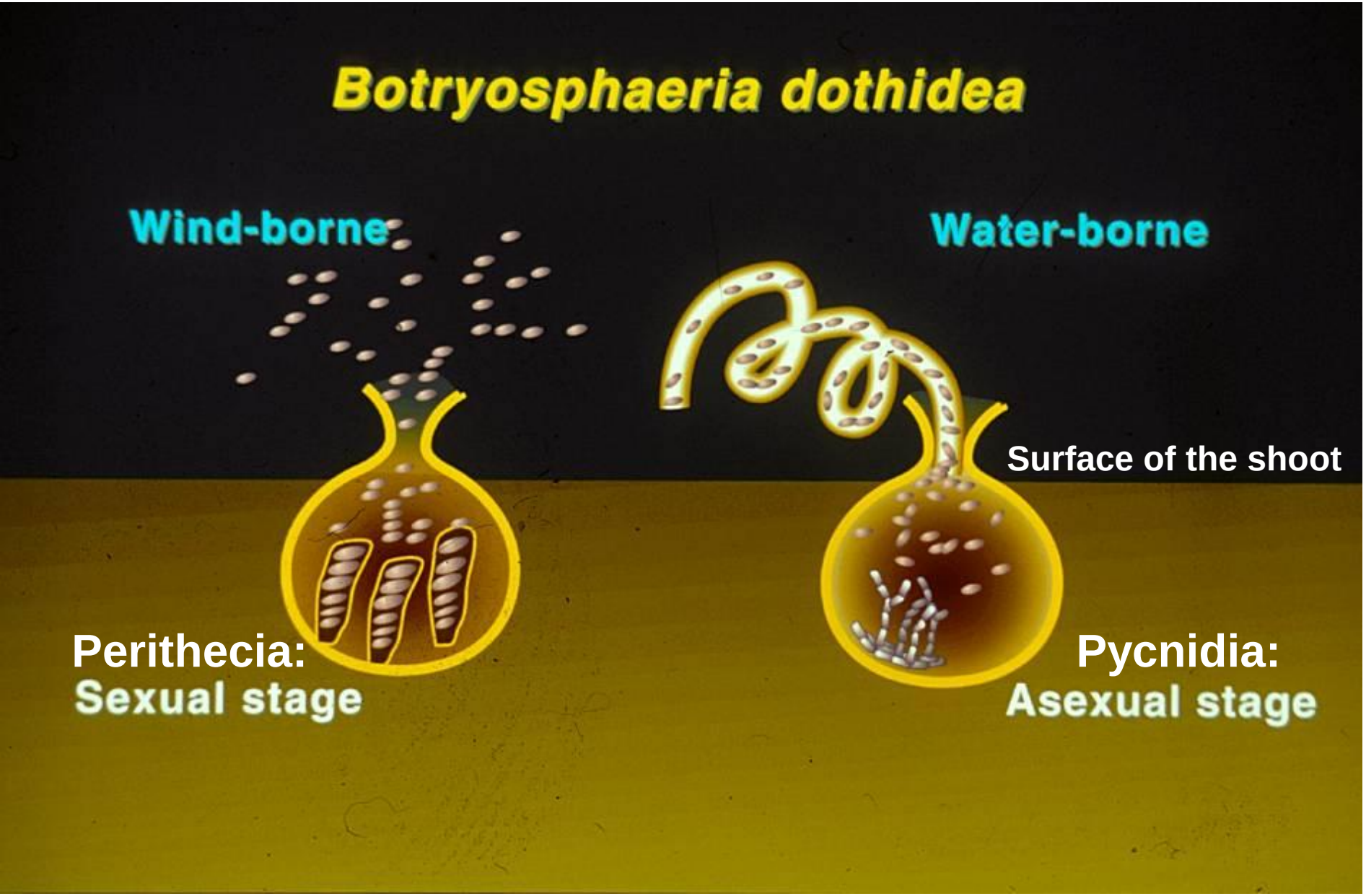
Growth temperatures (& optimum growth)

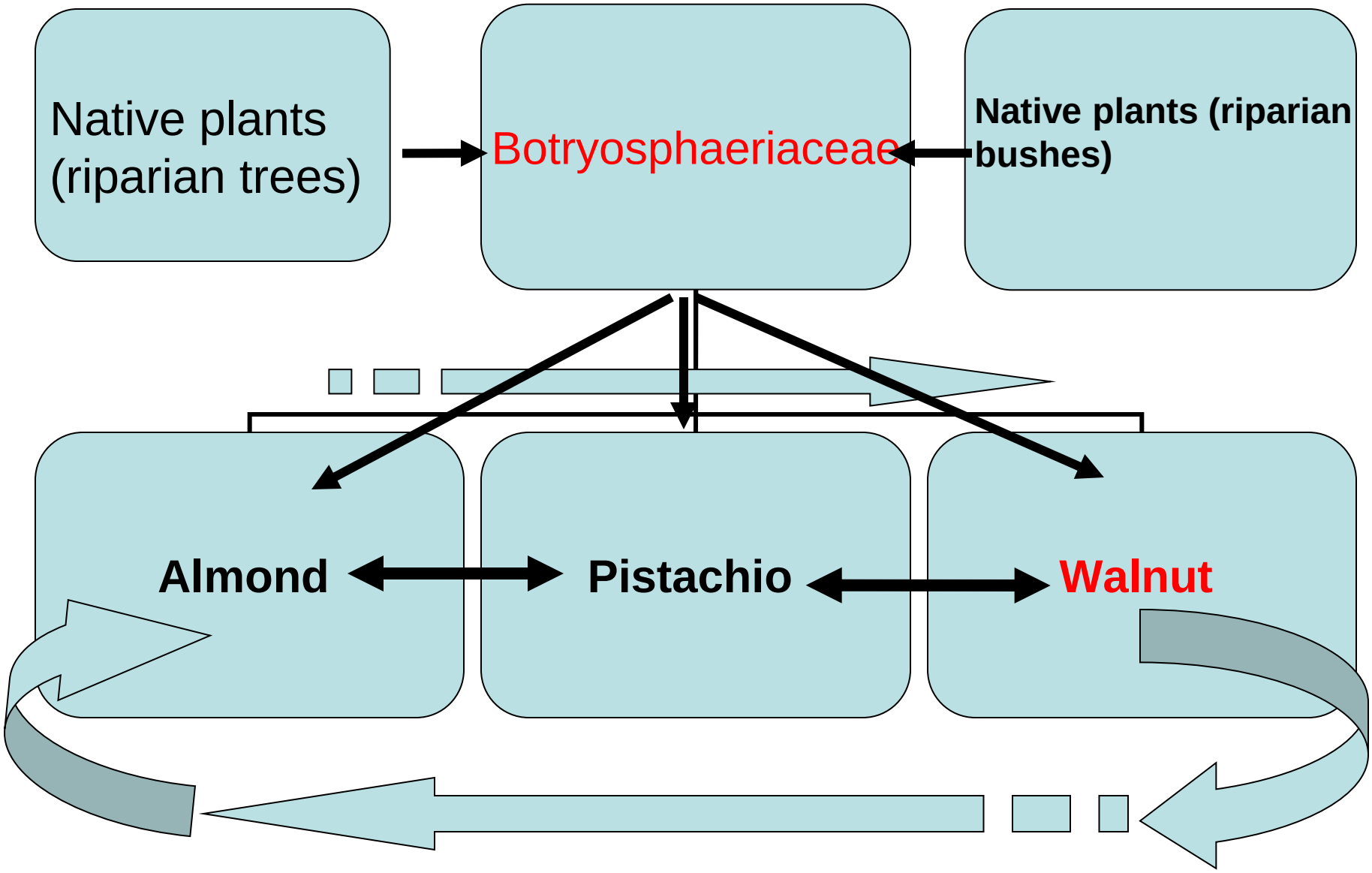


Perithecia of *Botryosphaeria*



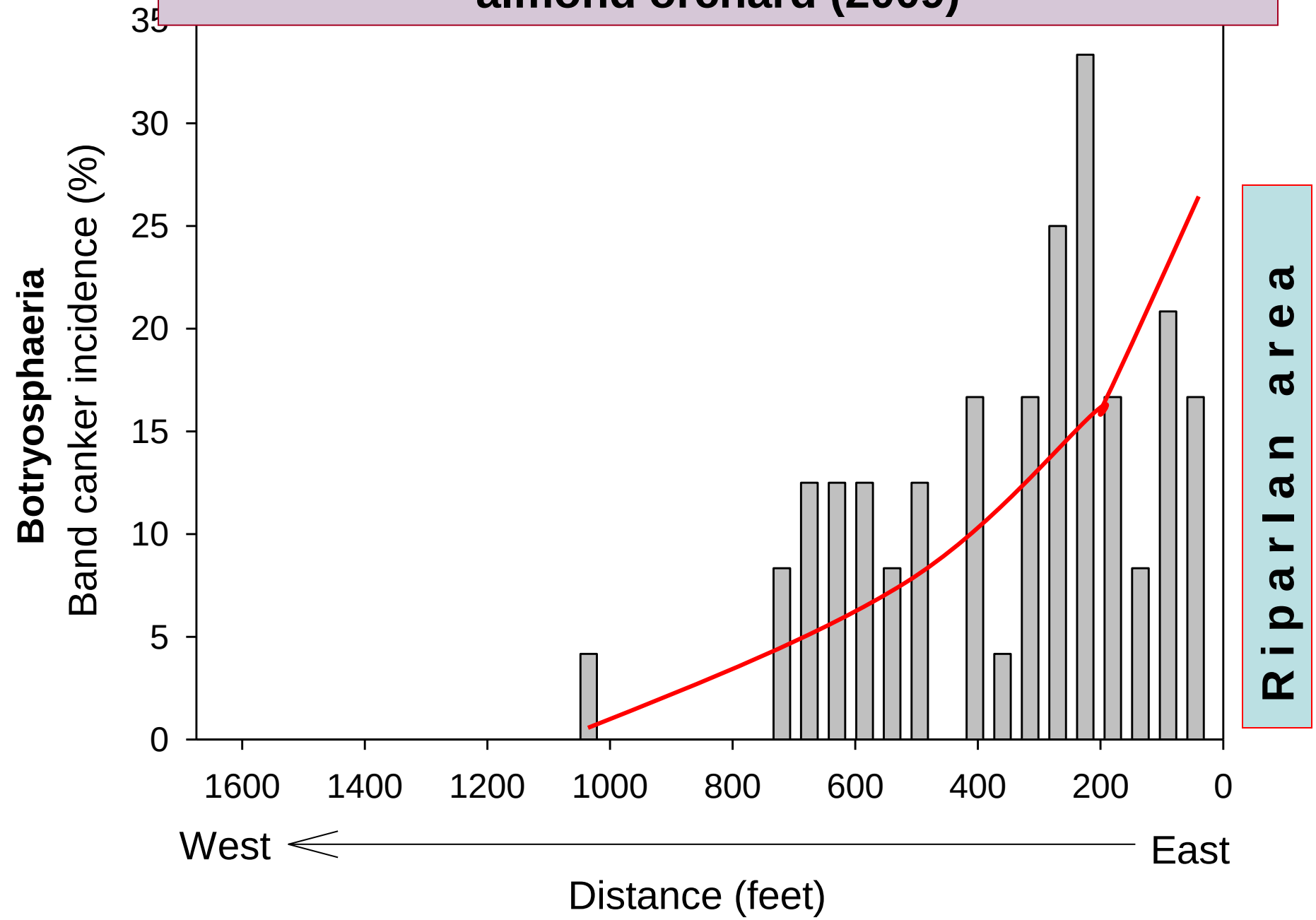
Pycnidia of *Botryosphaeria*

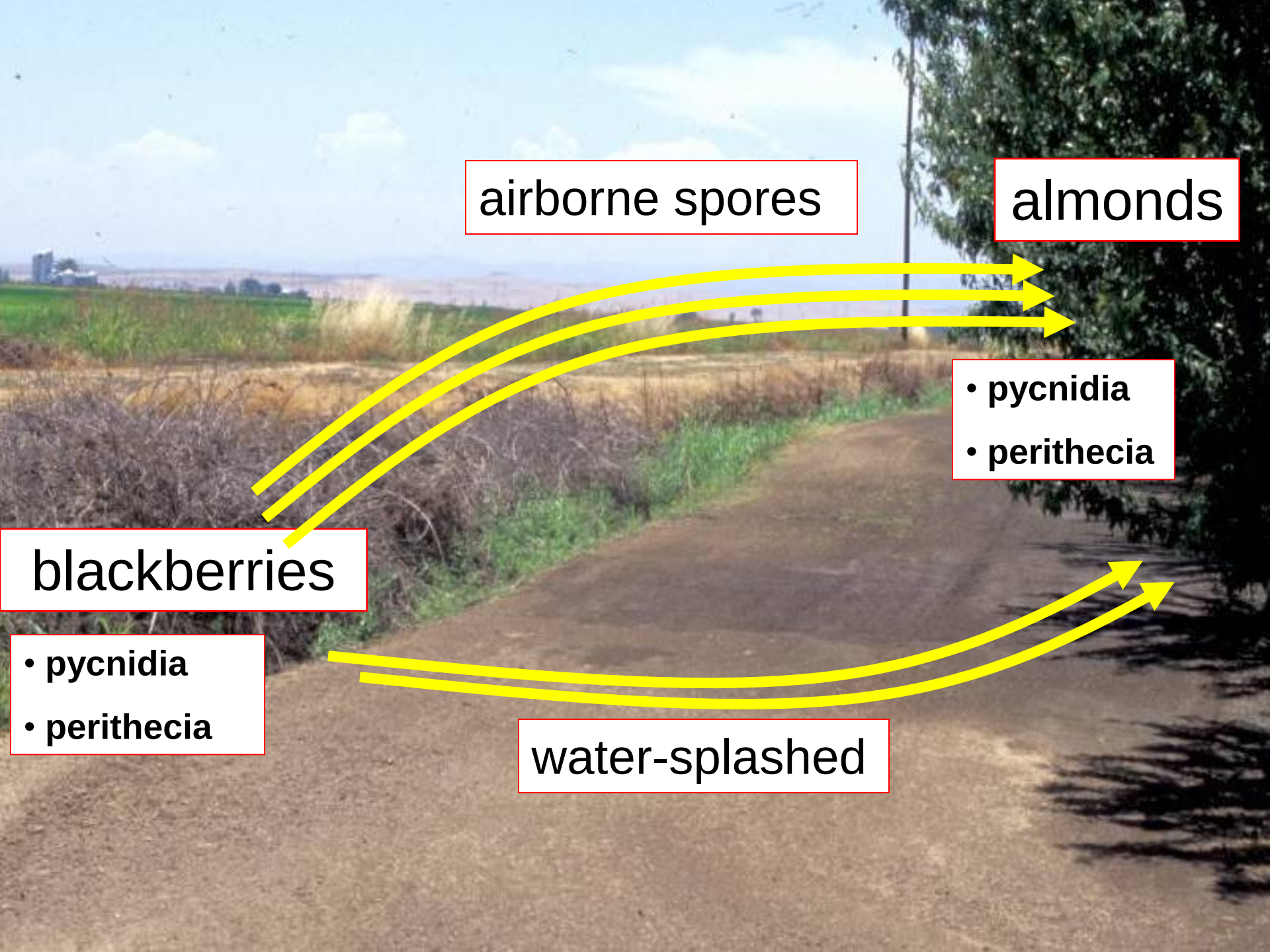

Botryosphaeria dothidea
Wind-borne
Water-borne
Surface of the shoot
Perithecia:
Sexual stage
Pycnidia:
Asexual stage

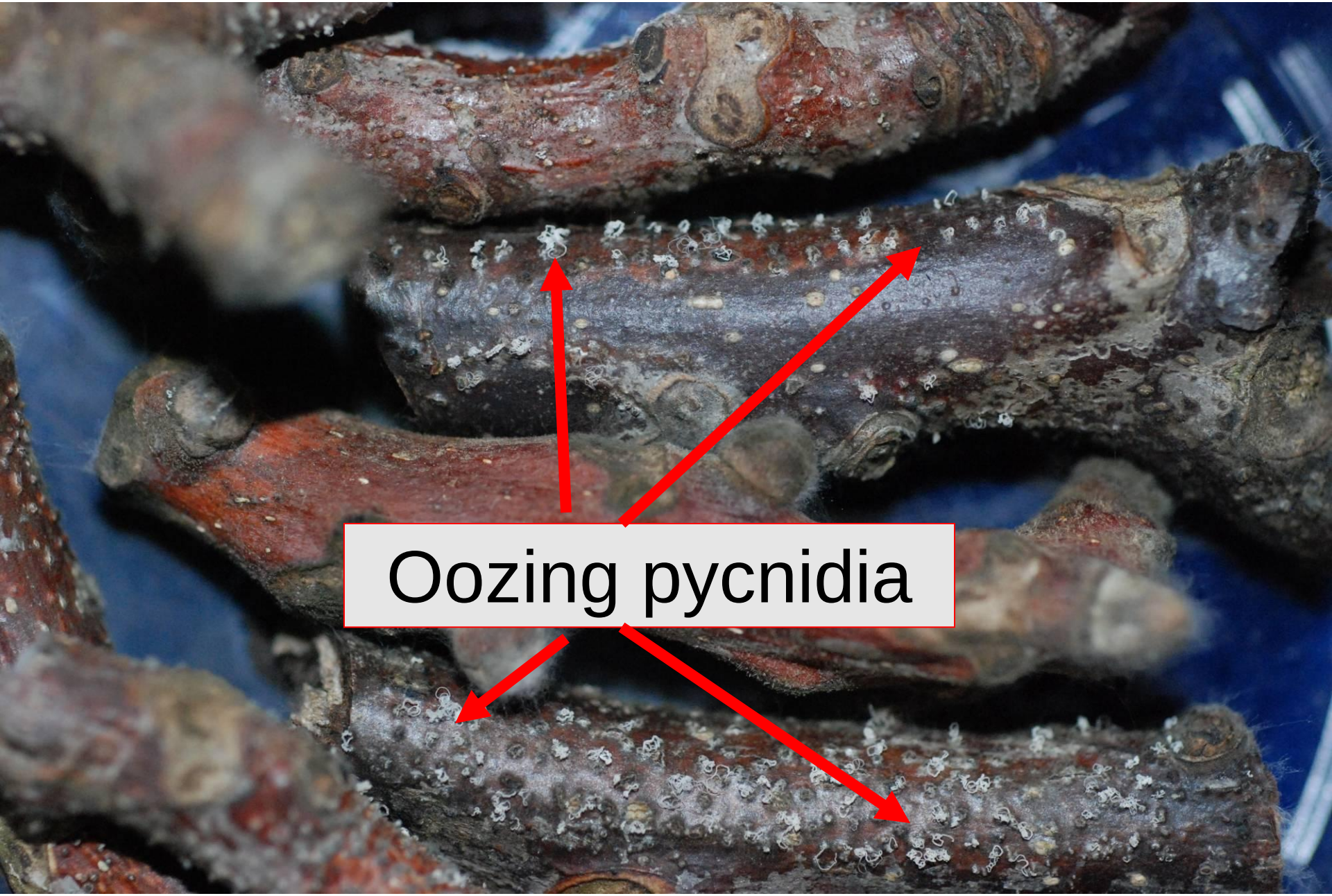

Native plants (riparian trees)
Botryosphaeriaceae
Native plants (riparian bushes)
Almond
Pistachio
Walnut


Young almond orchard
Riparian area

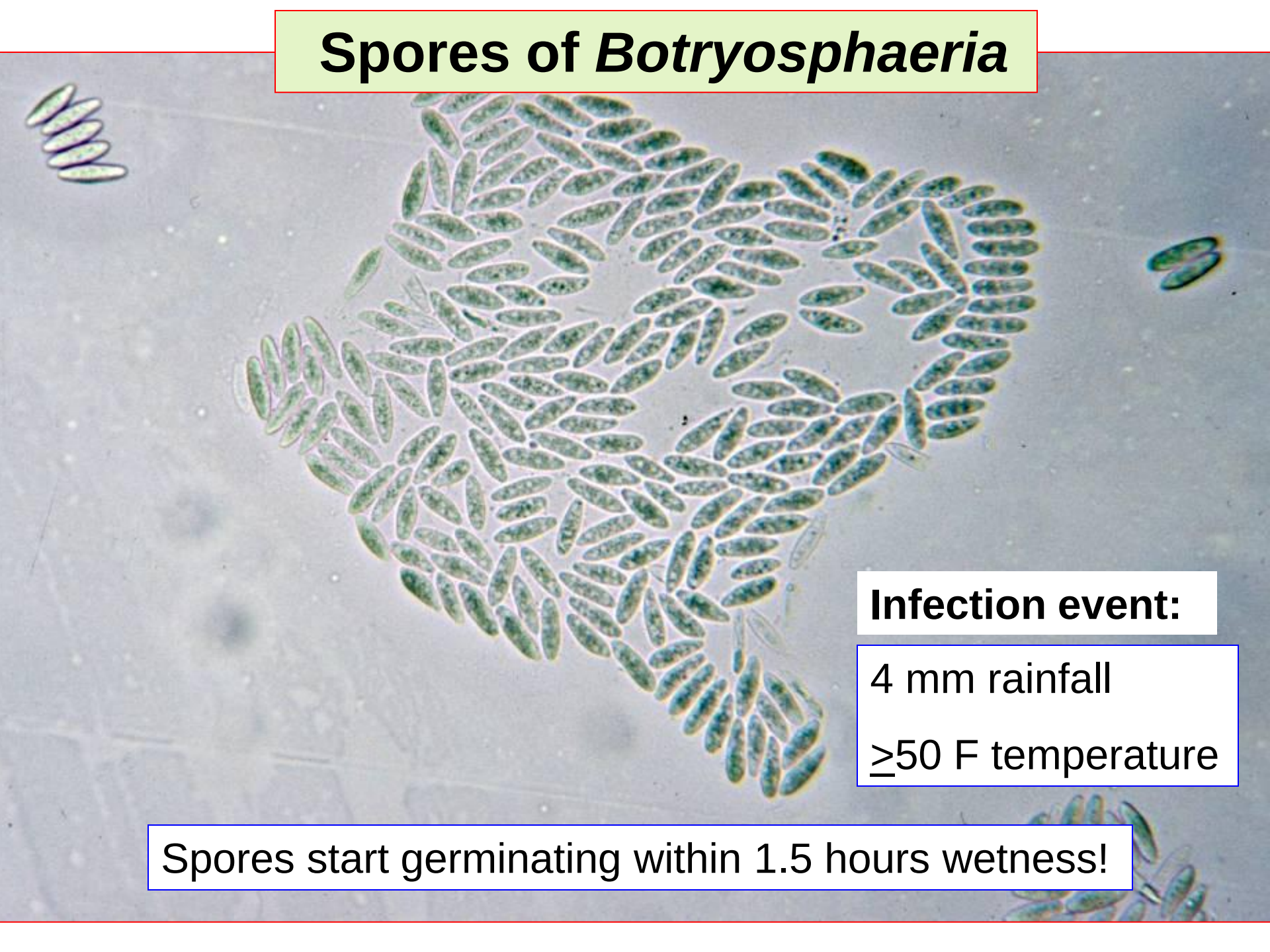
Distribution of almond band canker in a third-leaf almond orchard (2009)




airborne spores
almonds
• pycnidia
• perithecia
blackberries
• pycnidia
• perithecia
water-splashed


Oozing pycnidia

Spores of *Botryosphaeria*



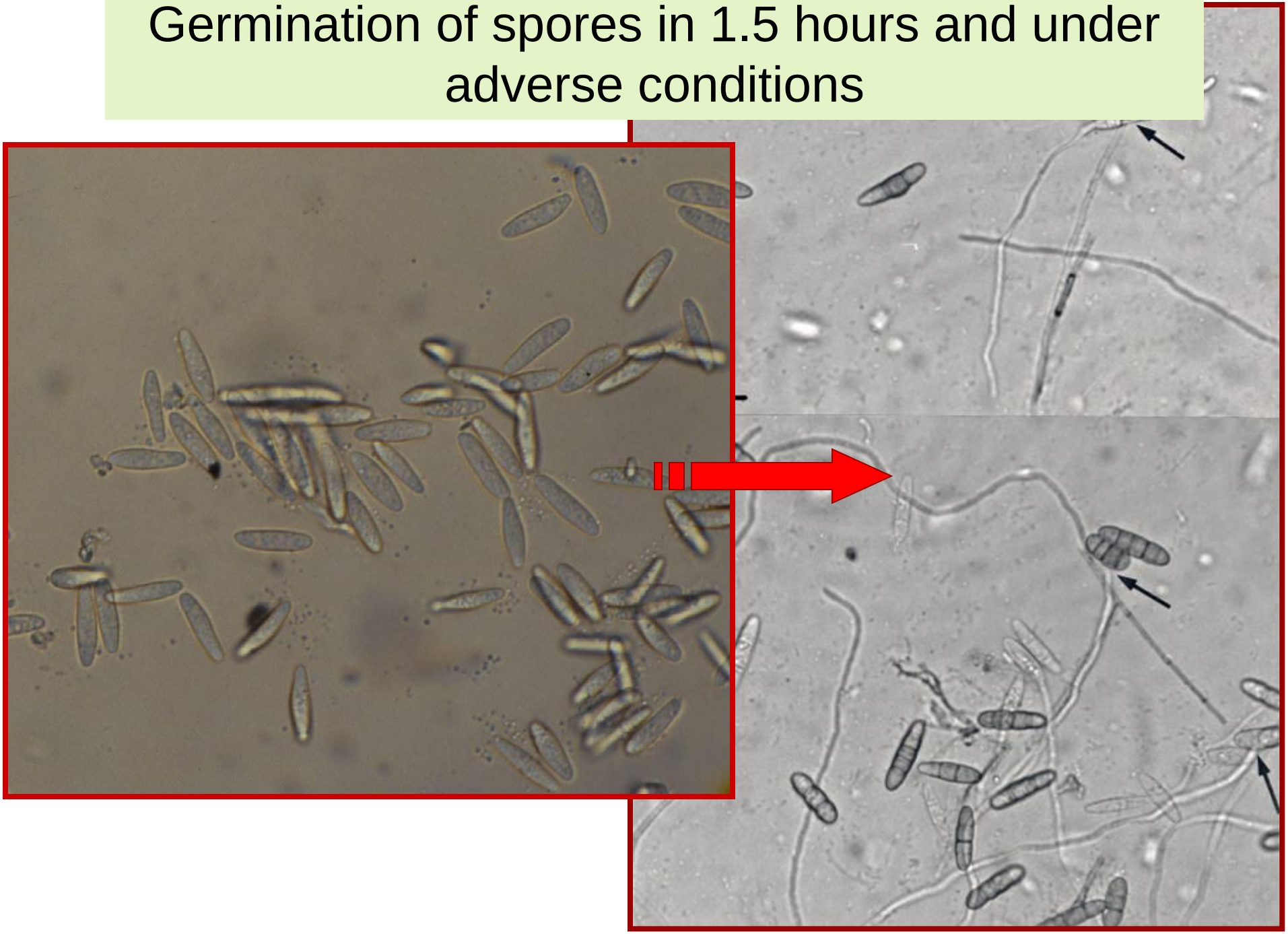
Infection event:

4 mm rainfall

≥50 F temperature

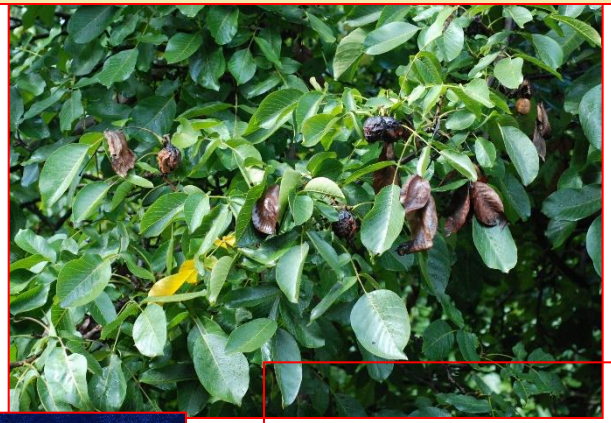
Spores start germinating within 1.5 hours wetness!

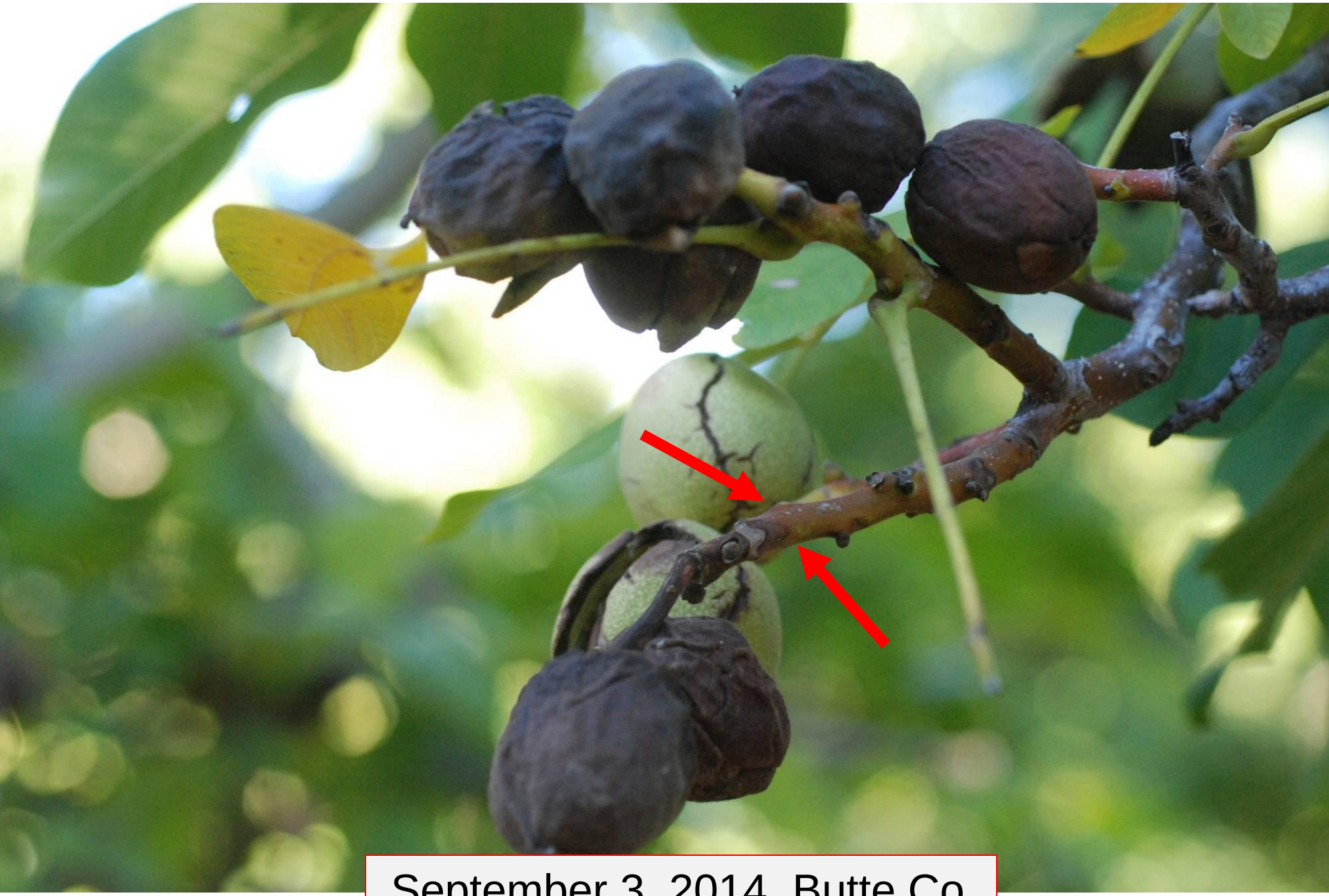
Germination of spores in 1.5 hours and under adverse conditions



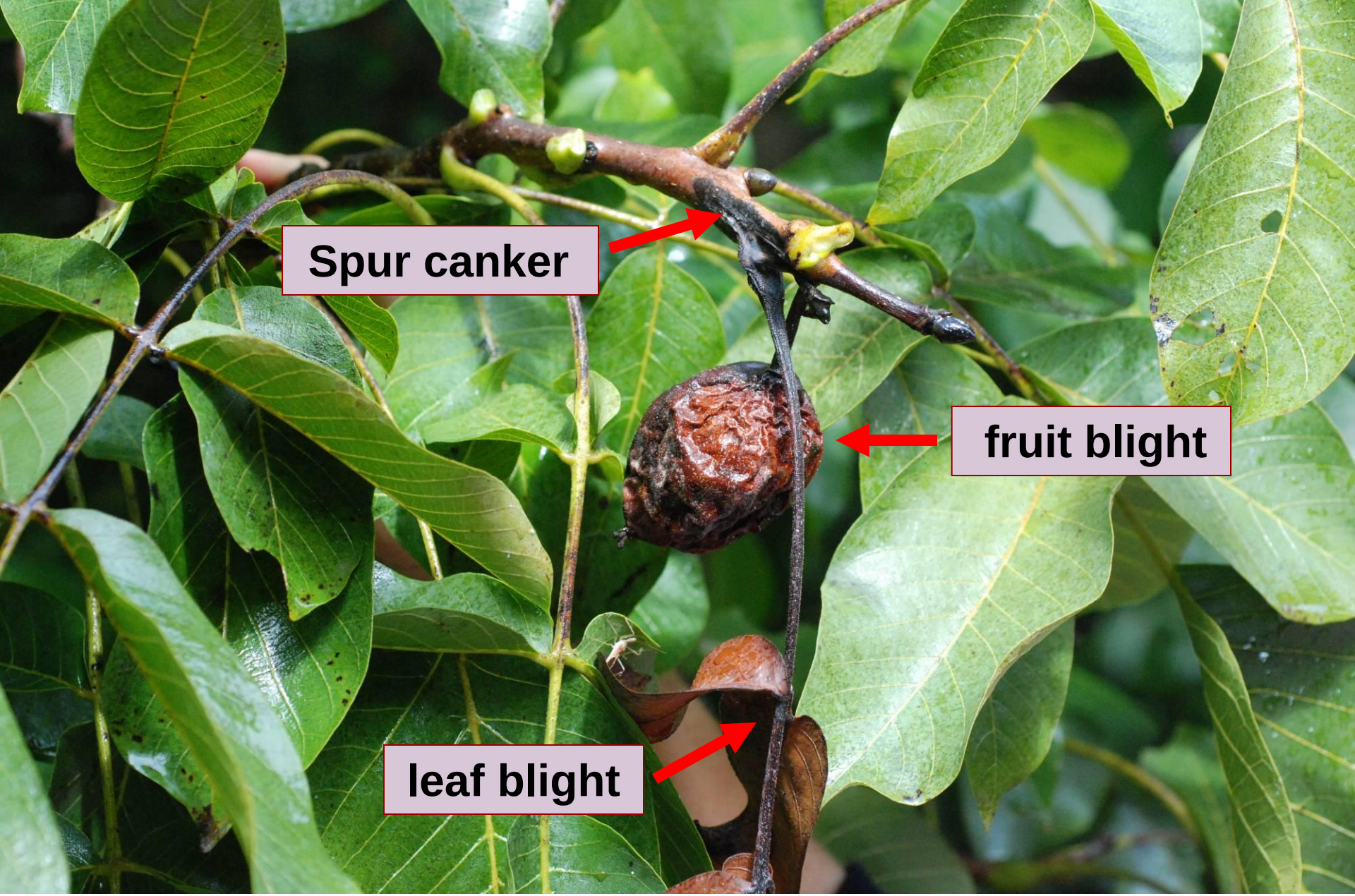


Symptoms of Botryosphaeria canker and blight

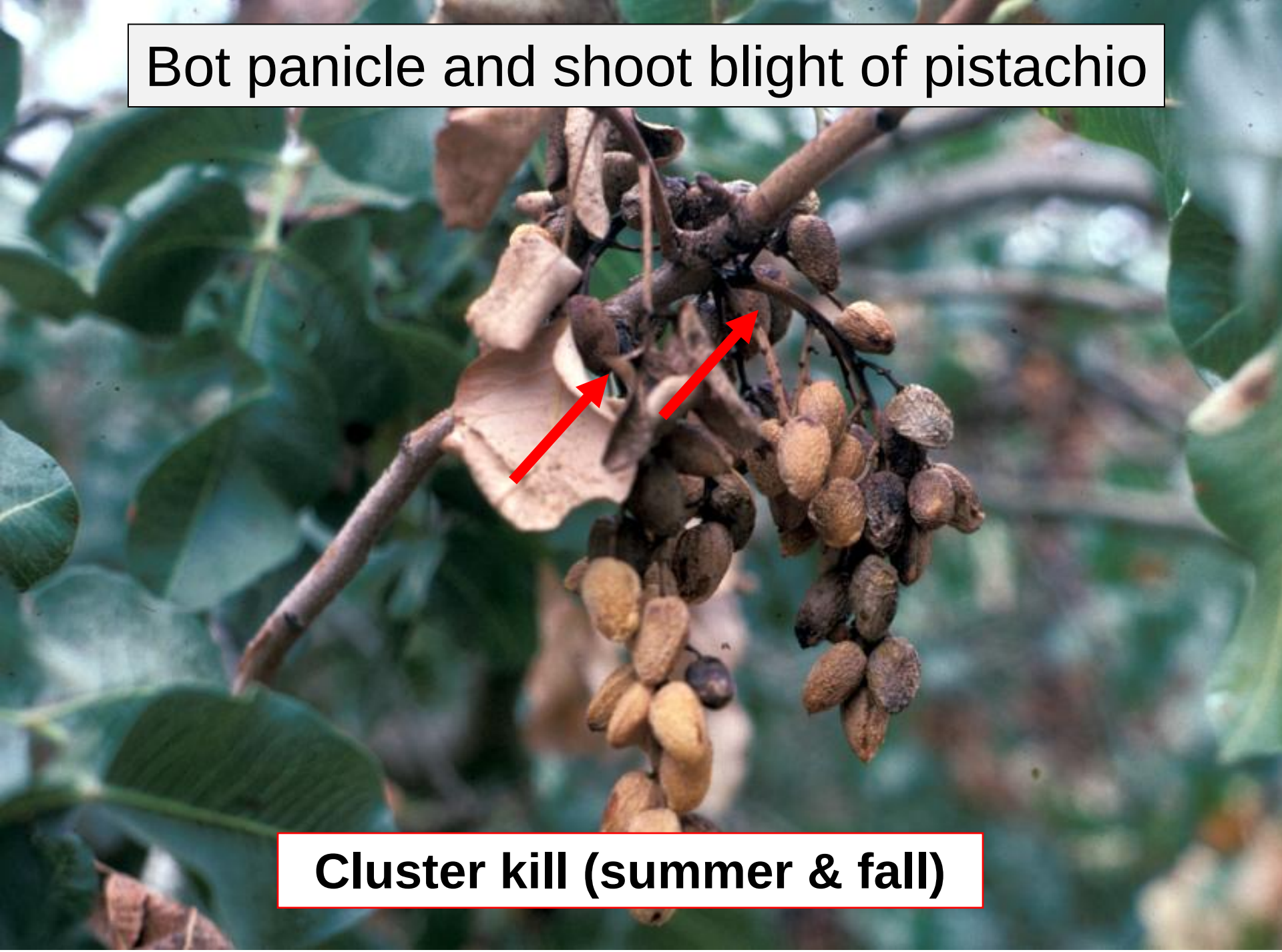



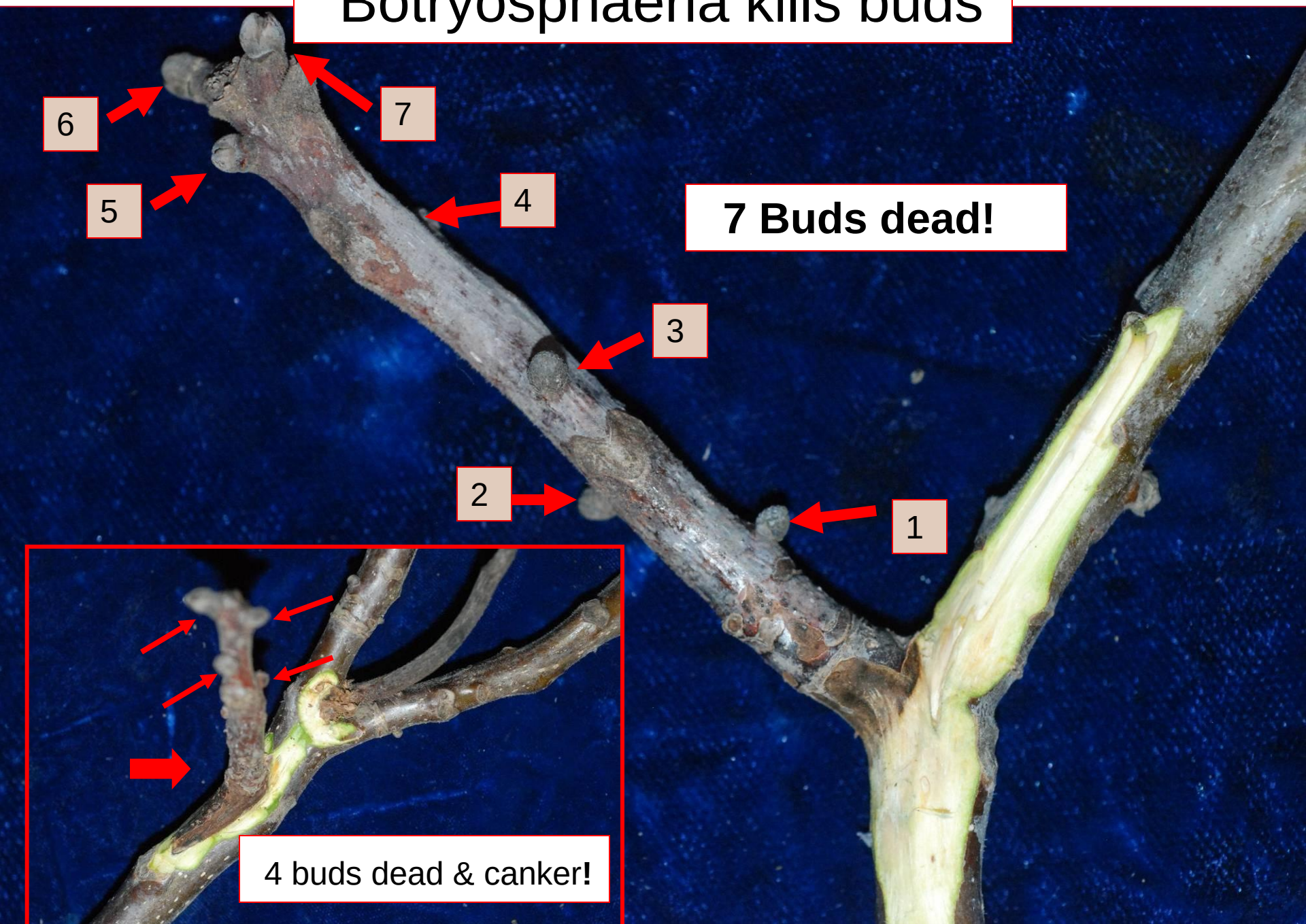
September 3, 2014, Butte Co.



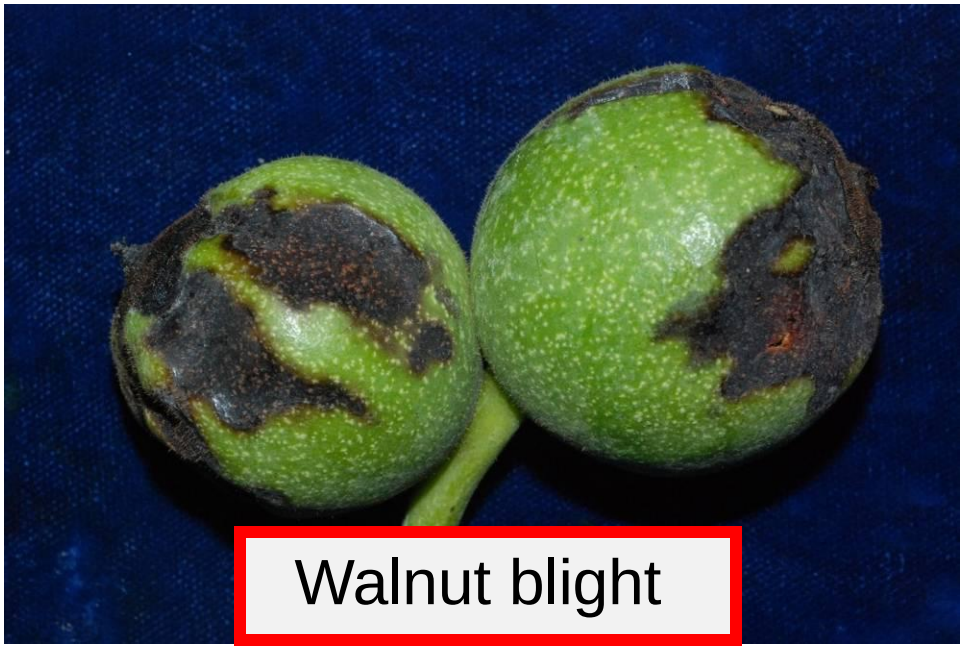
Fruit, leaf, and shoot blight


Bot panicle and shoot blight of pistachio
Cluster kill (summer & fall)

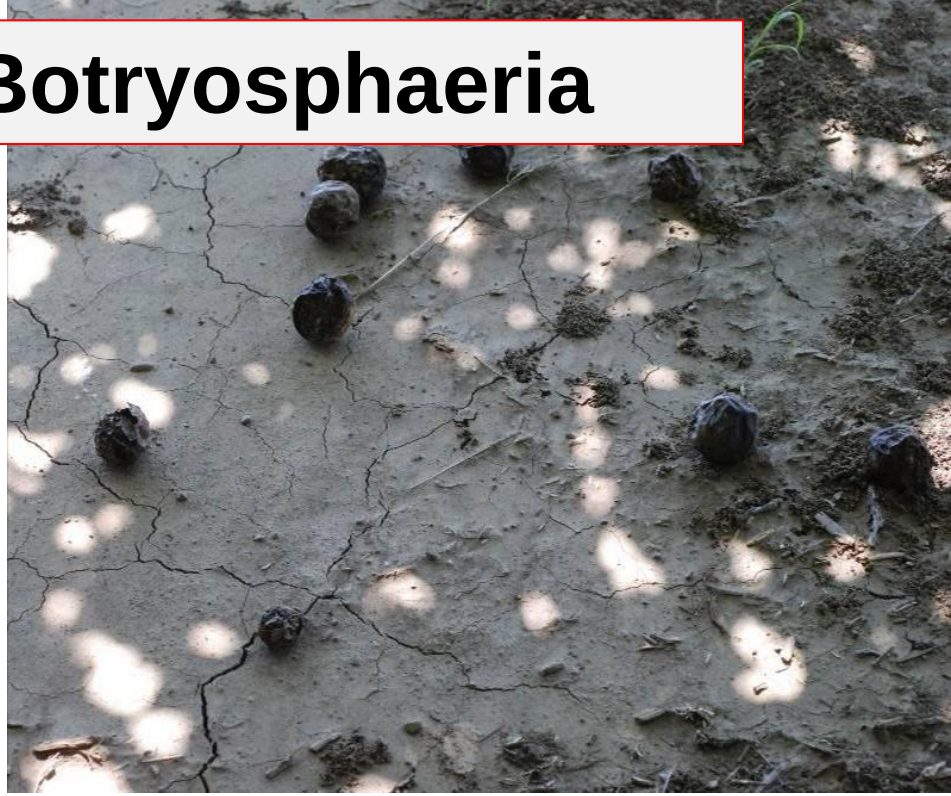
Botryosphaeria kills buds



Walnut Blight & Botryosphaeria



Walnut blight



Botryosphaeria

Phomopsis


Fusarium spp.


Alternaria alternata


Gloeosporium sp.


Colletotrichum acutatum

Incidence of fungal pathogens isolated from blighted fruit (collected from trees & ground)

Orchard	Collection	Walnut blight	Botryosph. /Phom (%)	Fusarium (%)	Alternaria (%)	Aspergillus (%)	Gloeosporium & Colletotrichum (%)
1	Tree	+	20	---	40		
2	Tree	-	12	---	12		
3	Tree	+	11	29	34		
4	Tree	ND	80	10	10		
1	Ground	+	67	67	50		
4	Ground	ND	50	50	25		

Fusarium

Alternaria

Gloeosporium

Aspergillus niger

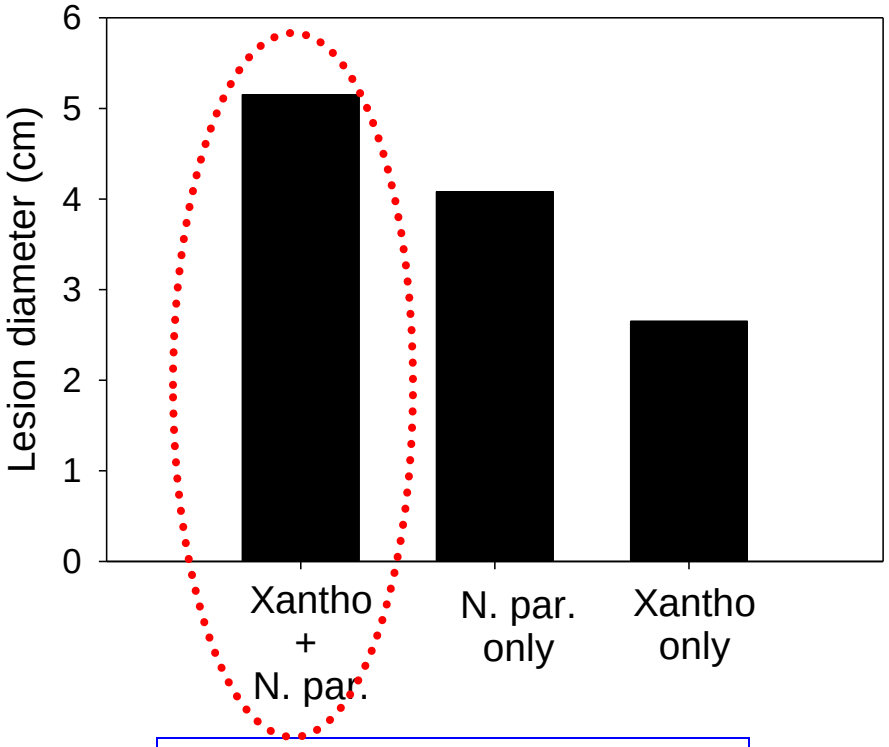
Epicoccum

Colletotrichum

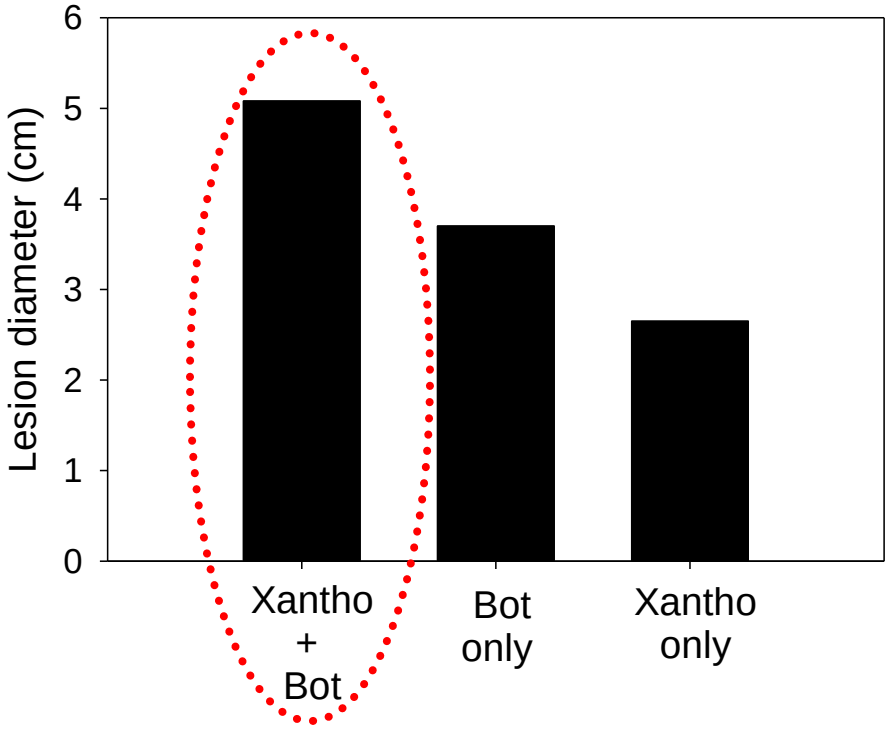
Aspergillus

Is walnut blight an entry for Botryosphaeria infections?

Effect of walnut blight on development of *Neofusicoccum* & Botryosphaeria

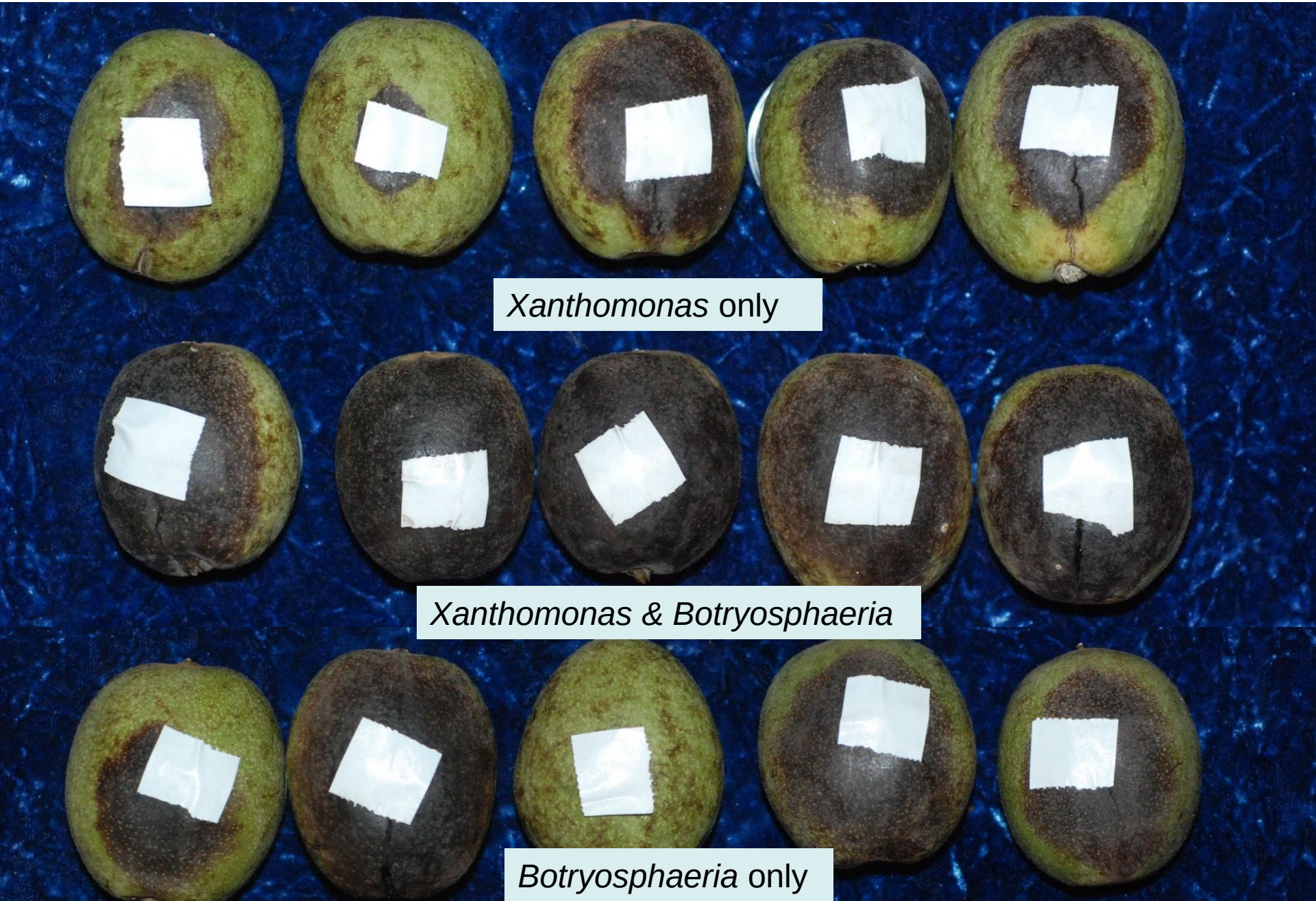


Neofusicoccum parvum



Botryosphaeria dothidea

Inoculation experiment



How long are pruning wounds susceptible to infection?

Pruning wound – infection experiment:

- Walnut shoots (Vina, Chandler, Tulare) were pruned:
  - Inoculated:
    - Lasiodiplodia
    - Neofusicoccum

    0 days

    3 days

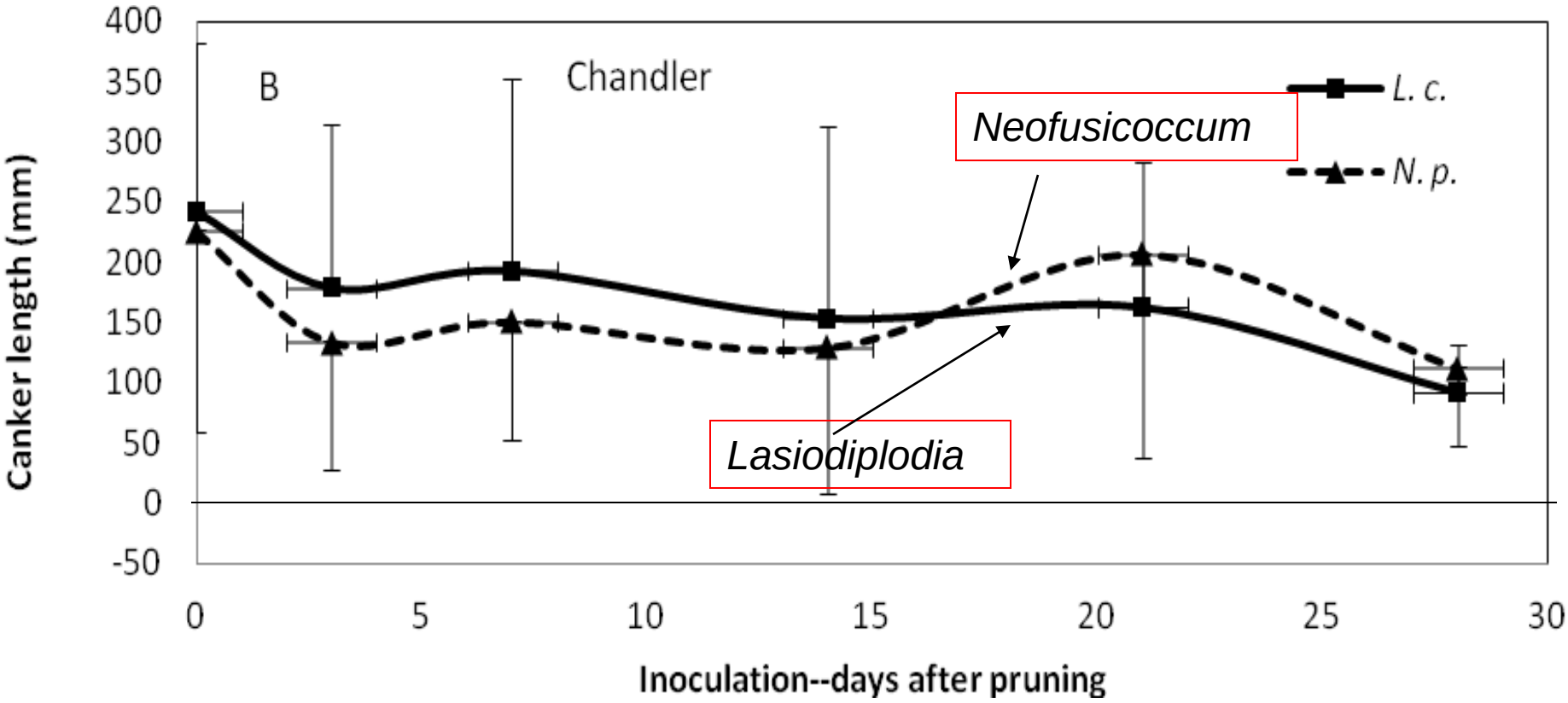
    7 days

    14 days

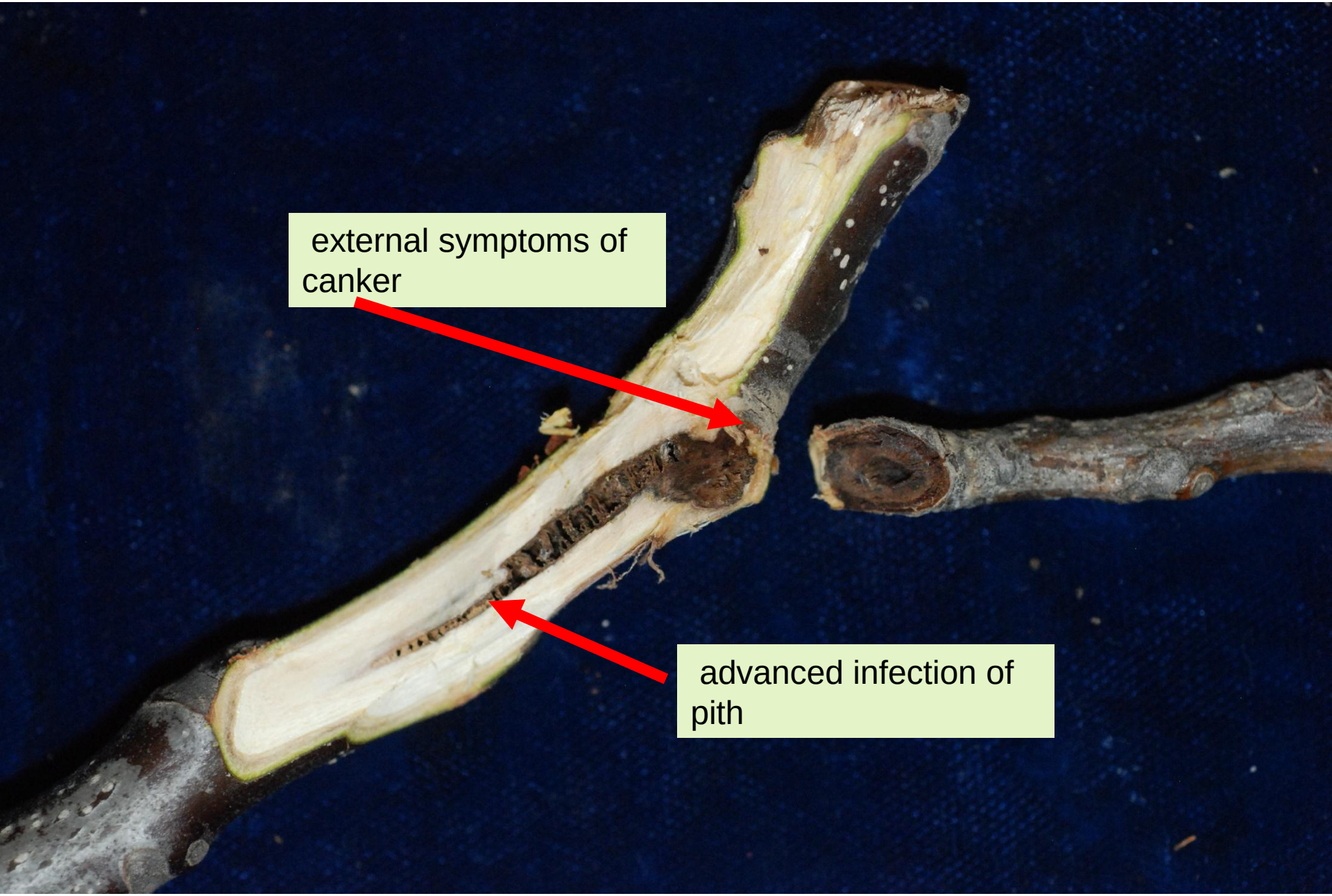
    21 day

  & 28 days after pruning;

Length of cankers after inoculation of pruning wounds at different times after pruning (Chandler)

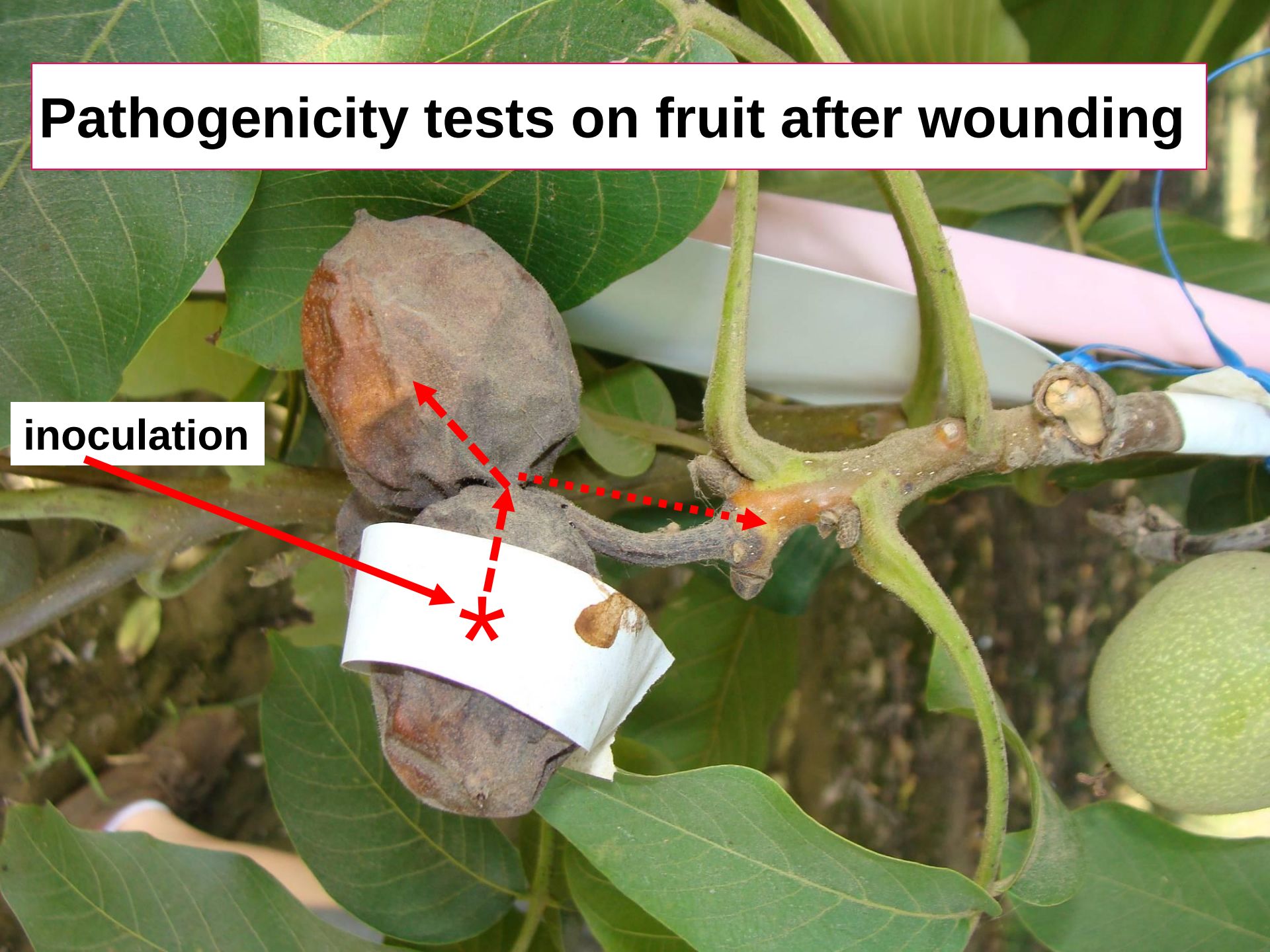


Pruning on 4 Feb 2014 ; recording on 3 Dec 2014


external symptoms of canker
advanced infection of pith

To manage the disease we need to know when infections take place…

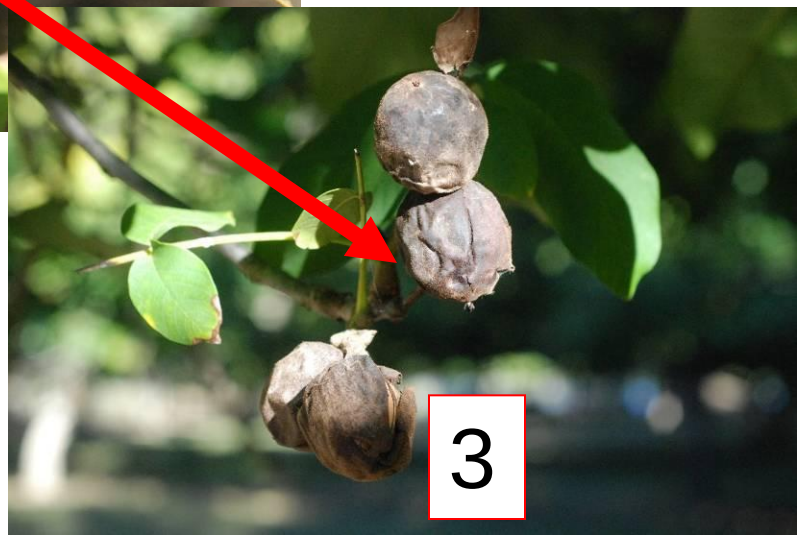
Pathogenicity tests on fruit after wounding



Infection of intact fruit in the orchard
--- Disease Progress ---

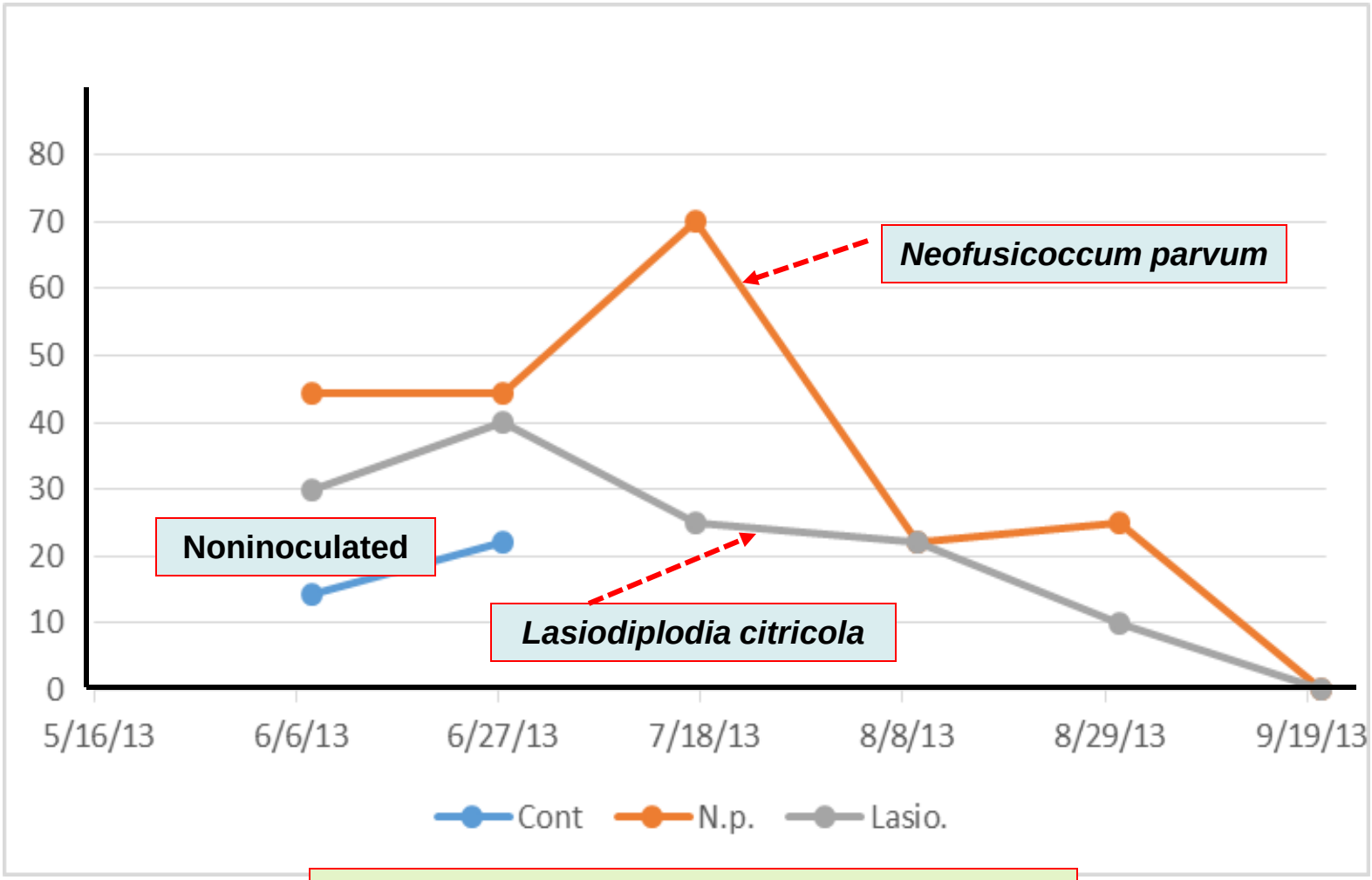
1

2



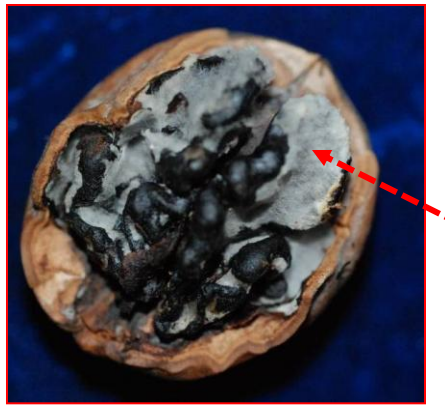
3

Periodic spray inoculations of Chandler fruit (latent infections – blighted fruit) - 2014



… without wounding…

Isolation of *Lasiodiplodia* and *Neofusicoccum parvum* from kernels of walnuts that were inoculated periodically



Lasiodiplodia citricola

Neofusicoccum parvum

Incidence of isolation from kernels (%)

70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

L. c.
N. p.

5/1 5/21 6/10 6/30 7/20 8/9 8/29 9/18 10/8

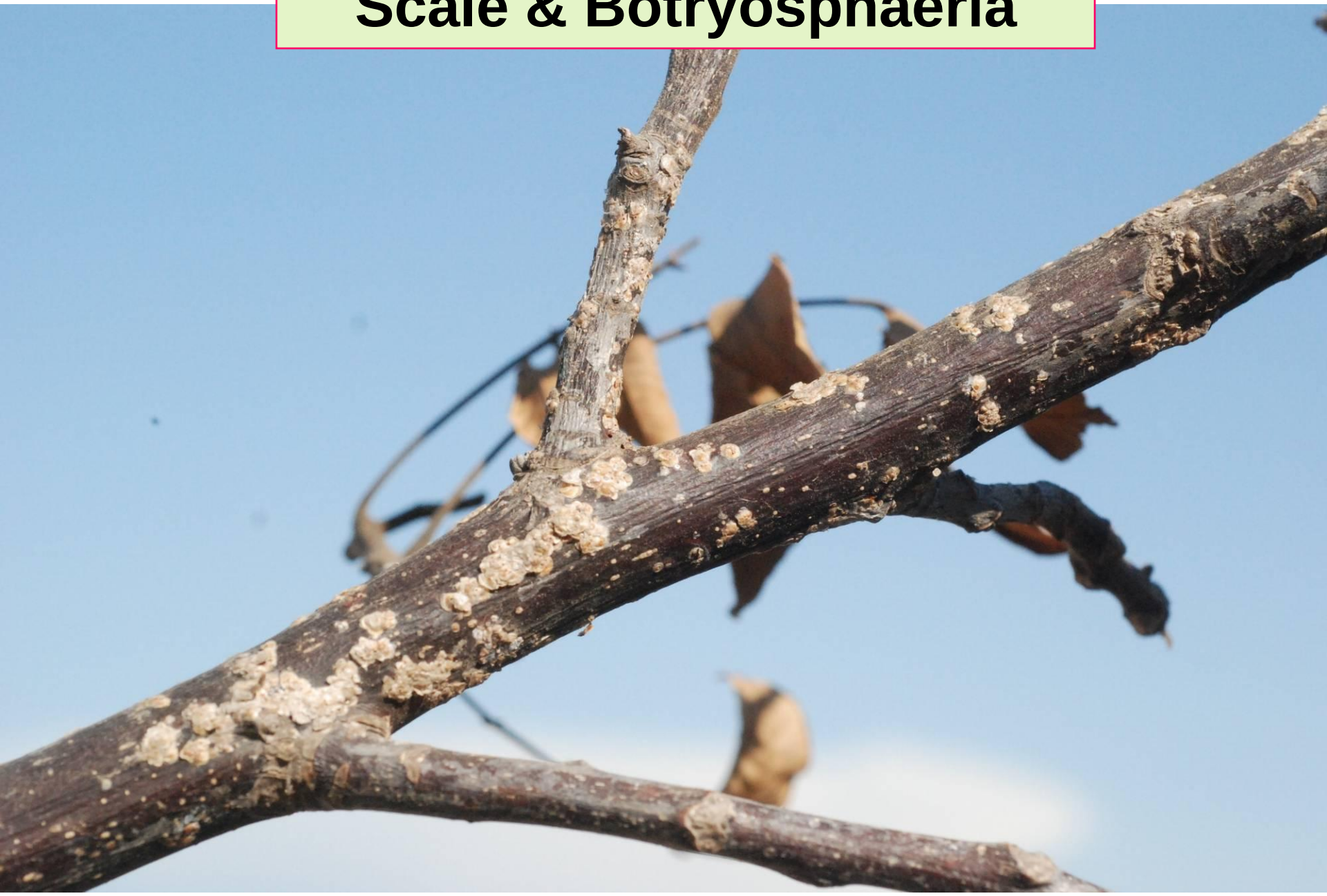
Inoculation date

Walnut tissues infected by *Botryosphaeria*

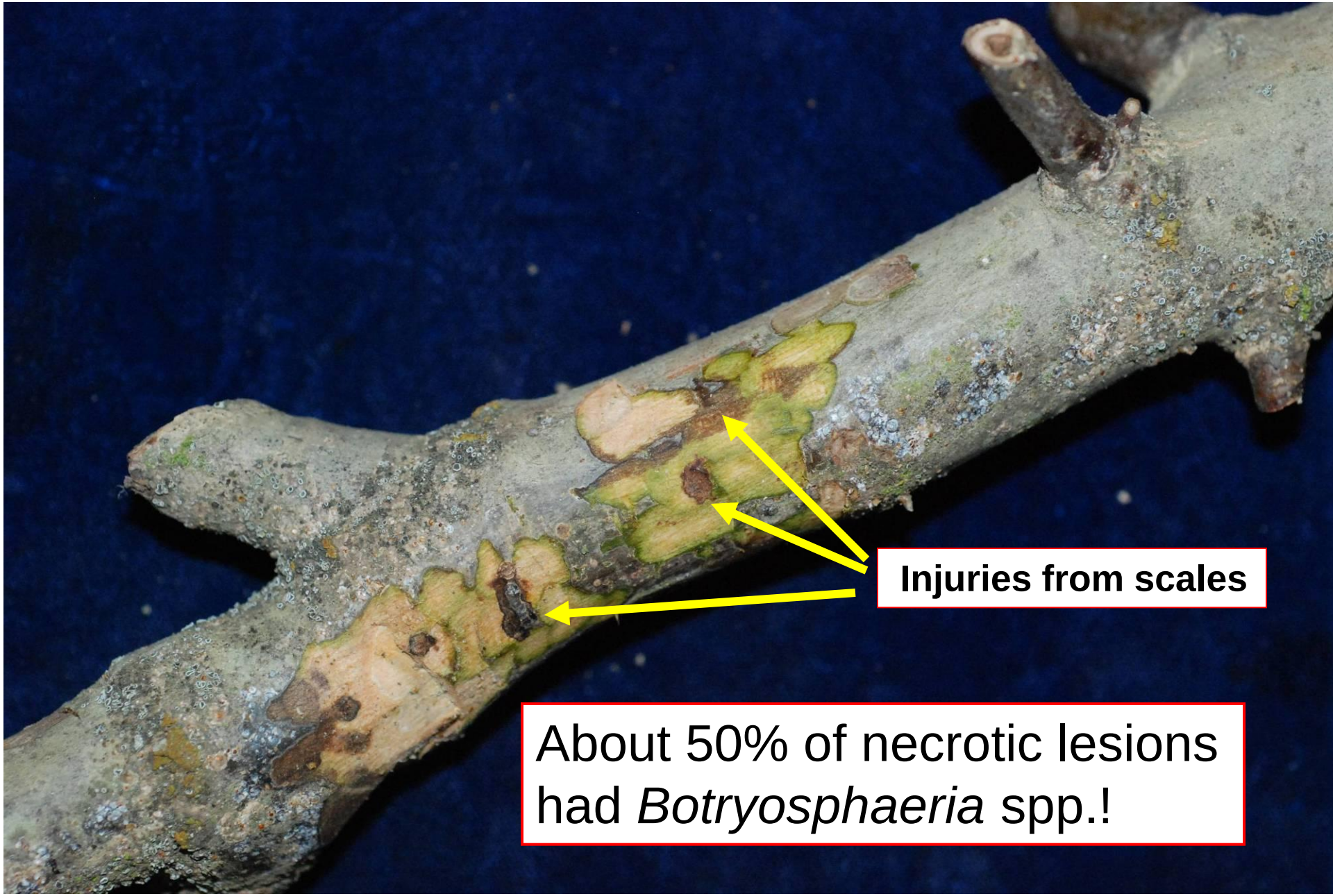
- ✓ **Fruit** **(wounded or non-wounded)**
- ✓ **Fruit** scars
- ✓ **Peduncle** scars
- ✓ **Leaf** scars
- ✓ **Pruning** wounds
- ✓ **Any** wounds (hail, wind,…)
- ✓ **Walnut blight** lesions
- ✓ **Scale** injuries


Leaf scar
infected by
Botryosphaeria

Scale & Botryosphaeria

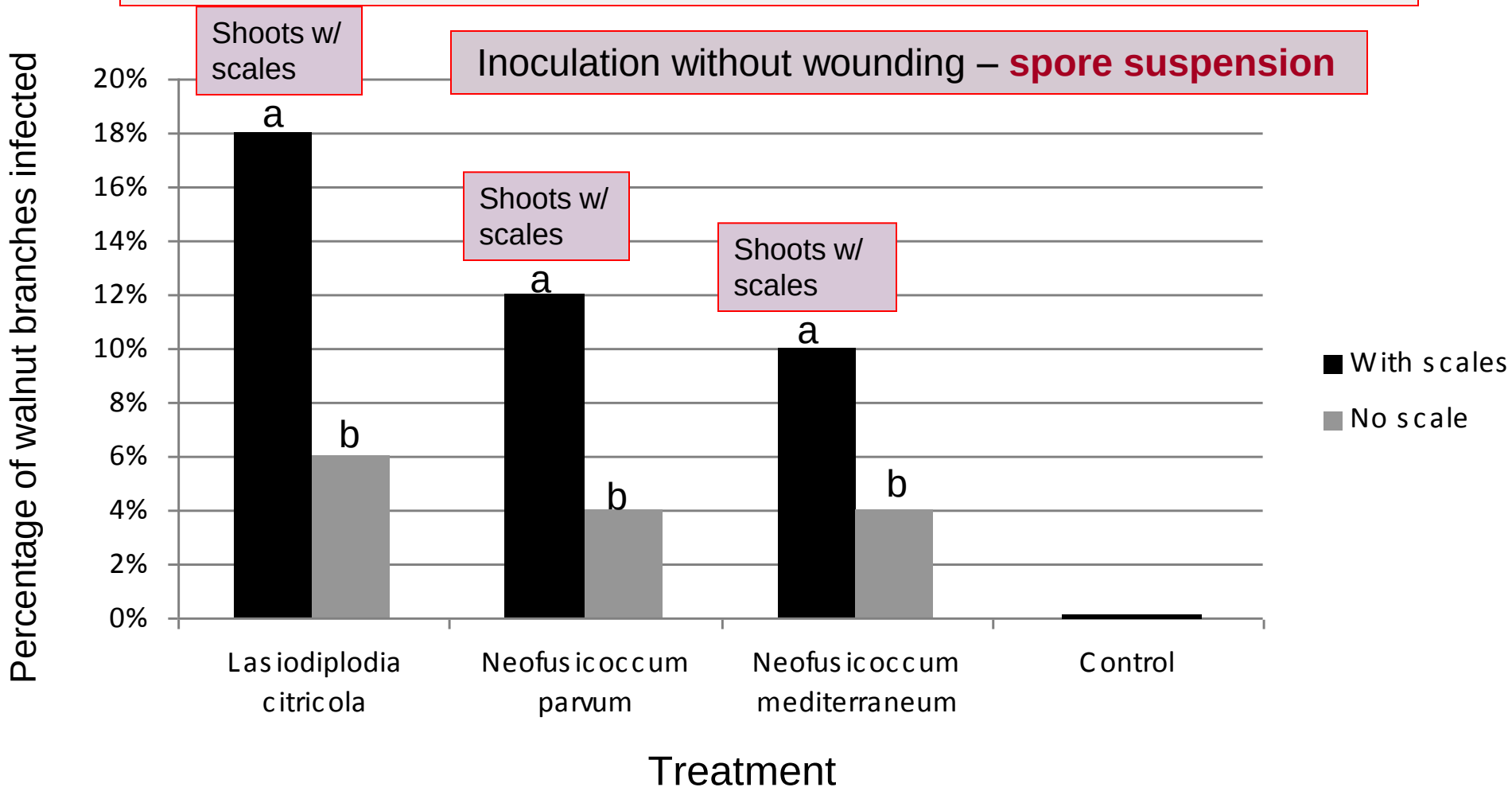


Effects of walnut scales on Botryosphaeria

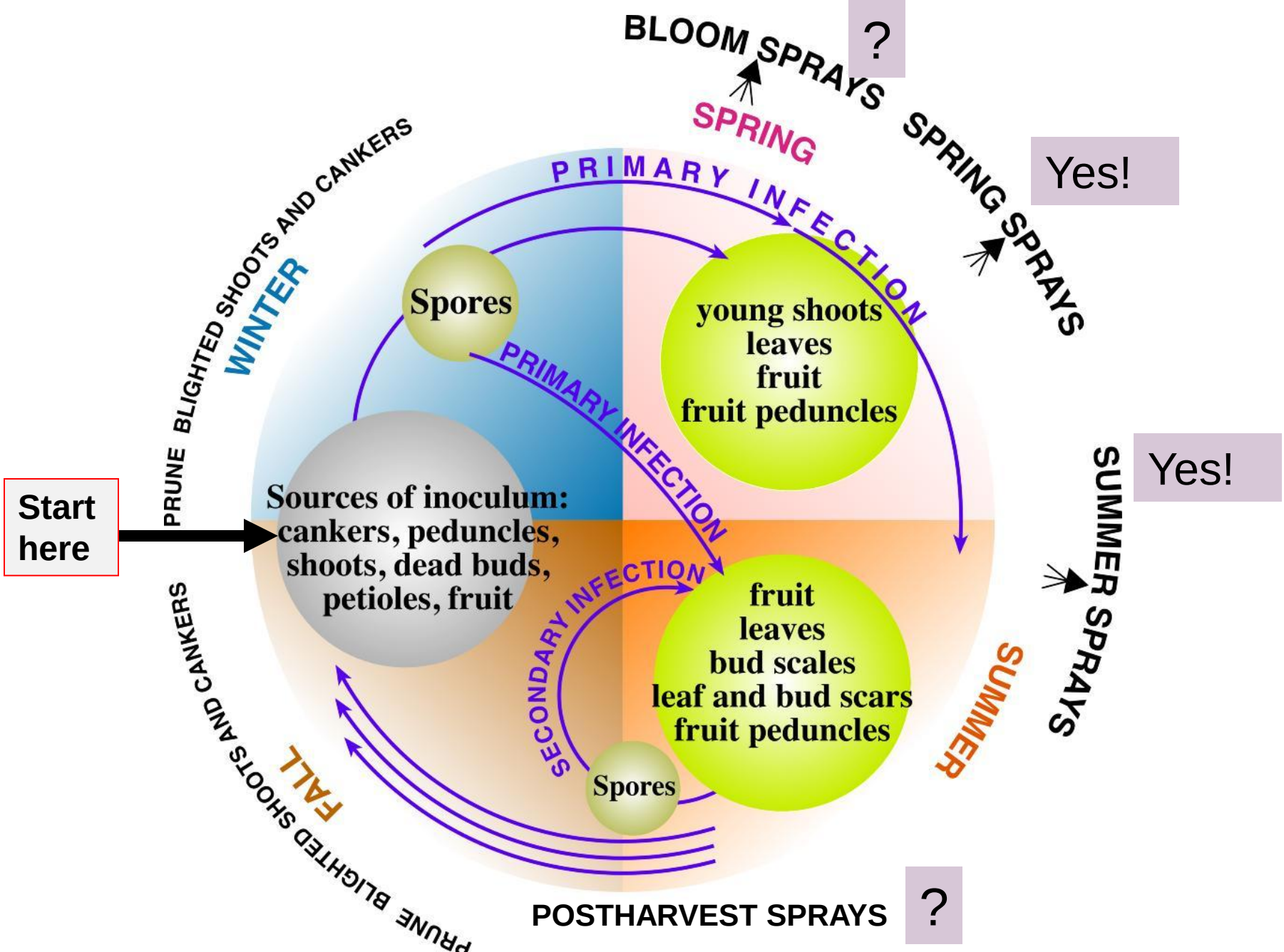


About 50% of necrotic lesions had *Botryosphaeria* spp.!

Effect of walnut scales on infection of walnut by Botryosphaeriaceae (cv. Vina)

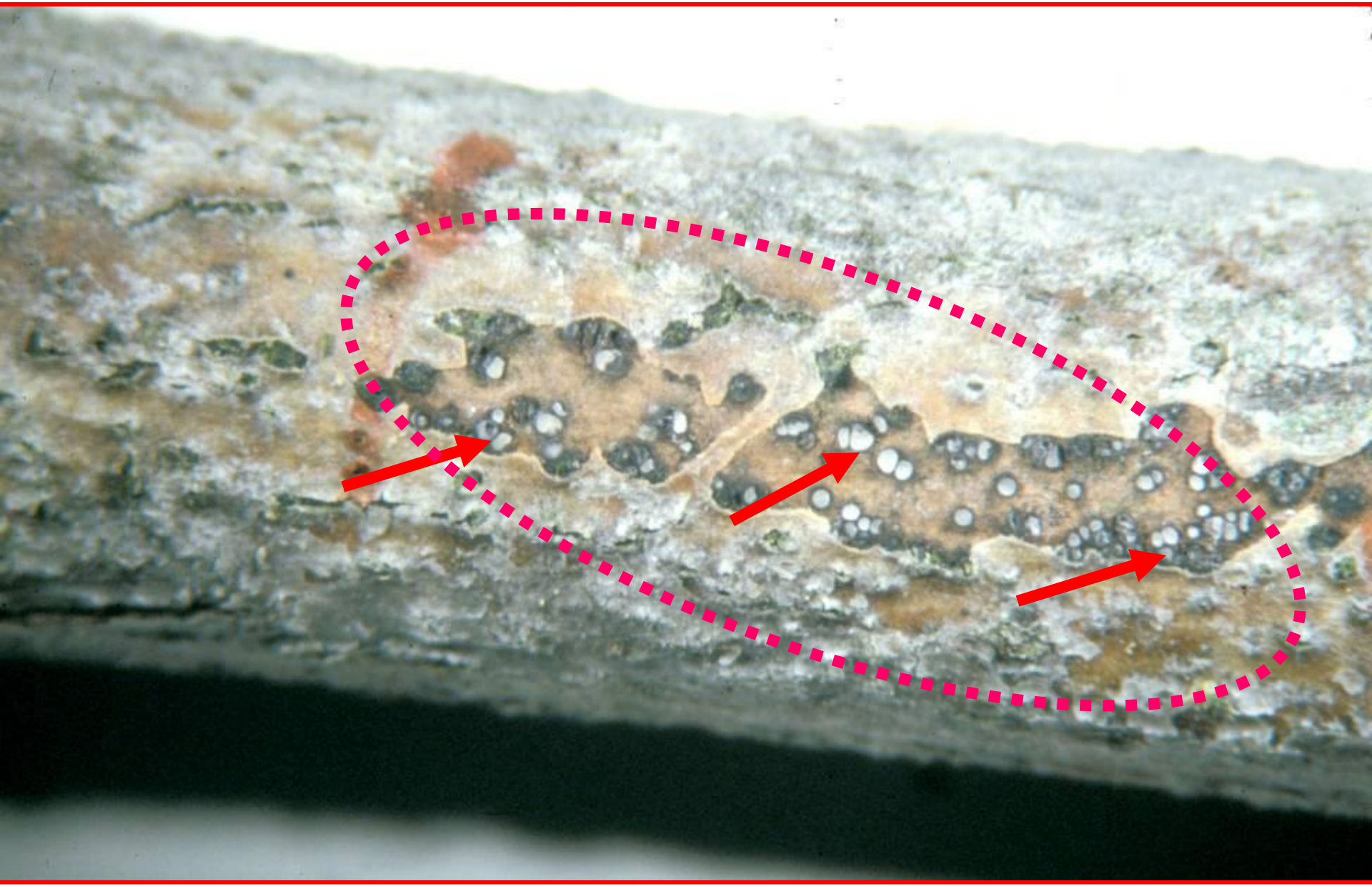


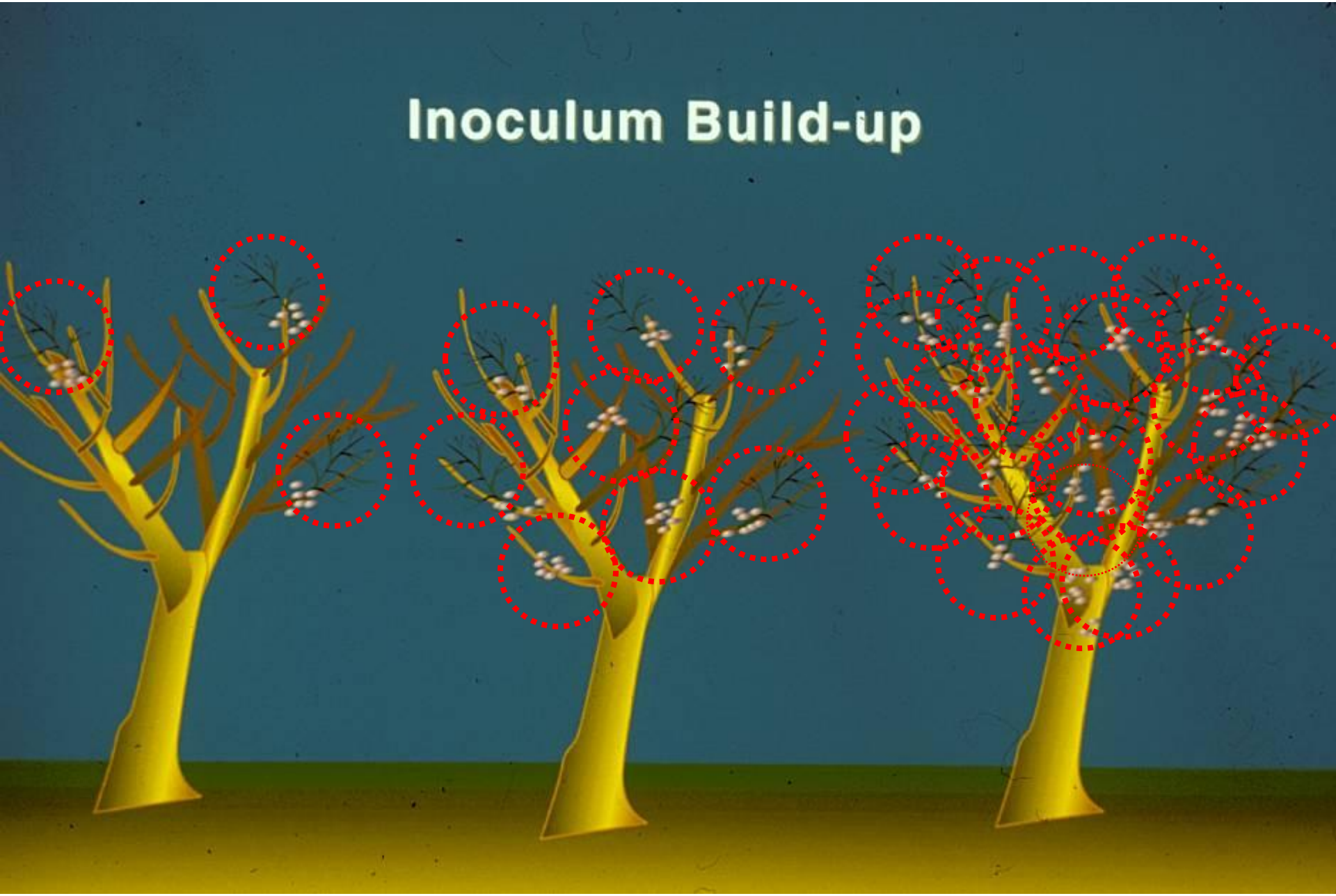
✓**60-75% more shoots were infected when walnut scale was present than shoots without scale.**

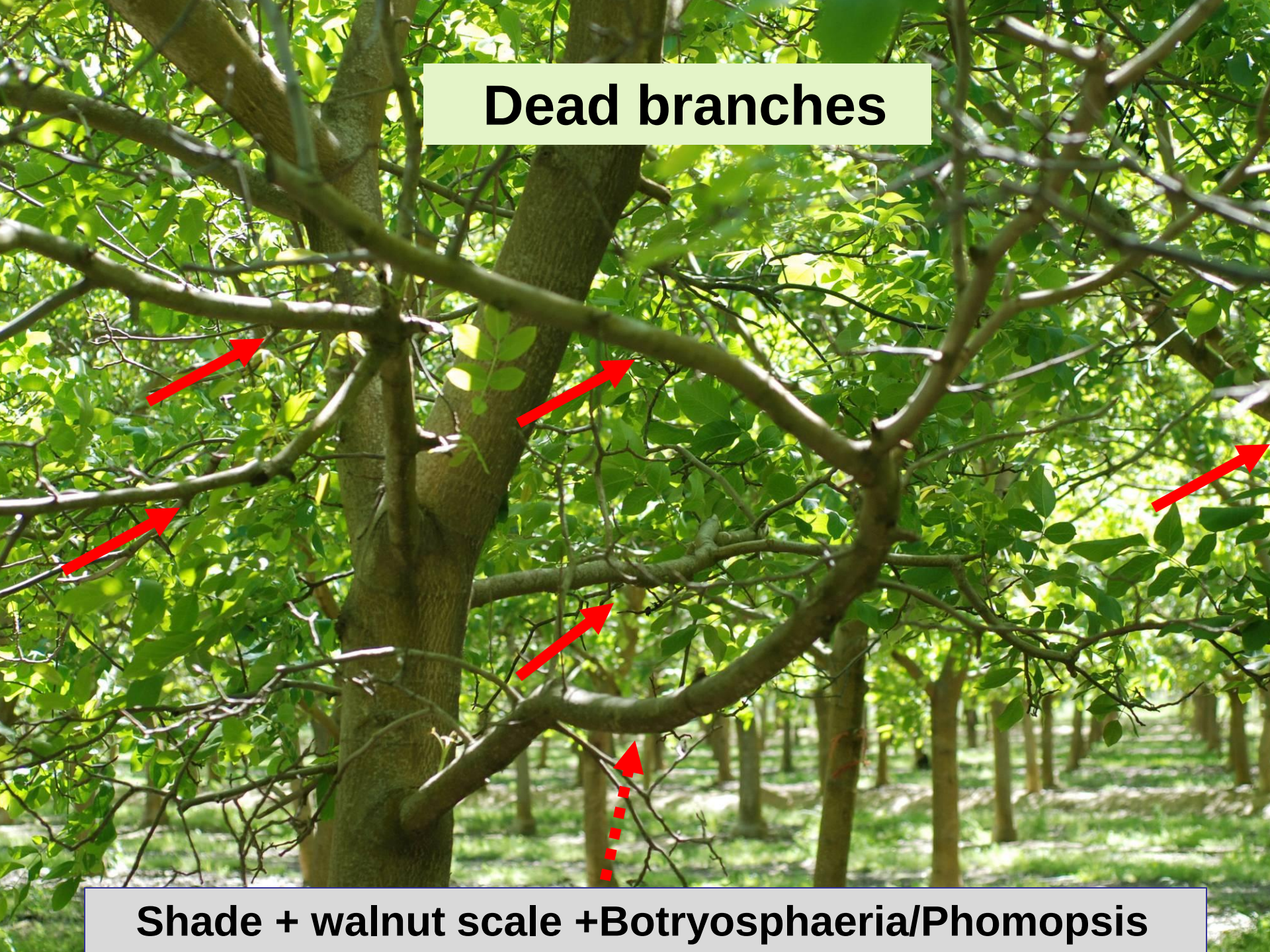


Botryosphaeria canker and blight disease cycle & management

Pycnidia develop in all infected parts of trees




Inoculum Build-up


Dead branches
Shade + walnut scale +Botryosphaeria/Phomopsis

Disease Management

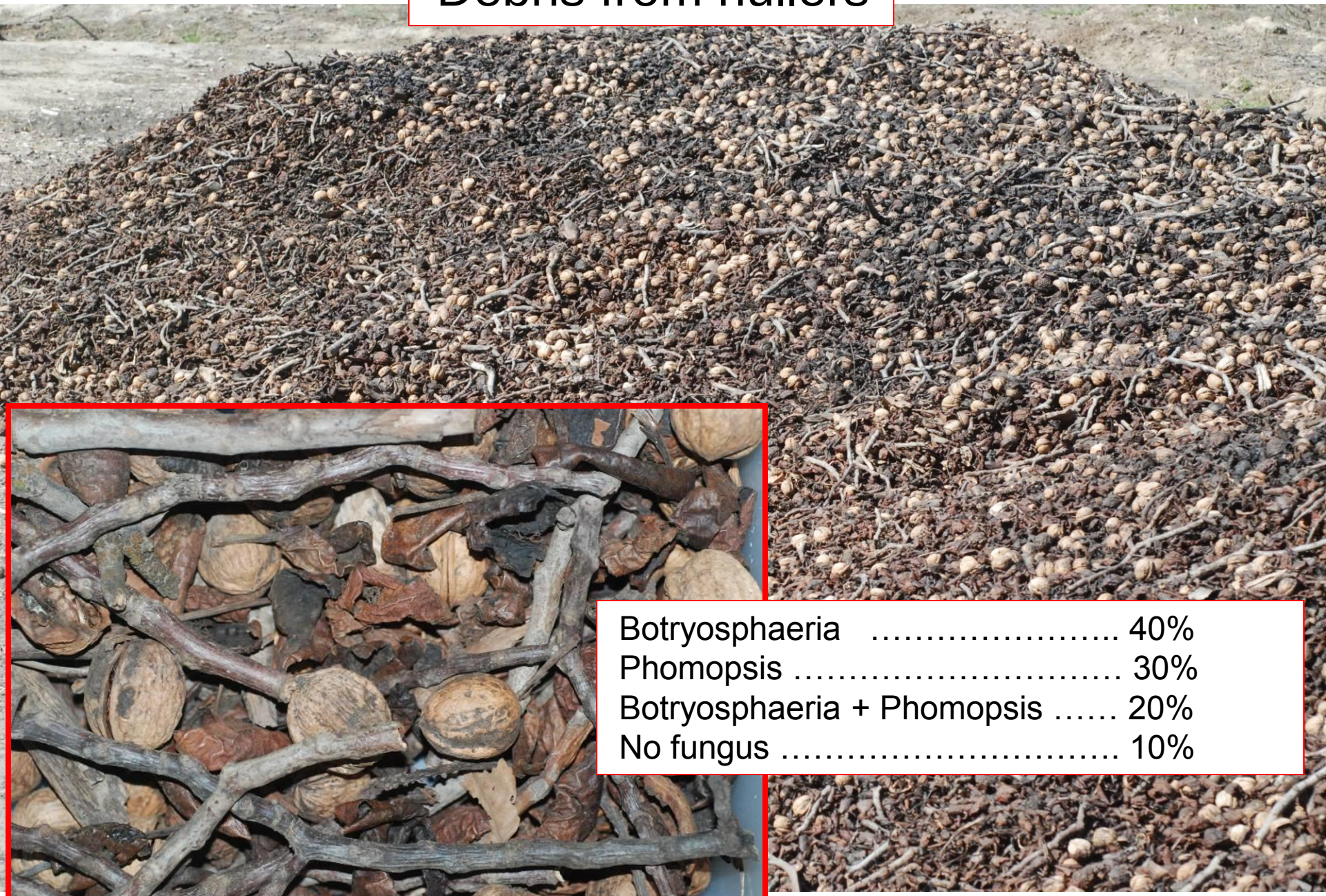
Best Control by intergrading cultural and chemical control practices

- **Cultural control:** Prune the dead branches or blighted shoots; avoid sprinkler irrigation that wets the canopy.

+

- **Chemical control:** Apply effective fungicides (no resistance in these fungi!)

Debris from hullers



Botryosphaeria 40%
Phomopsis 30%
Botryosphaeria + Phomopsis 20%
No fungus 10%

Walnut prunings?

✓ ***Orchards*** **- Heavy infection:** You can shred the prunings and leave in the orchard; yearly fungicide sprays to reduce infection and sources of inoculum.

✓ ***Orchards*** **- Light-to-medium infection:** Prune or hedge these orchards first and then move into heavily infected orchards; remove prunings out of the orchard; yearly fungicide spray program.

✓ ***Orchards*** **- No Bot infection (young orchards):** if pruning is done, prunings can be shred and left on the orchard floor.

Can chainsaws and blades spread the disease?

Pest Control Adviser's Trial (2013):

Fungicides and rates applied to control Botryosphaeria blight of walnut (Butte Co.)

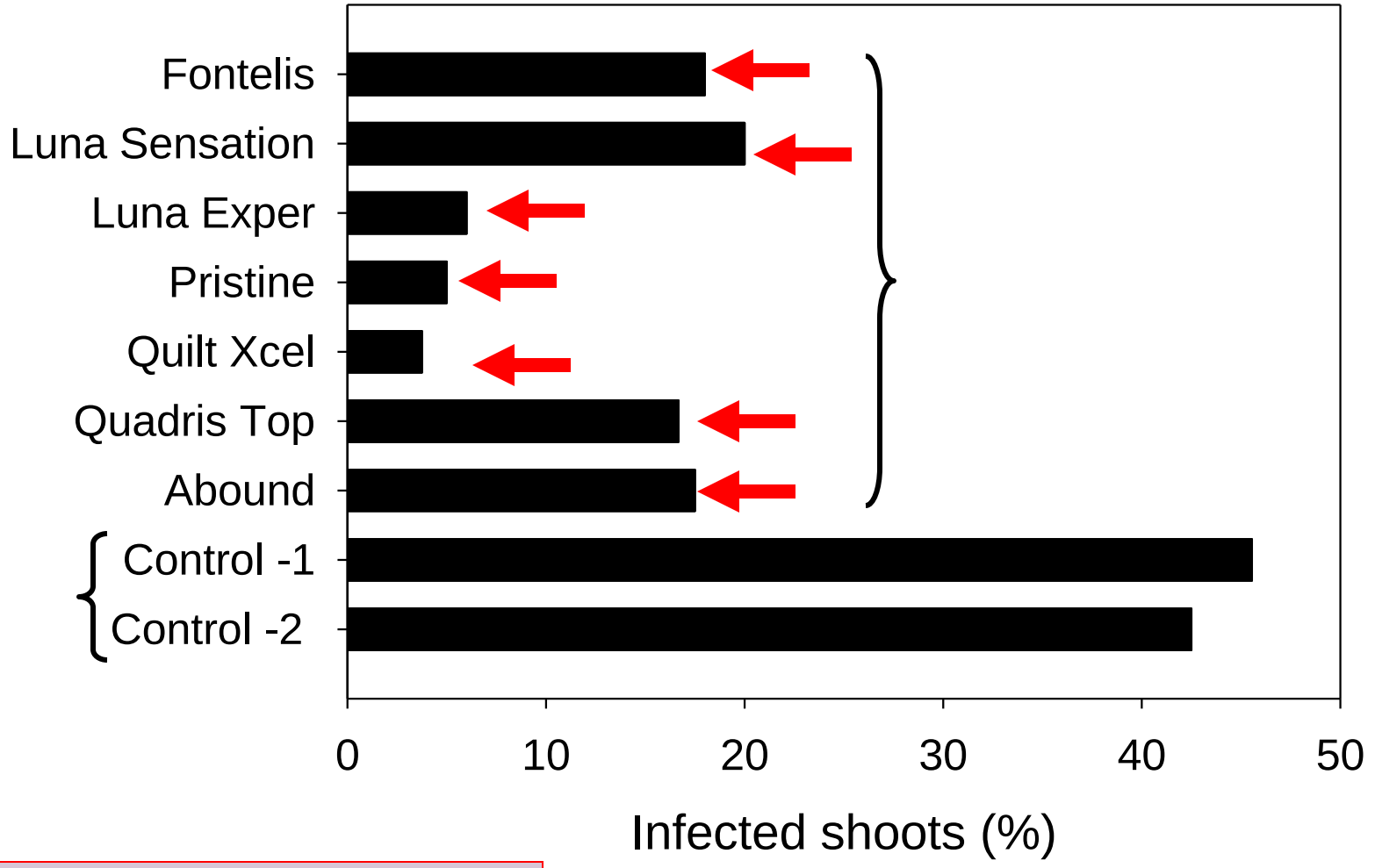
Fungicide	Active ingredient	Amount/acre
Fontelis …….	20.4% penthiopyrad + R-11	20 oz
Pristine …….	12.8% pyraclostrobin + 25.2% boscalid + R-11	14.5 oz
Luna Experience …….	17.6% fluopyram + 17.6% tebuconazole	9.6 fl oz
Luna Sensation ….....	21.4% trifloxystrobin + 17.6% fluopyram	7.6 fl oz
Abound…….	22.9% azoxystrobin	12.0 fl oz
Quadris Top…….	18.2% azoxystrobin + 11.4% difenoconazole	14.0 fl oz
Quilt Excel……	13.5% azoxystrobin + 11.7% propiconazole	21 fl oz
Untreated	---	

Spray dates: 17 May; mid June; & mid July

<u>On 25 October 2013 collected</u>:

- peduncles
- current growth shoots

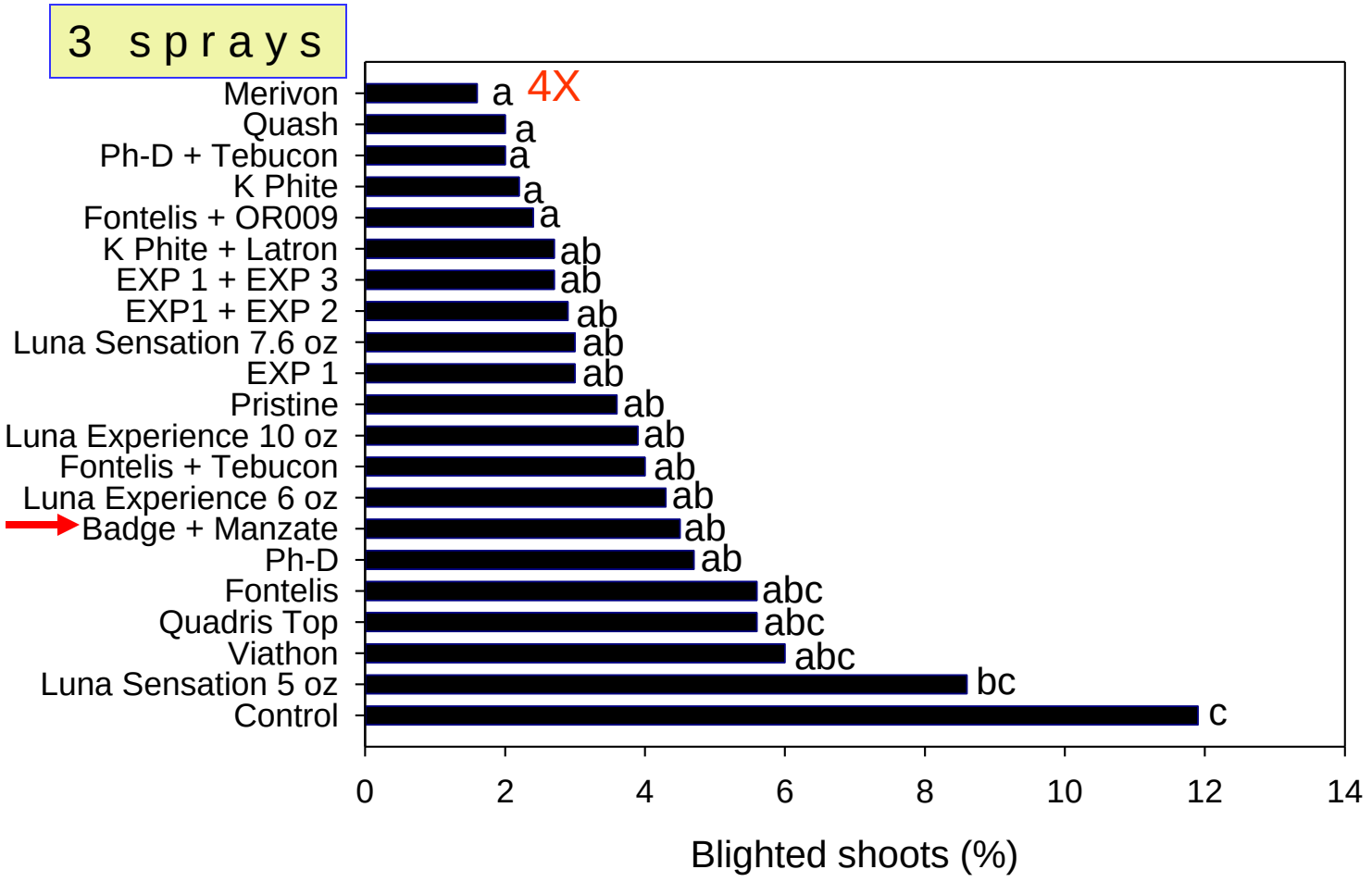
Pest Control Adviser's Trial (2013):
Effects of fungicides on Bot canker development on walnut shoots/spurs (Butte Co.)



Spray dates: 17 May; mid June; & mid July


2014

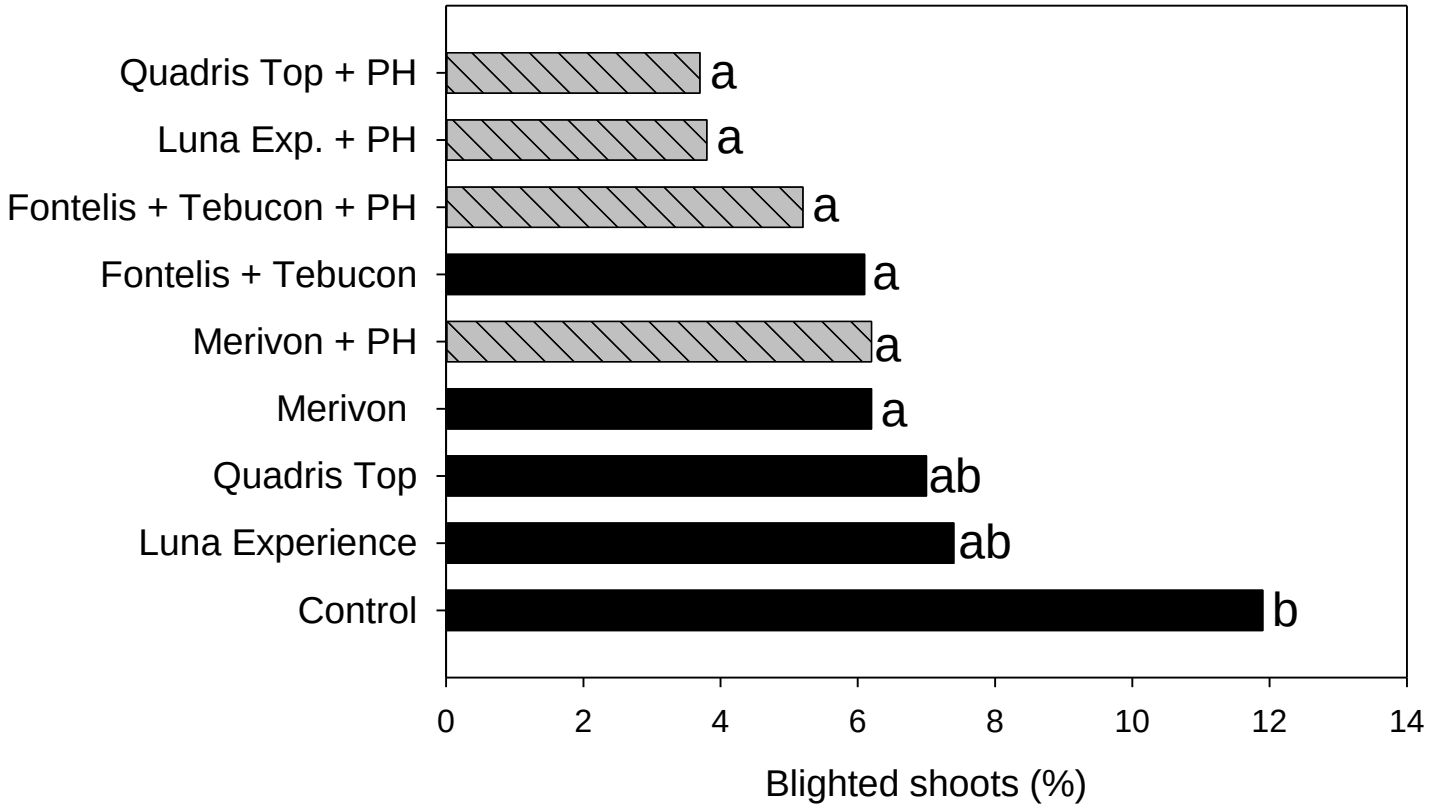
University of California Trial (2014):
Effects of fungicides on Botryosphaeria in Chandler walnut shoots (Butte Co.)



21 treatments sprayed on May 8, June 12, and July 10

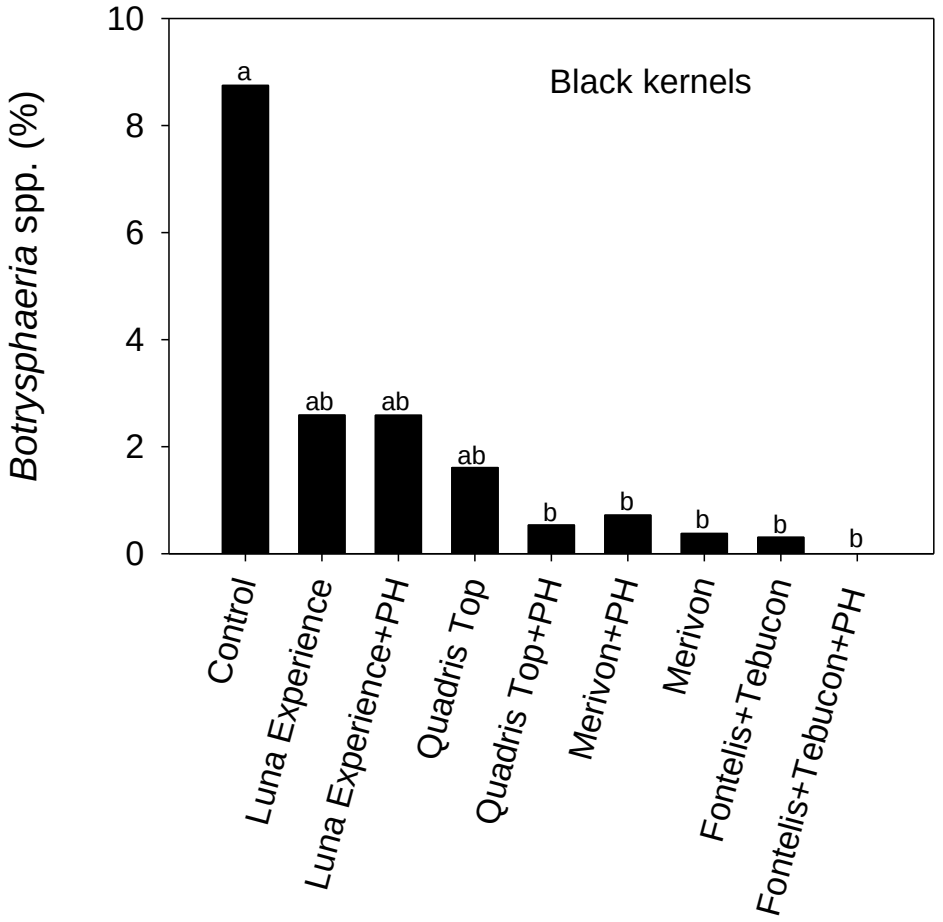
Effects of fungicides on Botryosphaeria in Chandler walnut shoots/spurs (Colusa Co.) - 2014

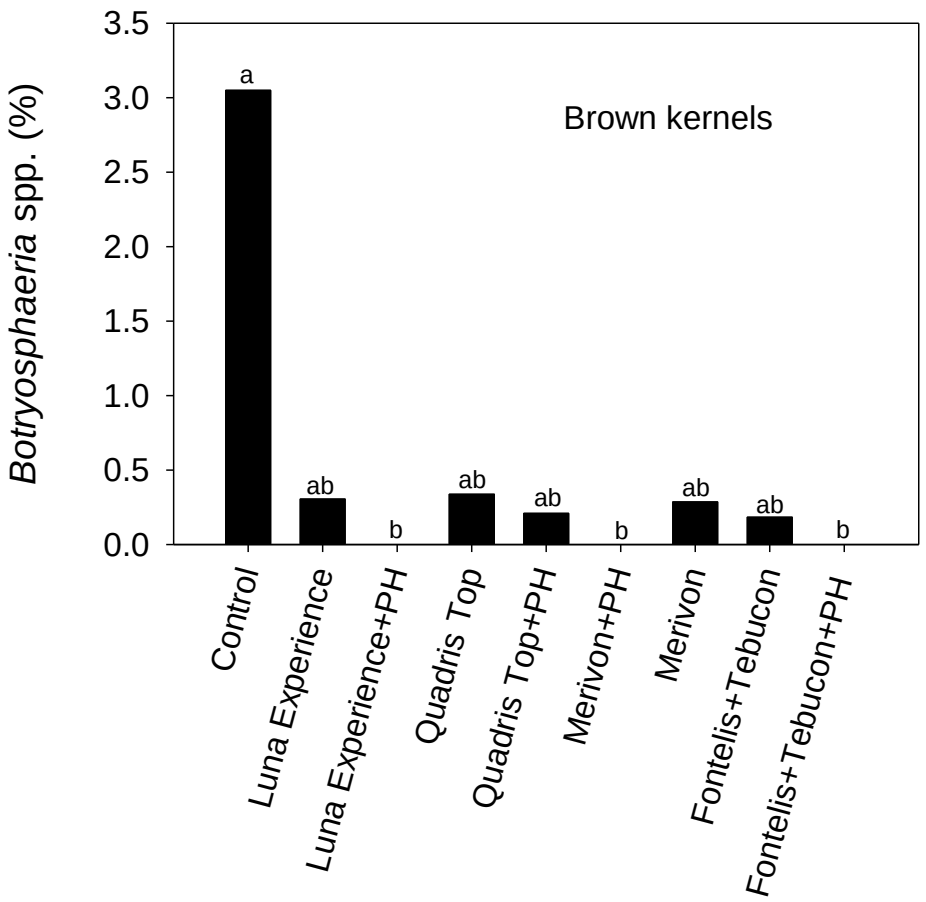
3 sprays regular, PH received 4 sprays




Black kernels
Brown kernels

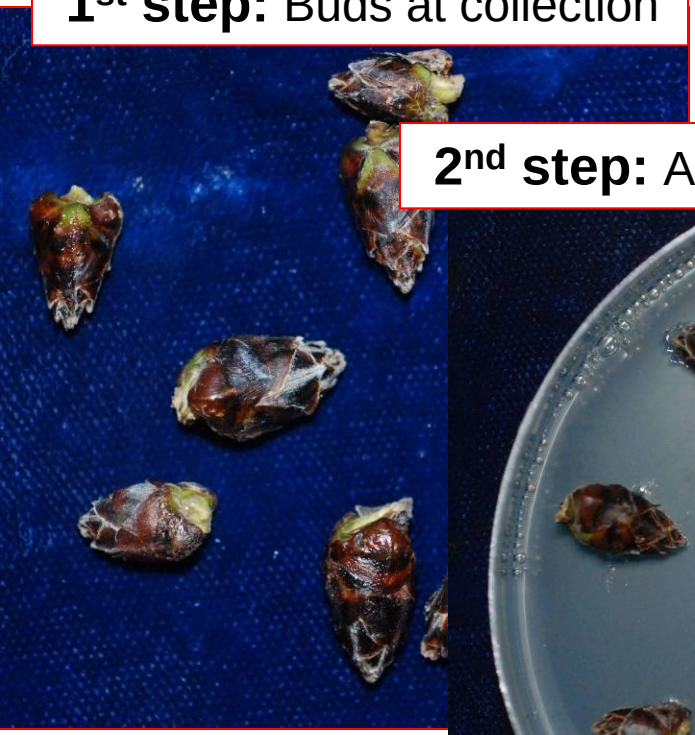
Effects of fungicides on Botryosphaeria in Chandler walnut (black and brown kernels) (Colusa Co.) - 2014



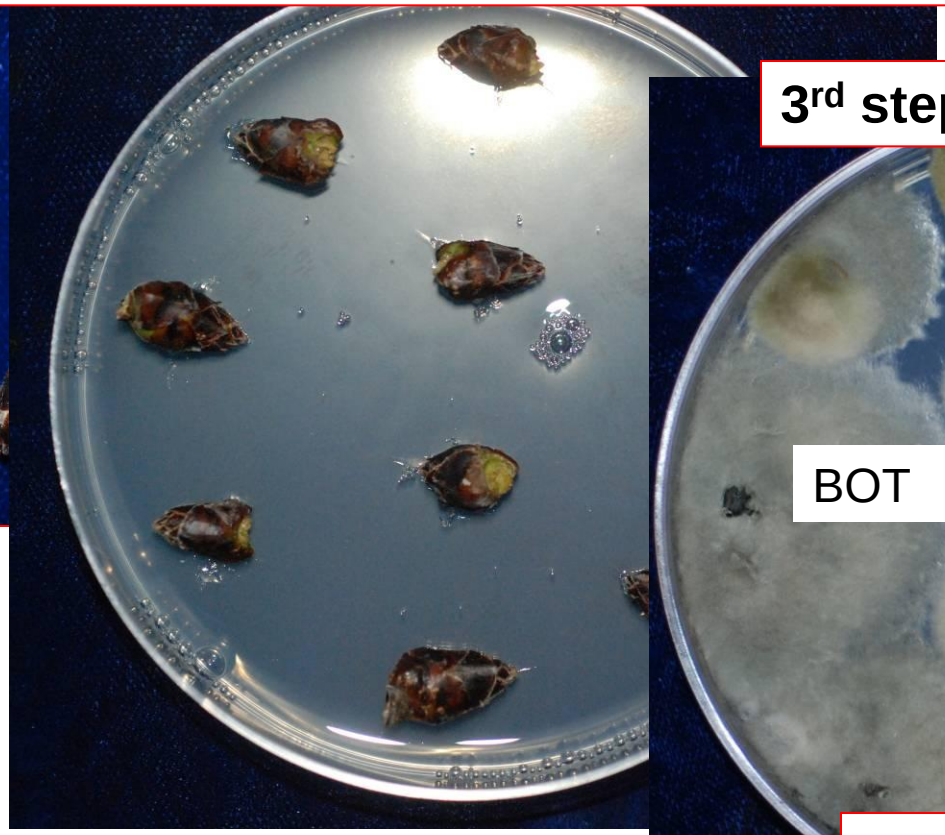


Long – term effects of fungicide sprays
BUDMON-Technique

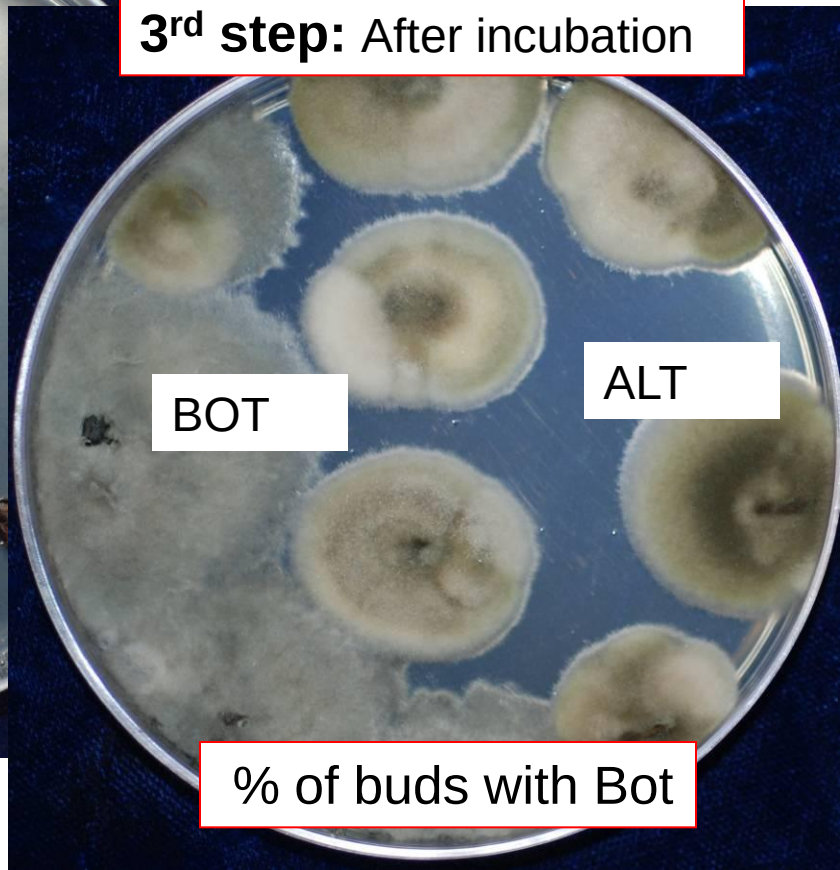
1st step: Buds at collection



2nd step: After surface sterilization & plating



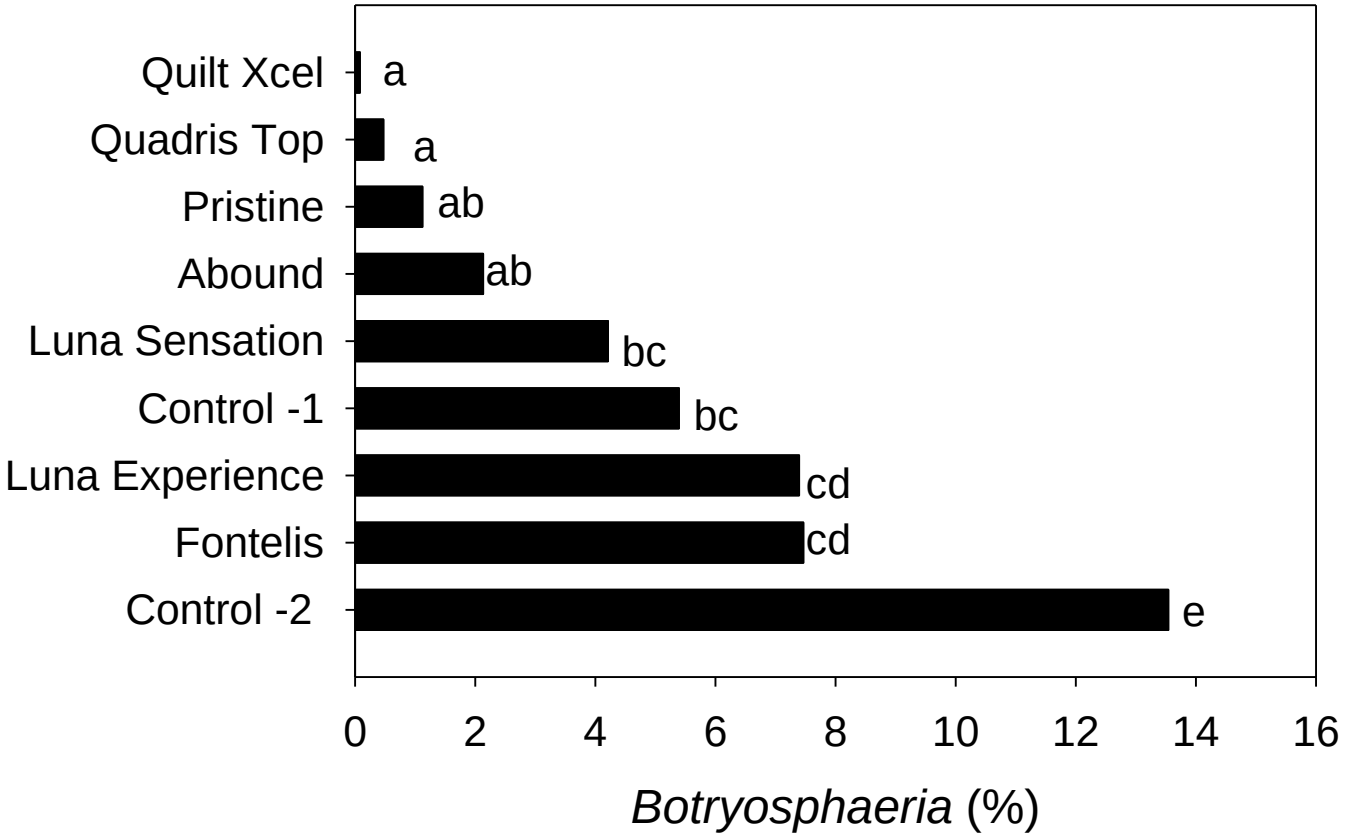
3rd step: After incubation



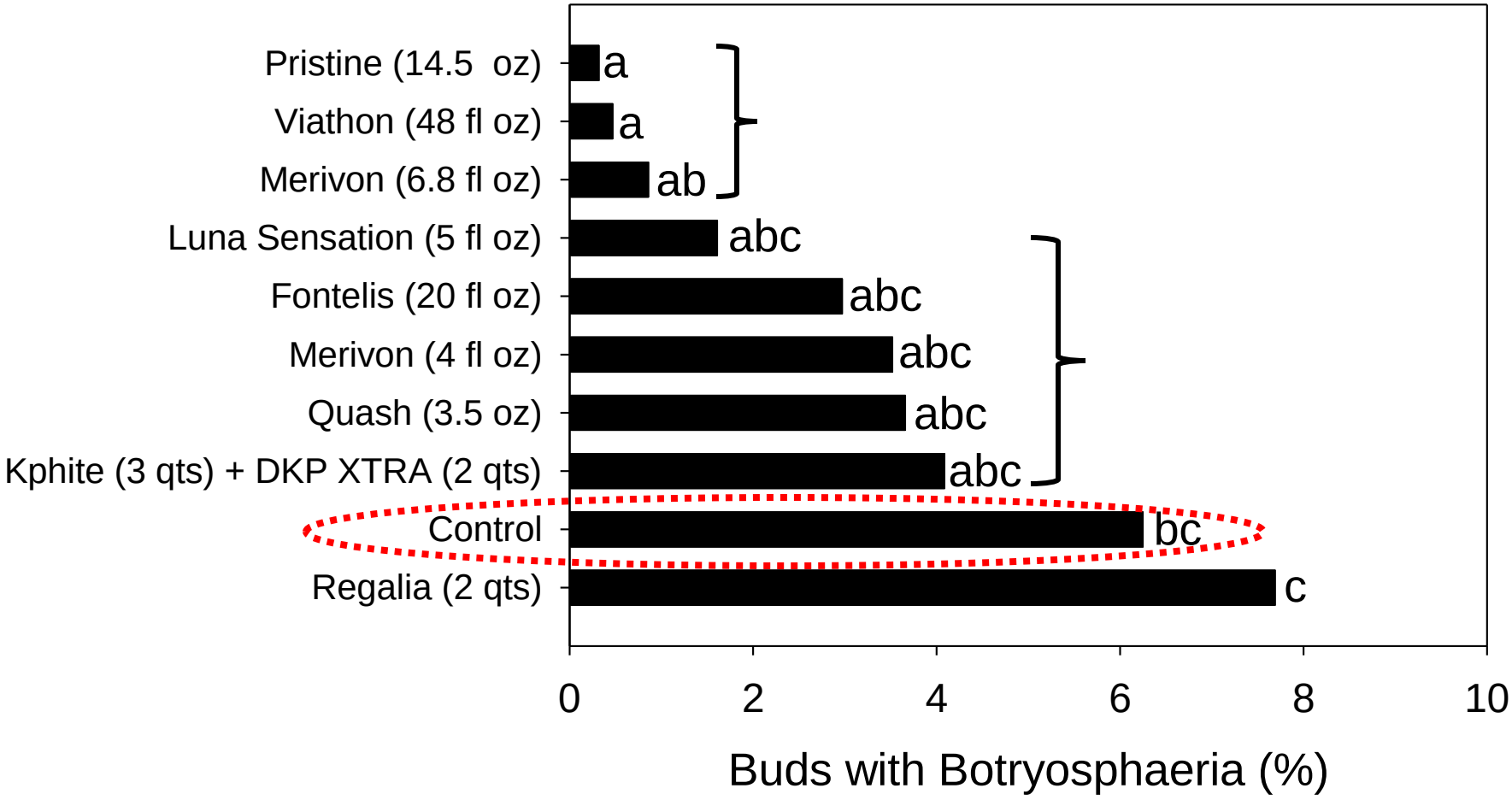
% of buds with Bot

Long-term effects of 2013 fungicide sprays on Botryosphaeria in buds of Chandler walnut in Butte Co.

(buds were collected in March 2014)



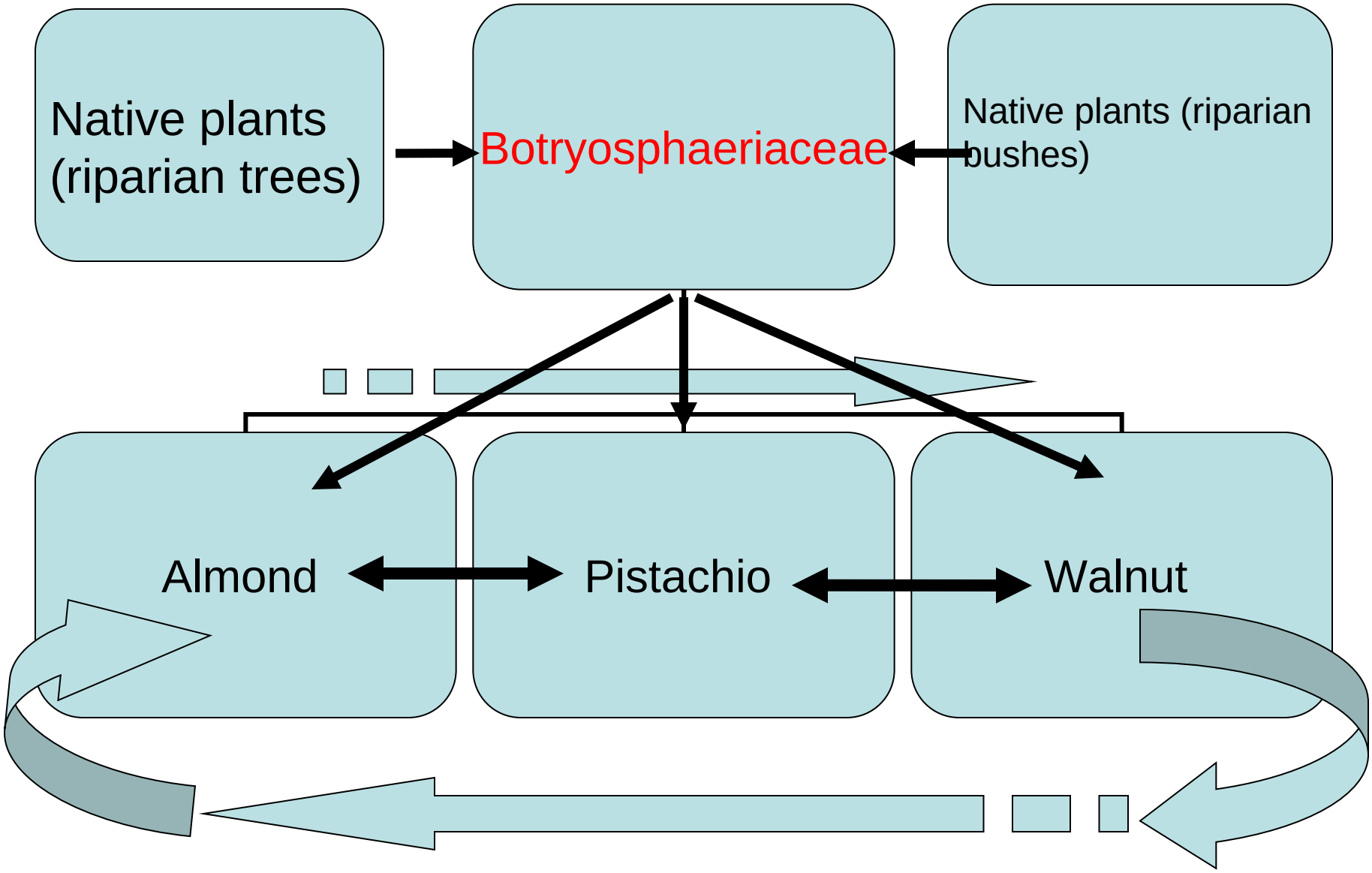
Long-term effects of fungicides on Botryosphaeria in buds of Serr walnut in San Benito Co. collected in March 2014

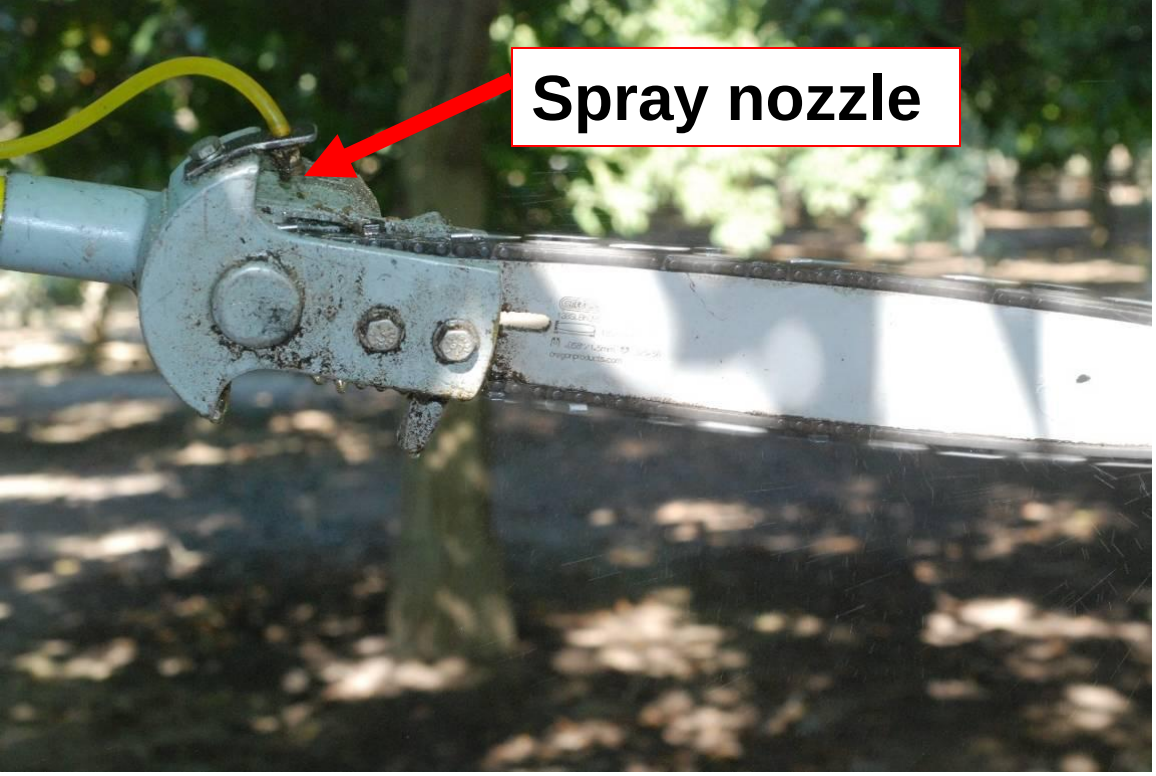


Conclusions

- ✓ **Botryosphaeriaceae can infect unwounded green fruit (latent infections) during the growing season.**
- ✓ **Pruning wounds are susceptible to infection for at least for 4 weeks.**
- ✓ **We confirmed the presence of perithecia (producing ascospores, spread by air) in more walnut growing regions.**
- ✓ **Walnut blight lesions and walnut scale damage serve as infection courts by the Botryosphaeriaceae and other decay fungi.**
- ✓ **Sprays during spring and summer reduce the disease significantly at harvest; we do not know about the efficacy of bloom or postharvest sprays?**
- ✓ **Cultural and chemical control together = the best disease management.**

Thank you

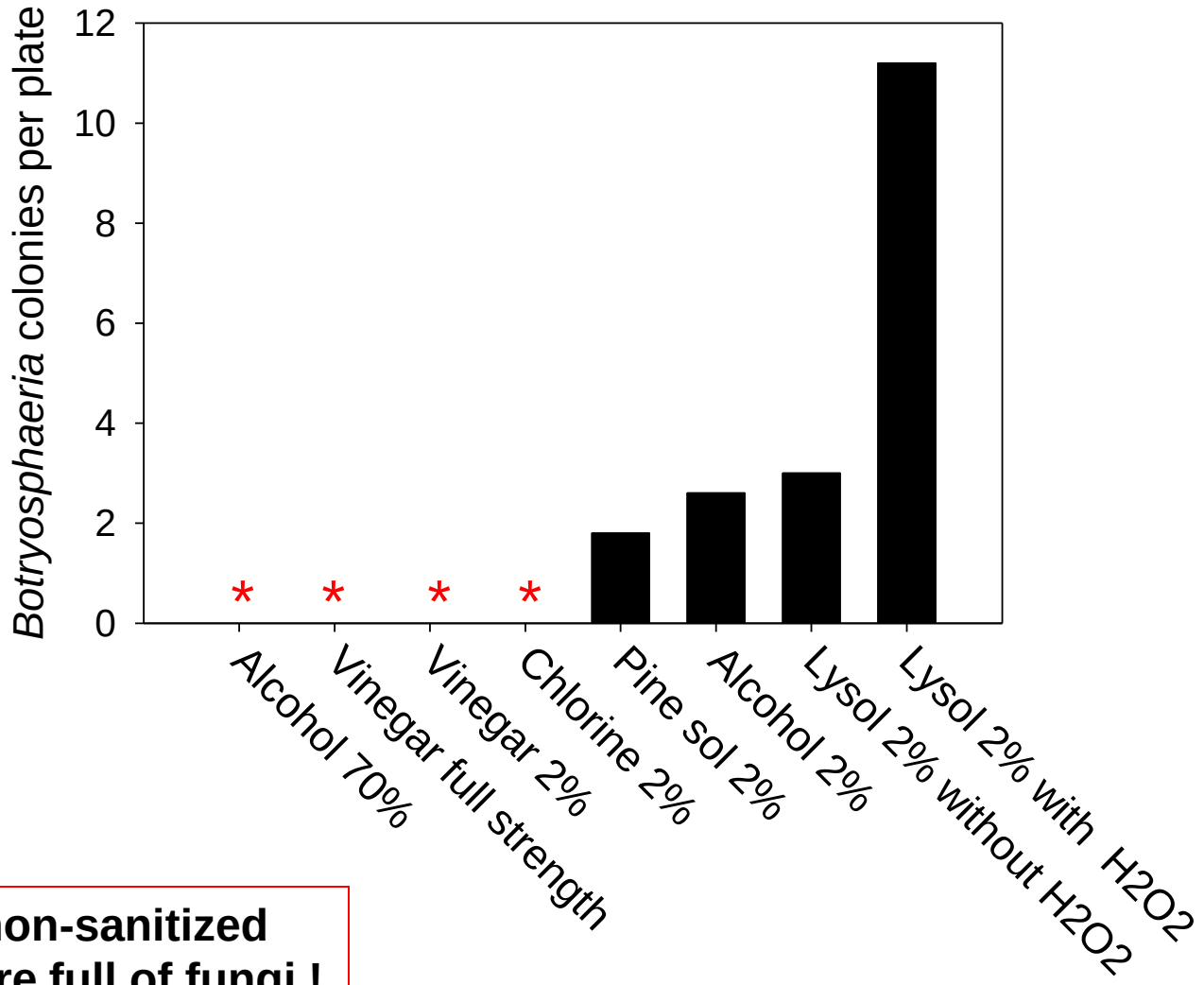

Native plants (riparian trees)
Botryosphaeriaceae
Native plants (riparian bushes)
Almond
Pistachio
Walnut



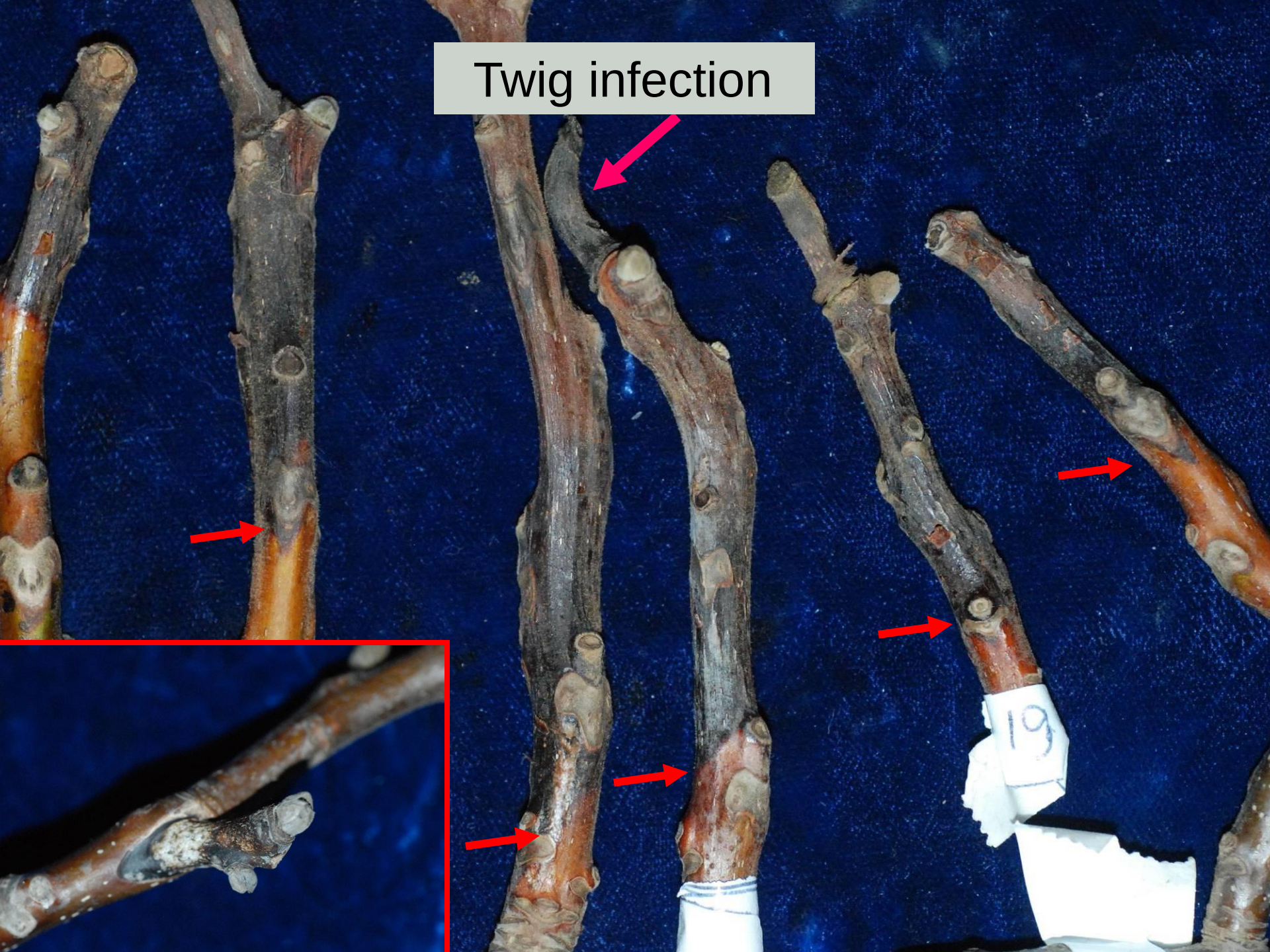
Chainsaw

Petri plates with agar and fungi

Effect of various sanitizers on cleaning a chainsaw after cutting *Botryosphaeria* – infected walnut wood

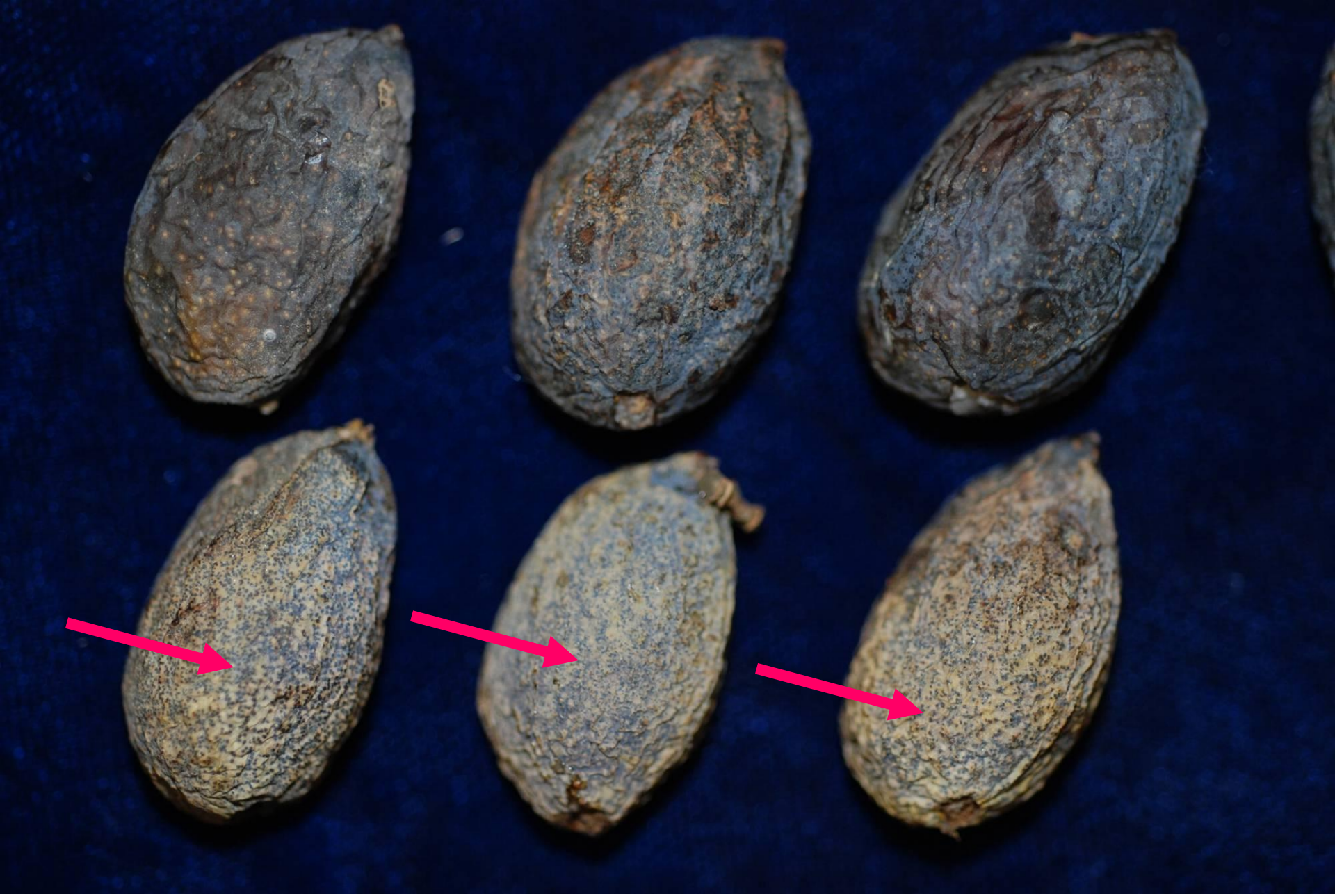


Plates from non-sanitized chainsaw were full of fungi !


Twig infection
19

Botryosphaeria fruit blight

Fruit blight; notice beige areas with pycnidia



Pistachio fruit with pycnidia of *Botryosphaeria*