

Understanding the Biology of Botryosphaeria/Phomopsis Canker of walnut & Ways to Manage the Disease

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

By HOWARD S. FAWCETT

BULLETIN No. 261

Berkeley, Cal., November, 1915

Nov 1915

Caused by *Botryosphaeria ribis*

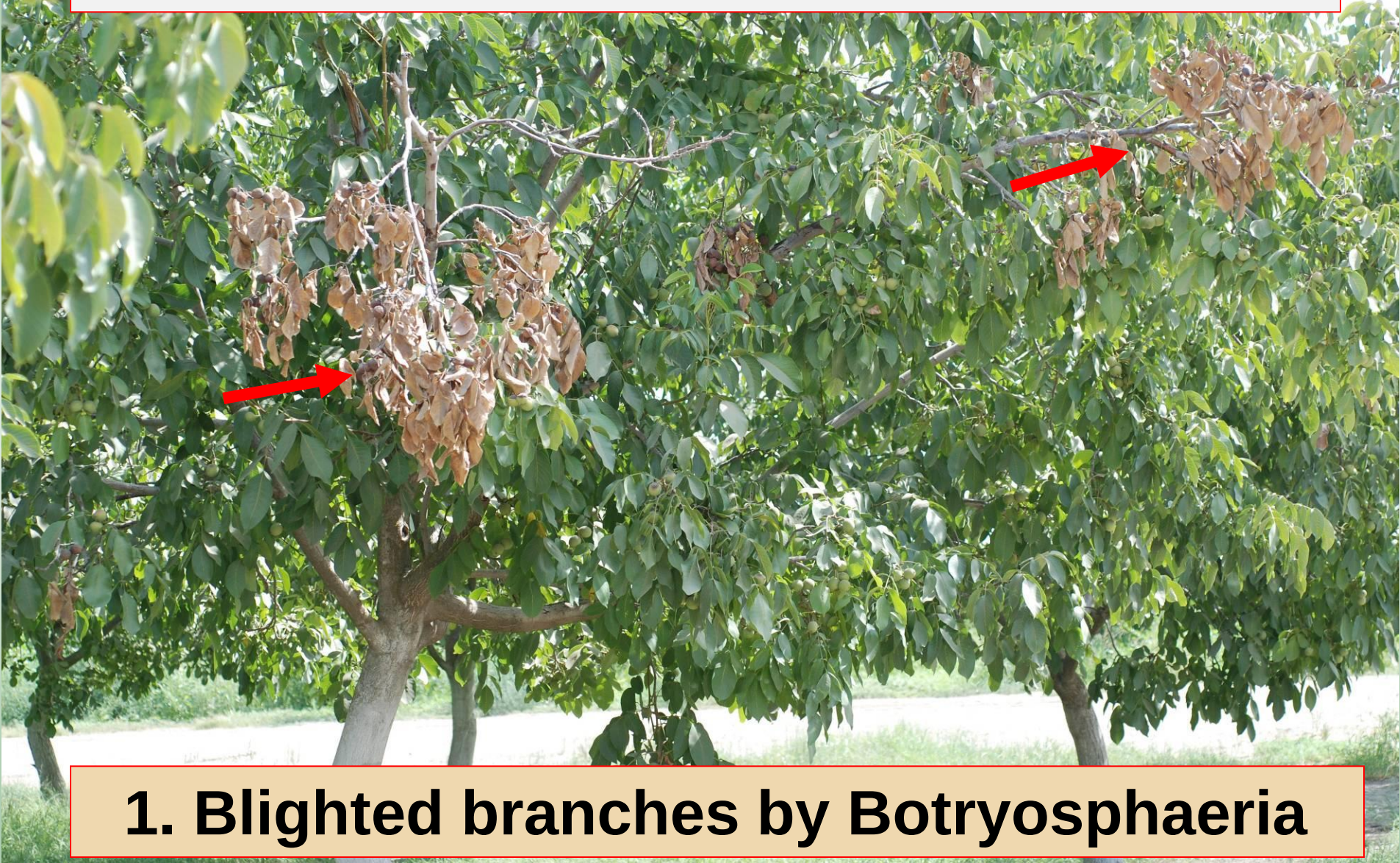
Are all these branch wilt?



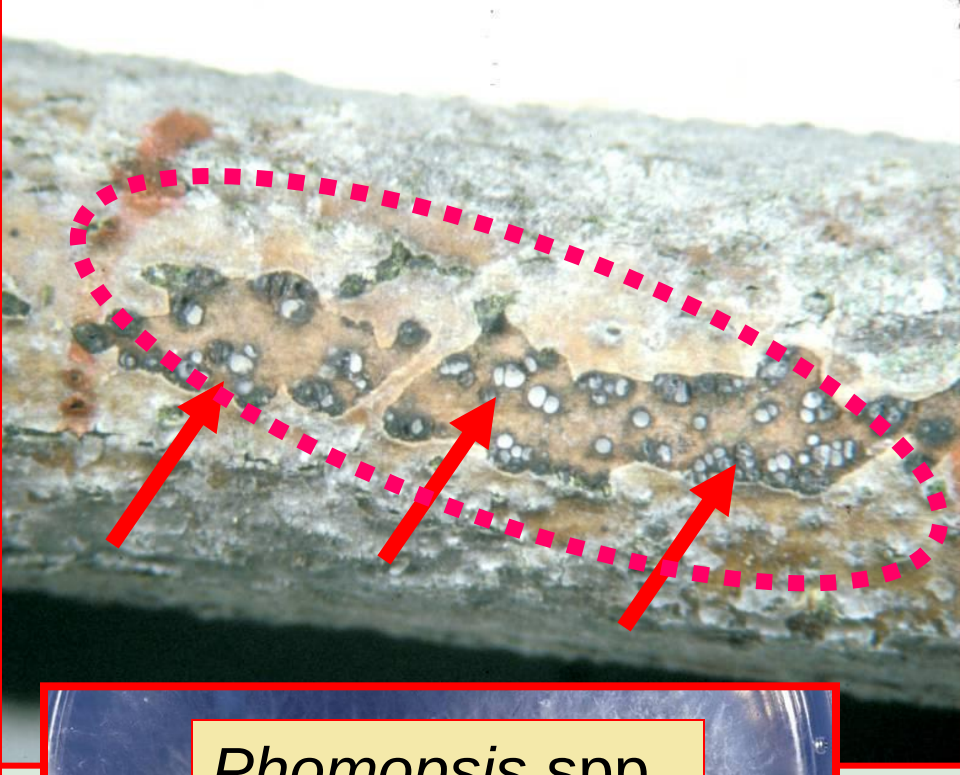


Branch wilt is caused by *Hendersonula toruloidea*
New name: *Neoscytalidium dimitiatum*

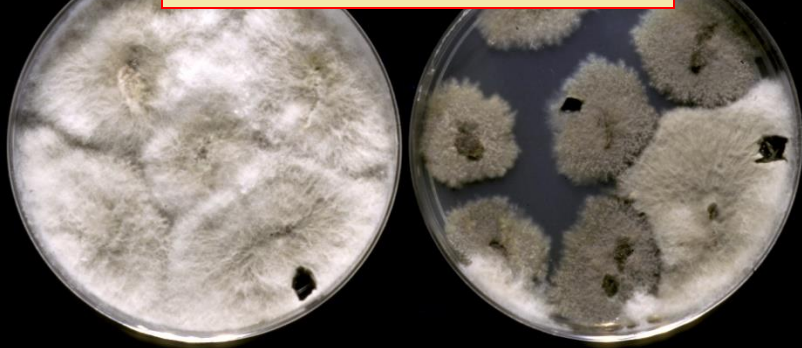
Six types of symptoms associated with Botryosphaeria/ Phomopsis cankers & blights:



1. Blighted branches by Botryosphaeria



Botryosphaeria



Phomopsis spp.



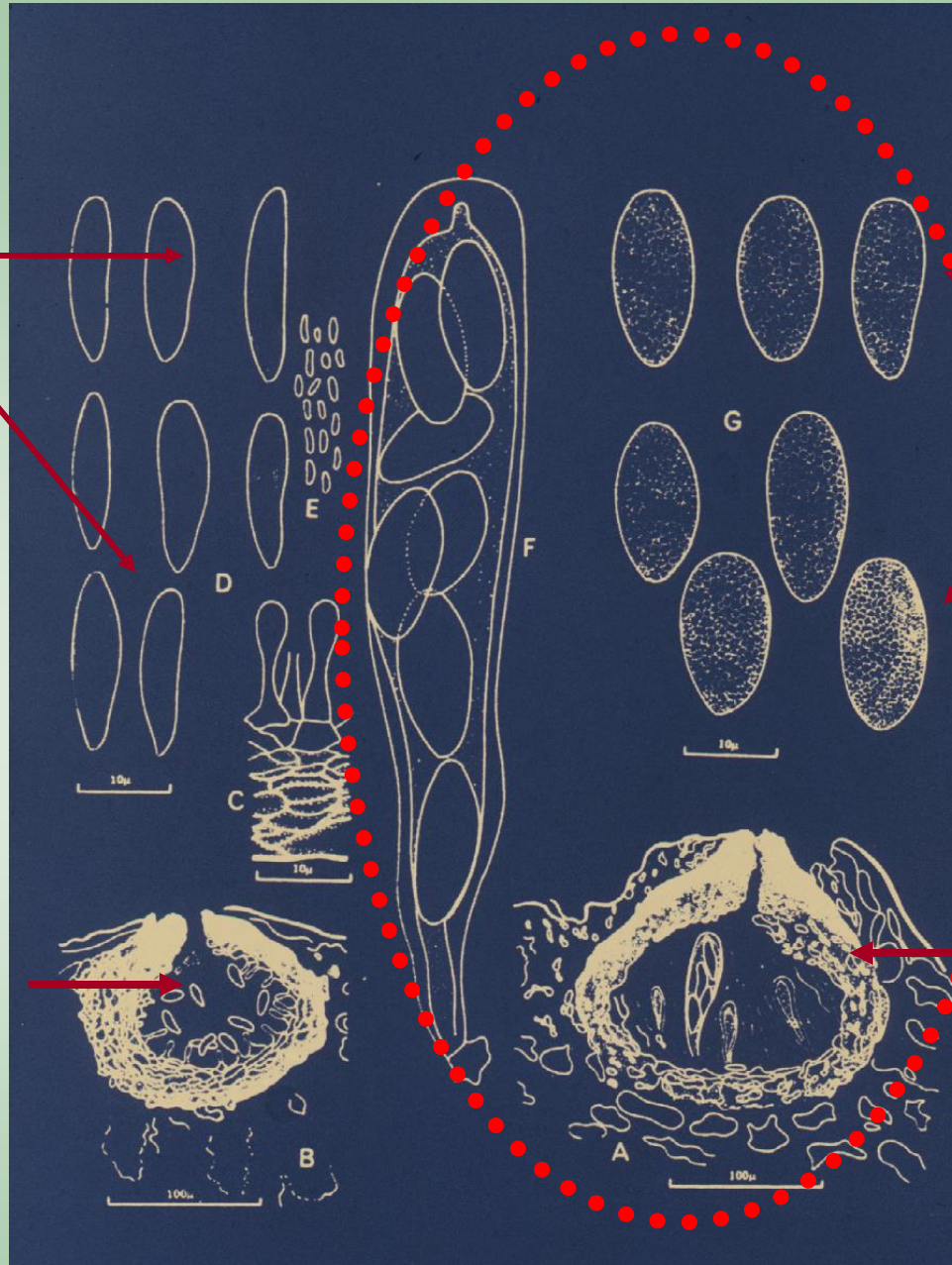
Cankers, pycnidia, and *Botryosphaeria* & *Phomopsis* in walnut branches

conidia

✓ water
splashed

✓ insect
spread

pycnidia



ascospores

✓ airborne

perithecia
(ascocarps)

***Botryosphaeria* reproductive structures in walnut**

Botryosphaeria dothidea

Wind-borne

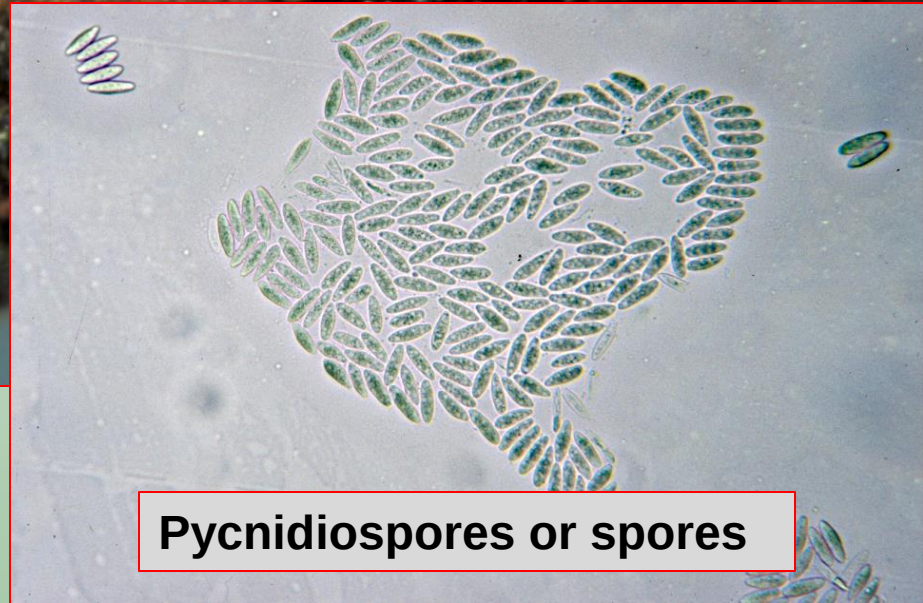
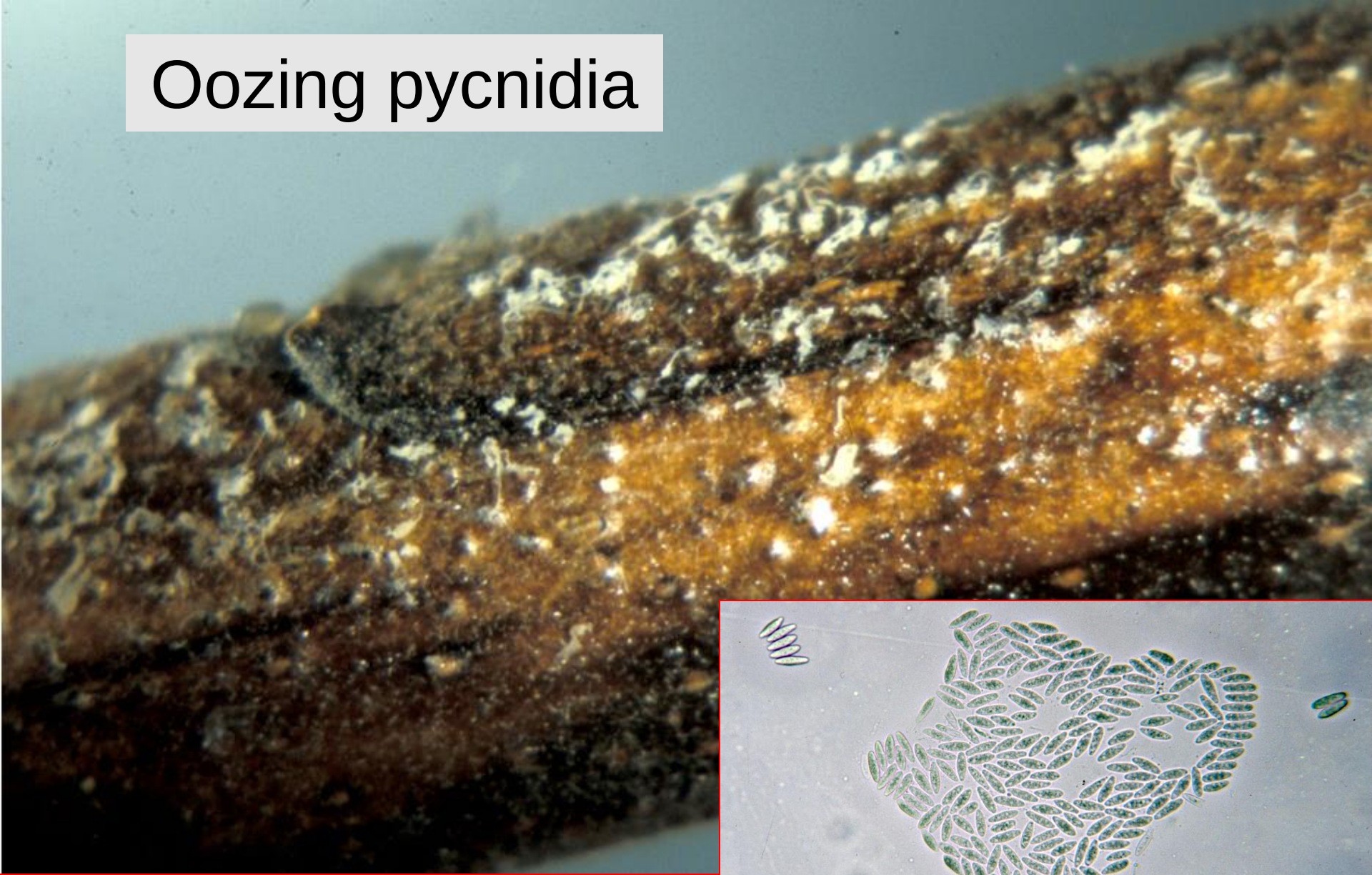
Water-borne

**Perithecia:
Sexual stage**

Pycnidia: Asexual stage



Oozing pycnidia



Pycnidiospores or spores

2. Active infections of fruit and leaves (Actual “Botryosphaeria blight”)



September 15, 2011, Stanislaus Co.

Botryosphaeria panicle and shoot blight of pistachio

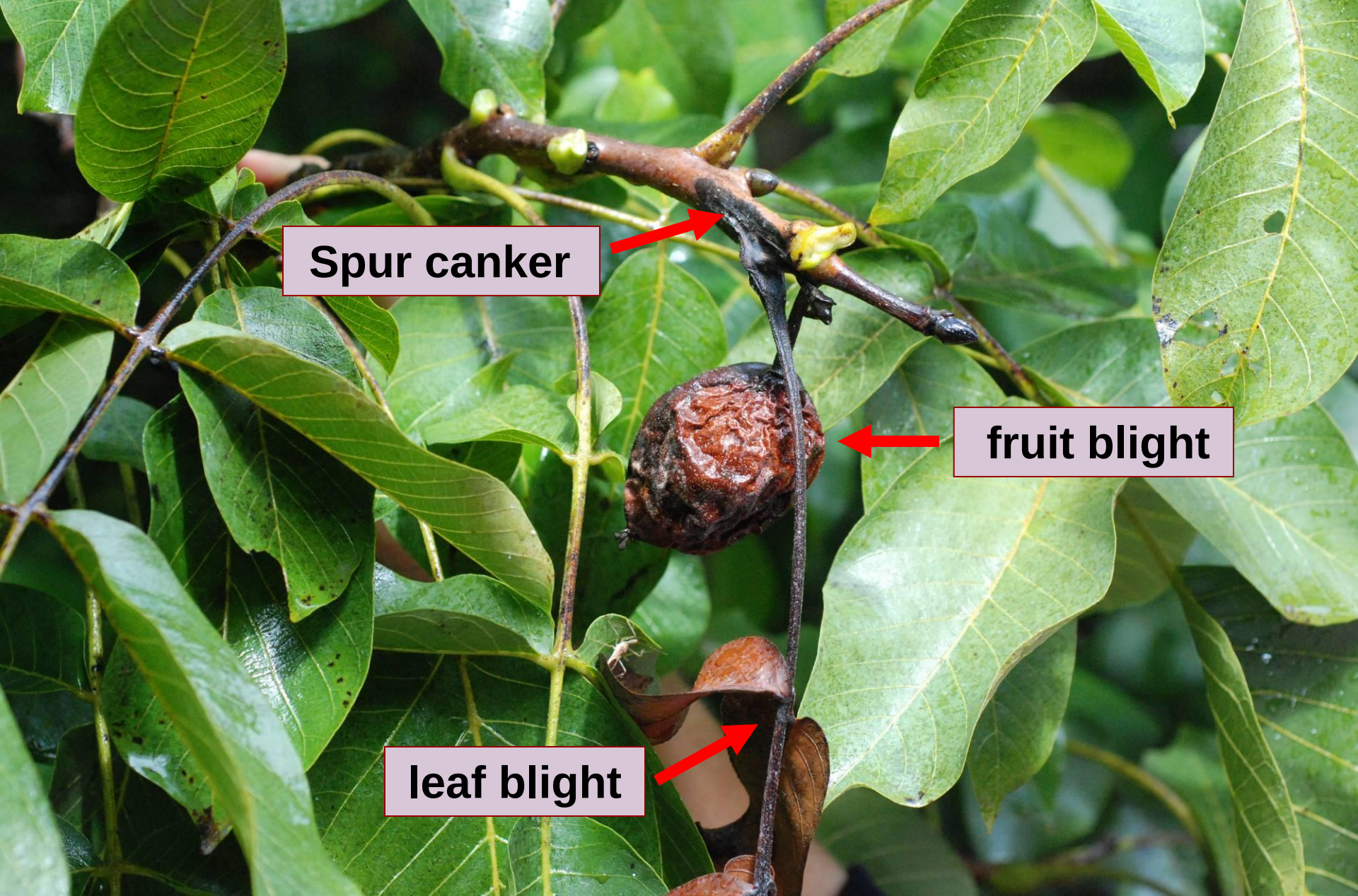


Botryosphaeria panicle and shoot blight of pistachio

Very devastating disease







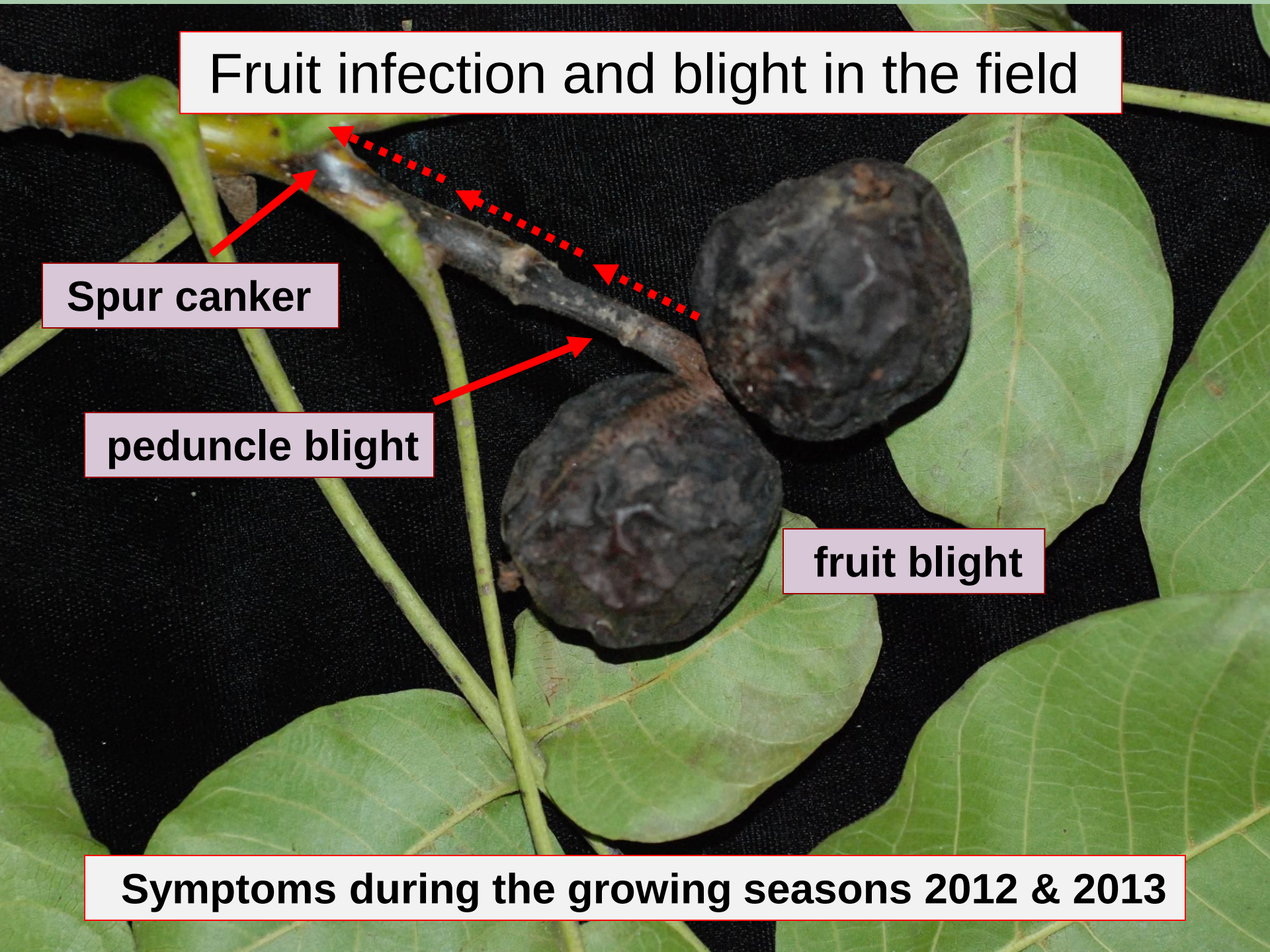
Spur canker

fruit blight

leaf blight

Botryosphaeria blight

Fruit infection and blight in the field



Spur canker

peduncle blight

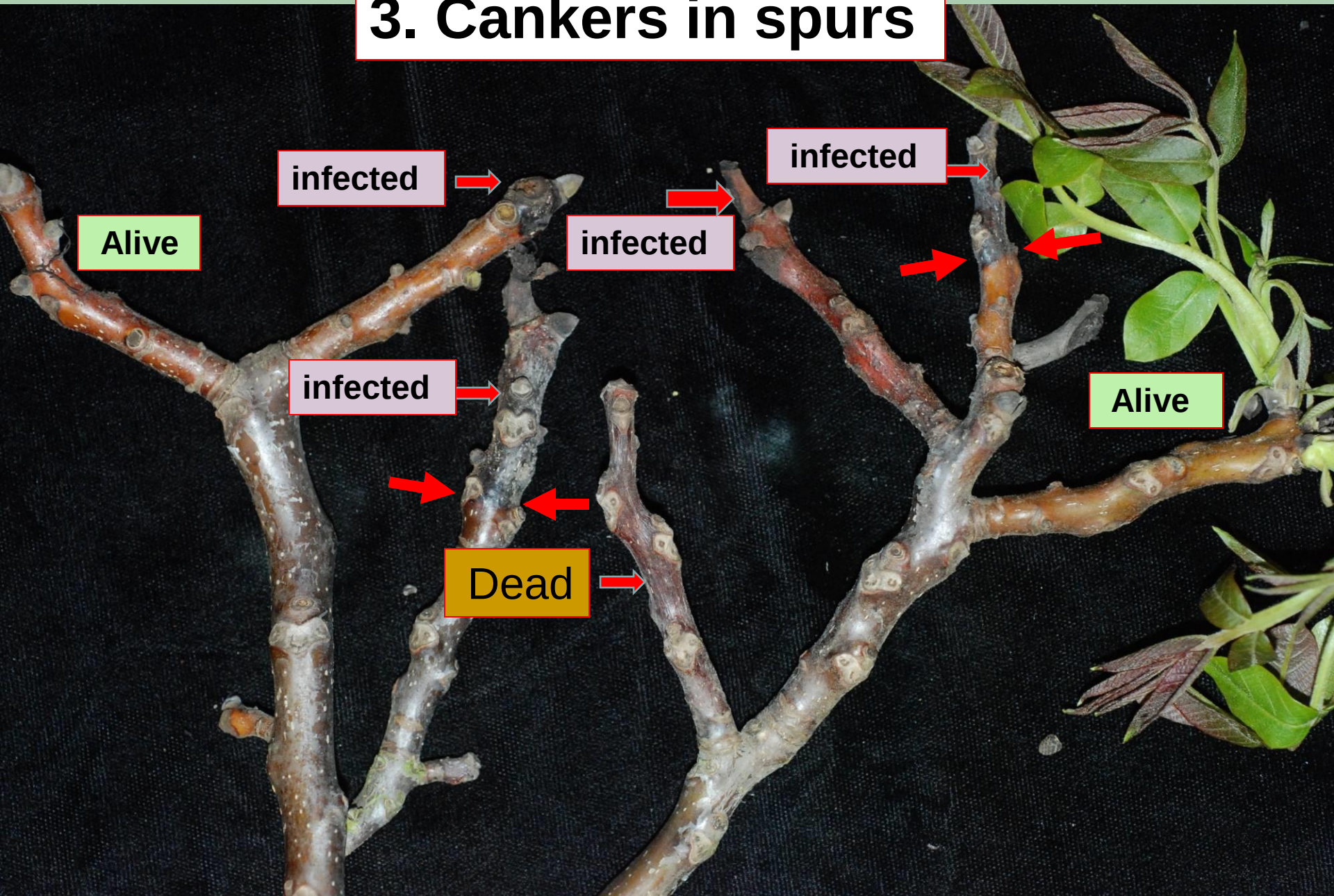
fruit blight

Symptoms during the growing seasons 2012 & 2013

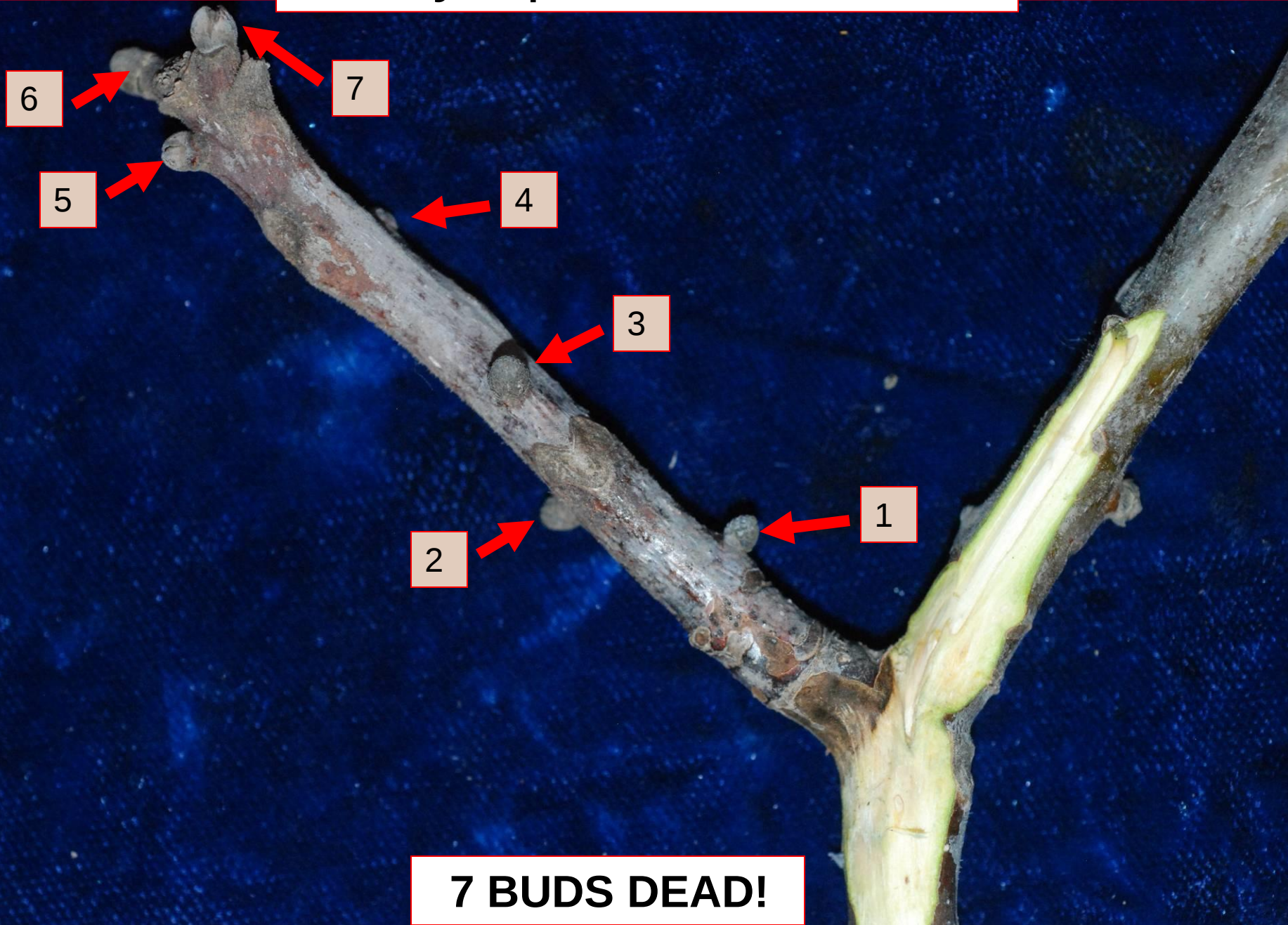


Botryosphaeria fruit blight: Notice **peduncles attached!**

3. Cankers in spurs

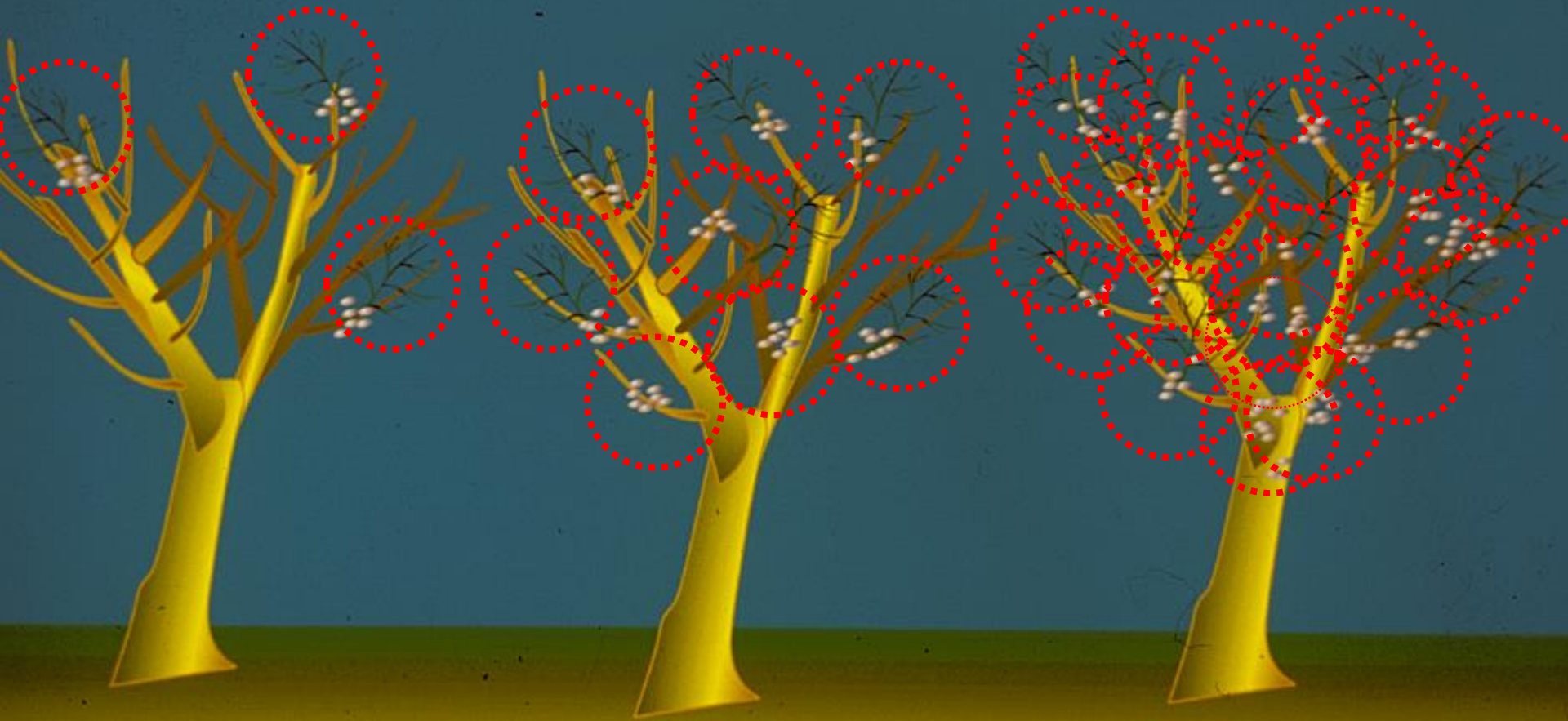


Botryosphaeria kills buds

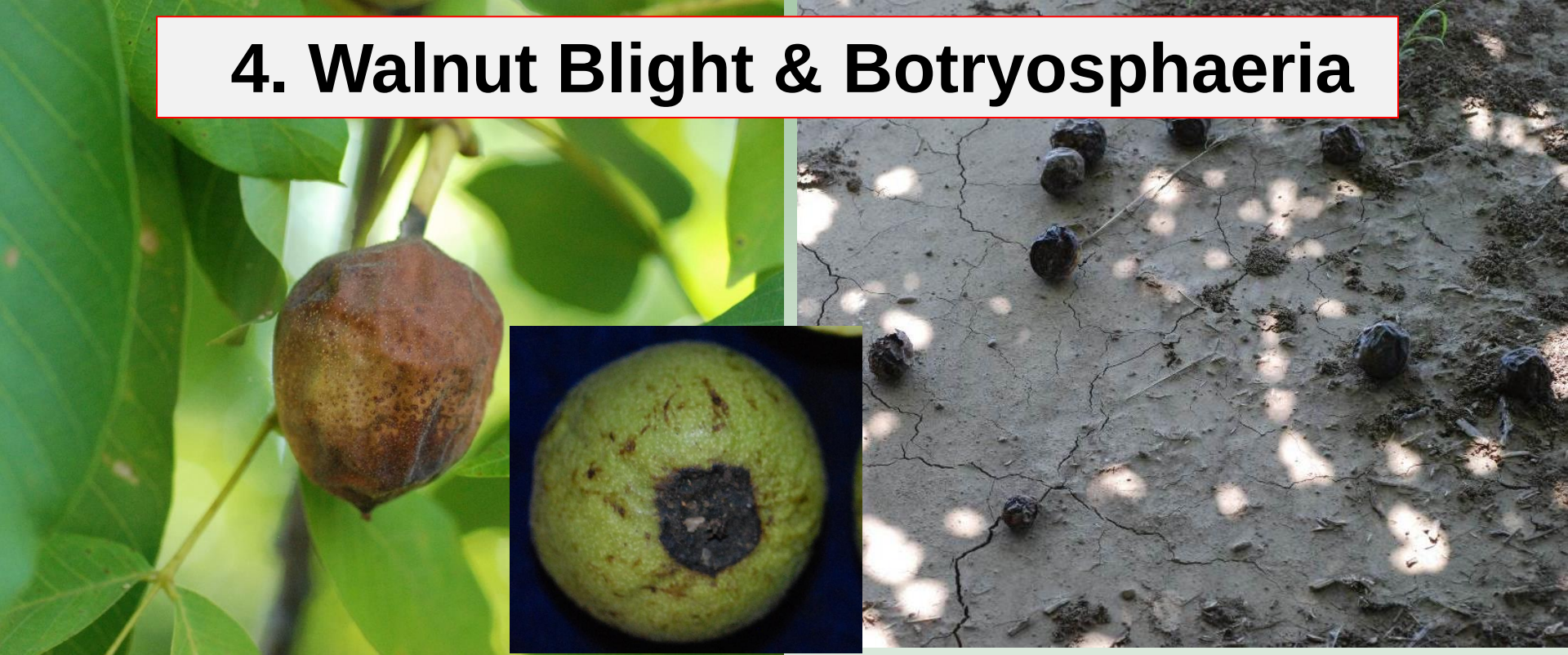


7 BUDS DEAD!

Inoculum Build-up

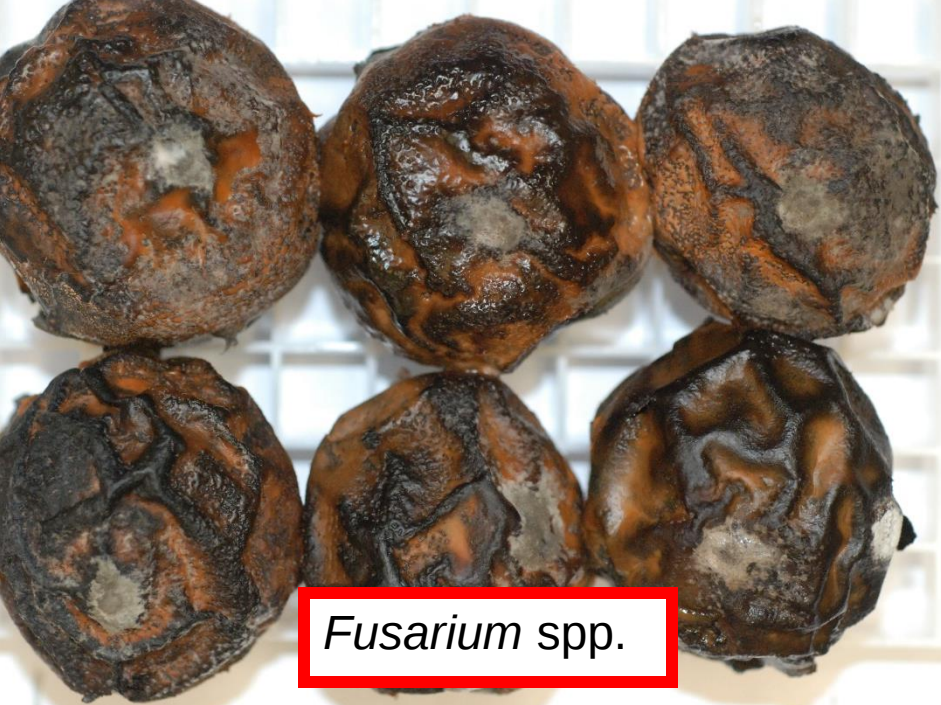


4. Walnut Blight & Botryosphaeria



Botryosphaeria

Phomopsis



Fusarium spp.



Alternaria alternata



Gloeosporium.



Colletotrichum acutatum

Incidence of fungal pathogens isolated from blighted walnuts fruit collected from trees

Orchard	Collection	Walnut blight (%)	Botryosph. /Phom (%)	Other fungi (%)
1	Tree	+20	10	<i>Botryosphaeria</i>
2	Tree	+10	10	<i>Phomopsis</i>
3	Tree	+10	20	<i>Fusarium</i>
4	Tree	+20	30	<i>Alternaria</i>
5	Tree	—	50	<i>Gloeosporium</i>
6	Tree	—	0	<i>Aspergillus niger</i>
7	Tree	+	0	<i>Epicoccum</i>
				<i>Colletotrichum</i>

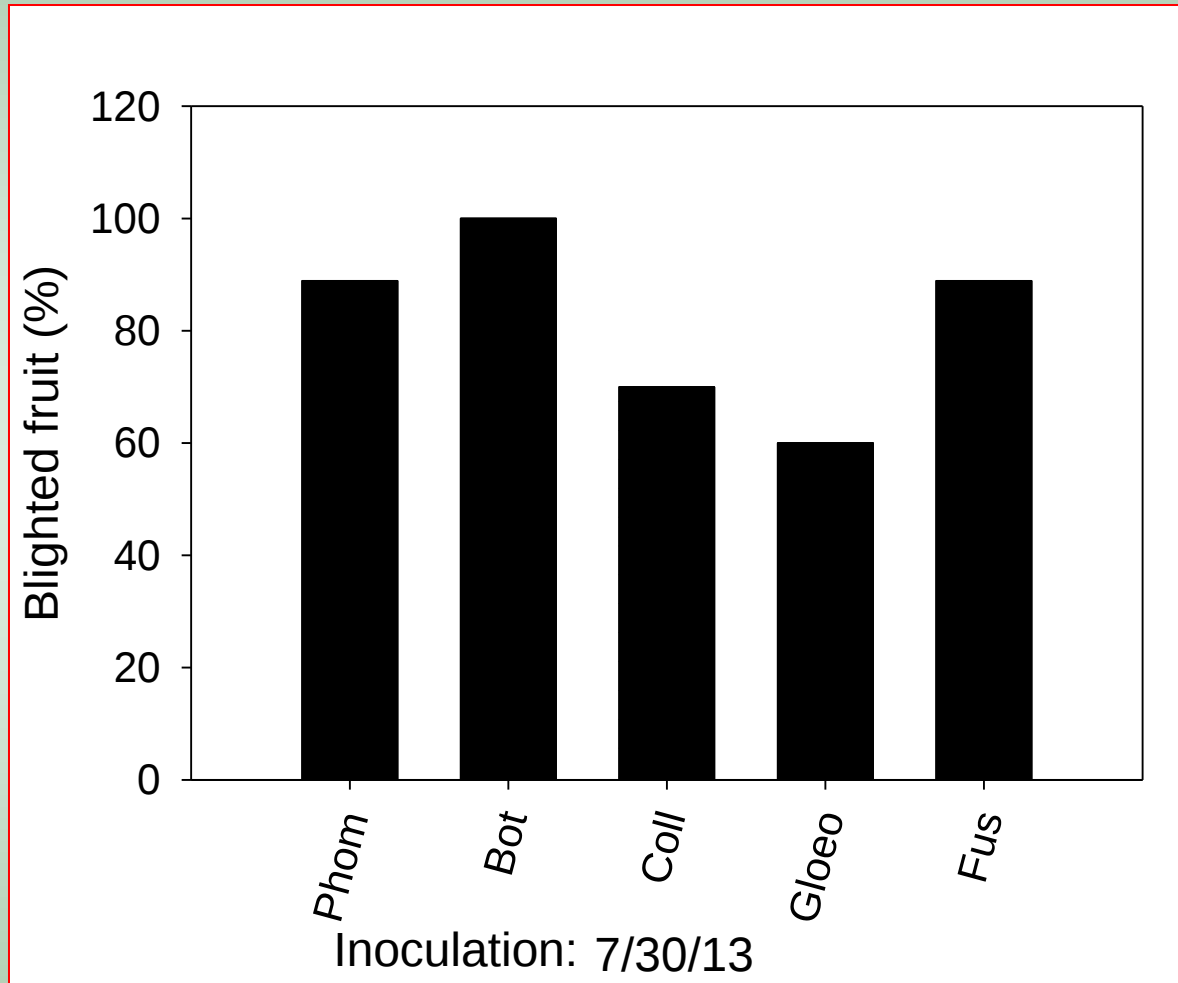
Is walnut blight an entry for *Botryosphaeria* infections?

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

Orchard	Collection	Walnut blight	Botryosph. /Phom (%)	Fusarium (%)
1	Tree	+	20	<i>Botryosphaeria</i>
2	Tree	–	12	<i>Phomopsis</i>
3	Tree	+	11	<i>Fusarium</i>
4	Tree	ND	80	<i>Alternaria</i>
				<i>Gloeosporium</i>
				<i>Aspergillus niger</i>
1	Ground	+	67	<i>Epicoccum</i>
				<i>Colletotrichum</i>

The association of **walnut blight** with **Botryosphaeria** & **other fungi** needs to be studied in detail...

Inoculation of walnut fruit with various fungi recovered from walnuts

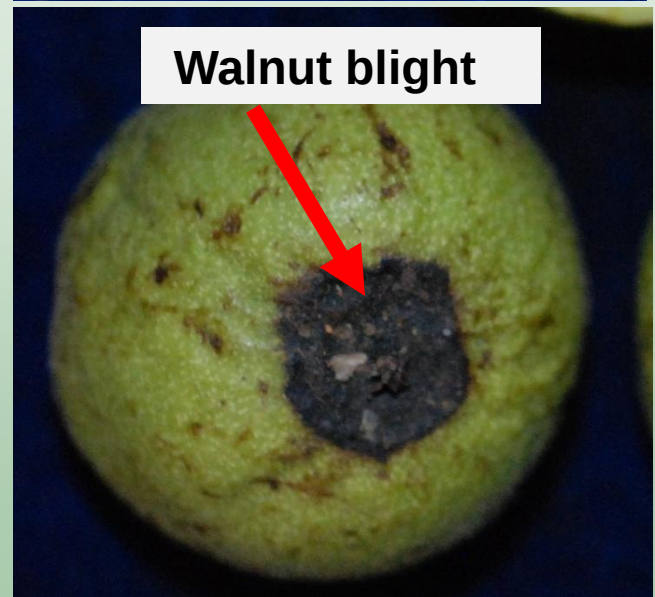


Phom = *Phomopsis* sp. ; Bot = *Botryosphaeria* ; Coll = *Colletotrichum acutatum*;
Gloeo = *Gloeosporium* sp.; Fus = *Fusarium* sp.

Brown Apical Necrosis



Walnut blight



5. Cankers associated with pruning wounds

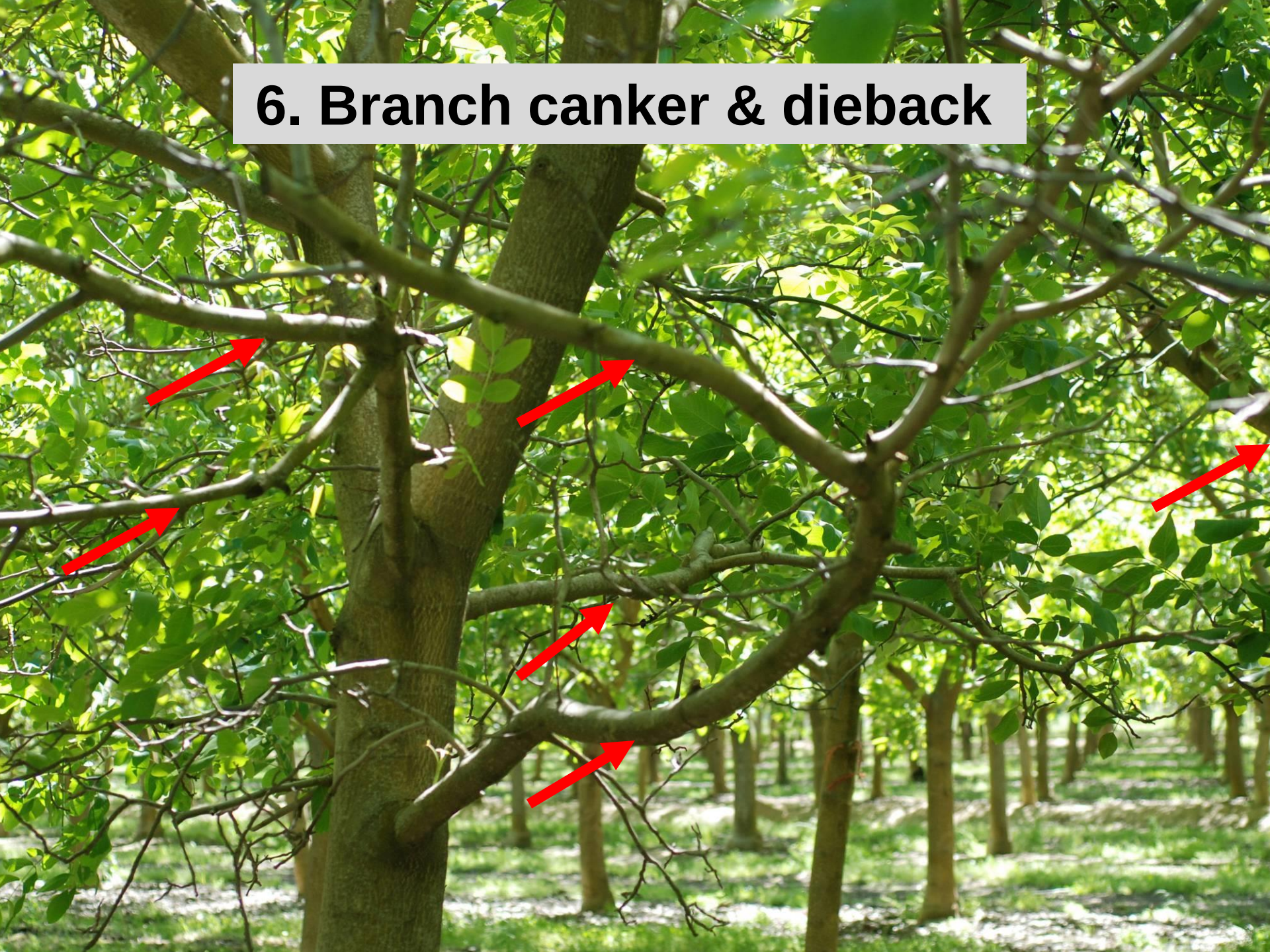




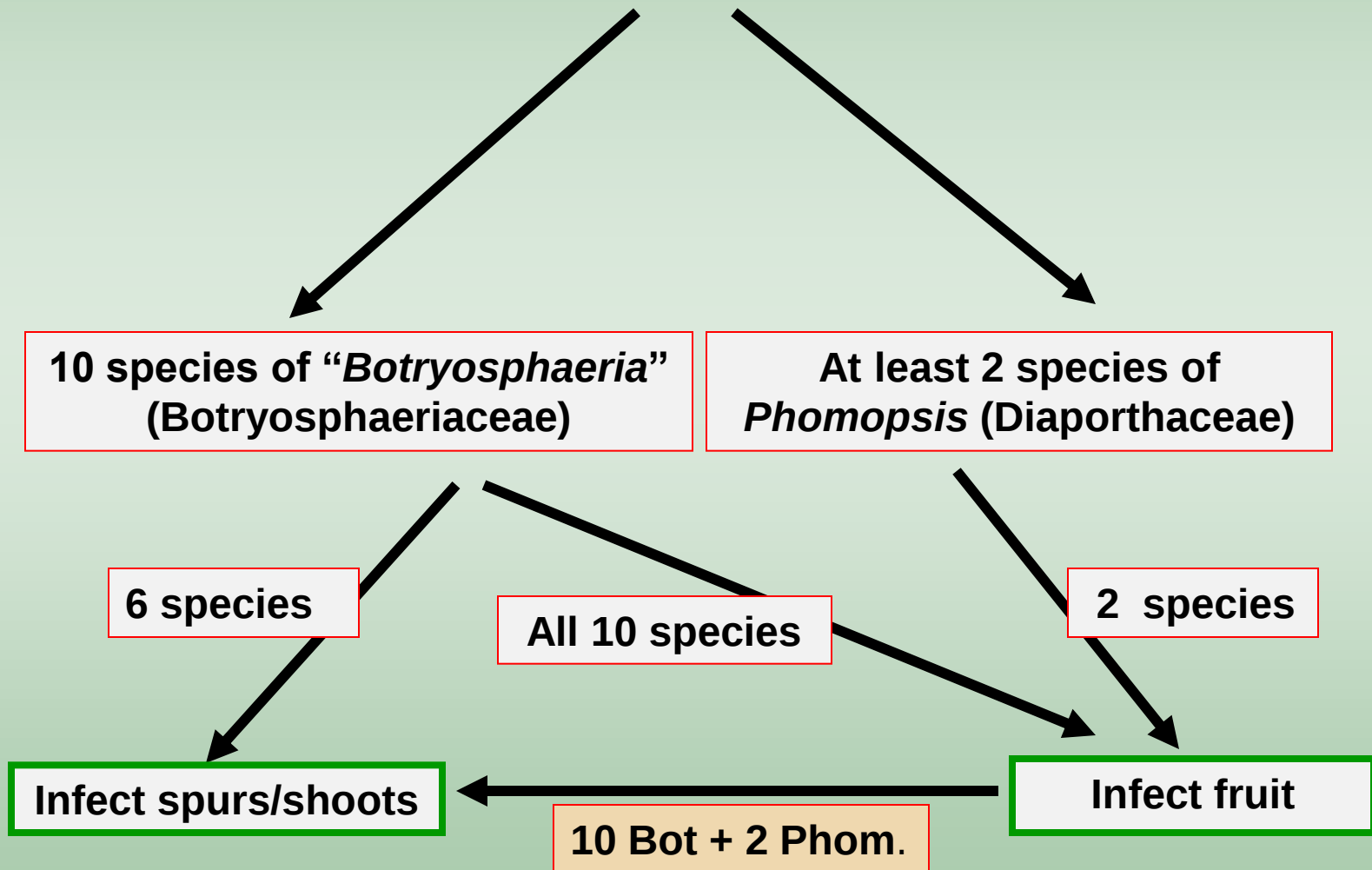
Cultivar: Howard

**Plenty of light; no shade;
however, a lot of dead
wood!**

6. Branch canker & dieback



The pathogens



FUNGAL SPECIES

Botryosphaeriaceae

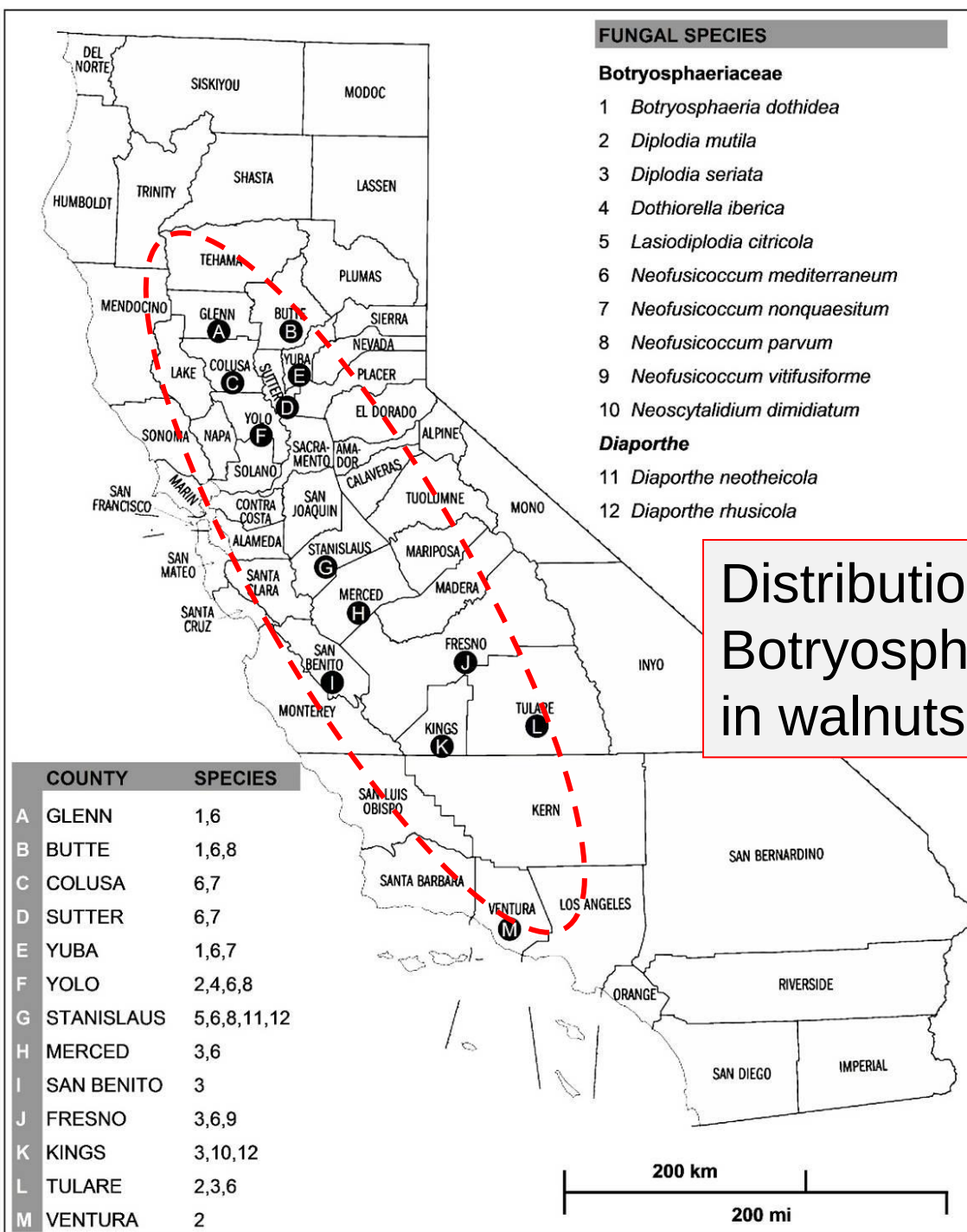
- 1 *Botryosphaeria dothidea*
- 2 *Diplodia mutila*
- 3 *Diplodia seriata*
- 4 *Dothiorella iberica*
- 5 *Lasiodiplodia citricola*
- 6 *Neofusicoccum mediterraneum*
- 7 *Neofusicoccum nonquaesitum*
- 8 *Neofusicoccum parvum*
- 9 *Neofusicoccum vitifusiforme*
- 10 *Neoscytalidium dimidiatum*

Diaporthe

- 11 *Diaporthe neotheicola*
- 12 *Diaporthe rhusicola*

Distribution of
Botryosphaeriaceae
in walnuts

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



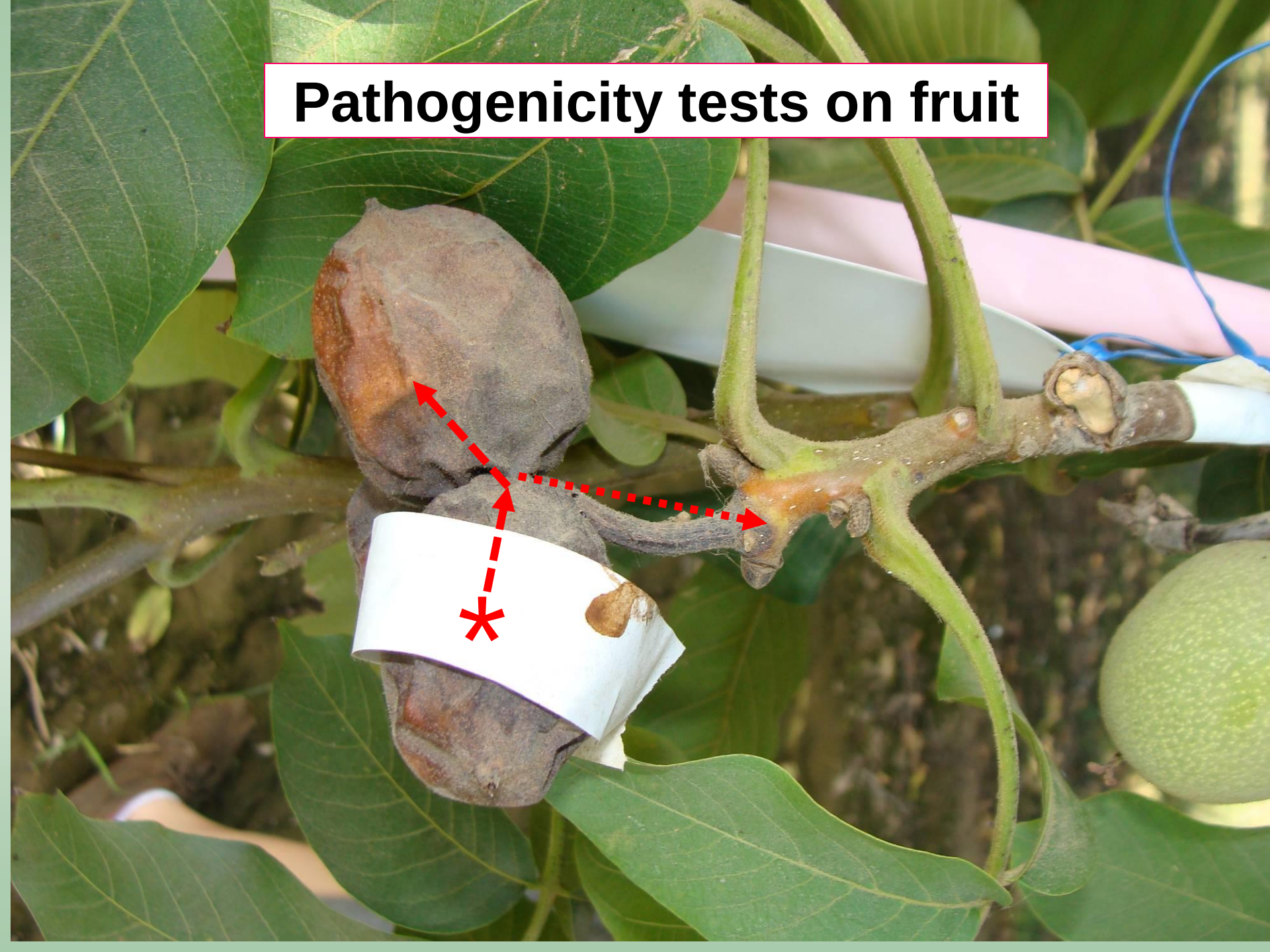
Pathogenicity tests on shoots

inoculation



Lasiodiplodia citricola inoculated on cultivar Vina after 3 weeks

Pathogenicity tests on fruit



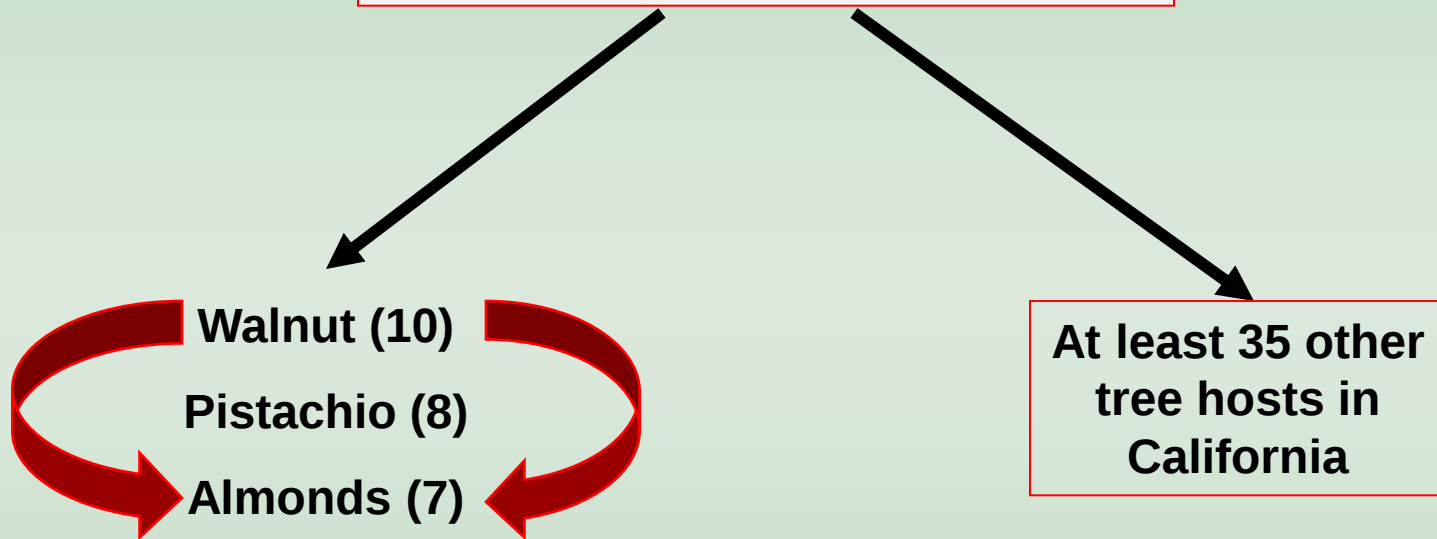
After artificial inoculation



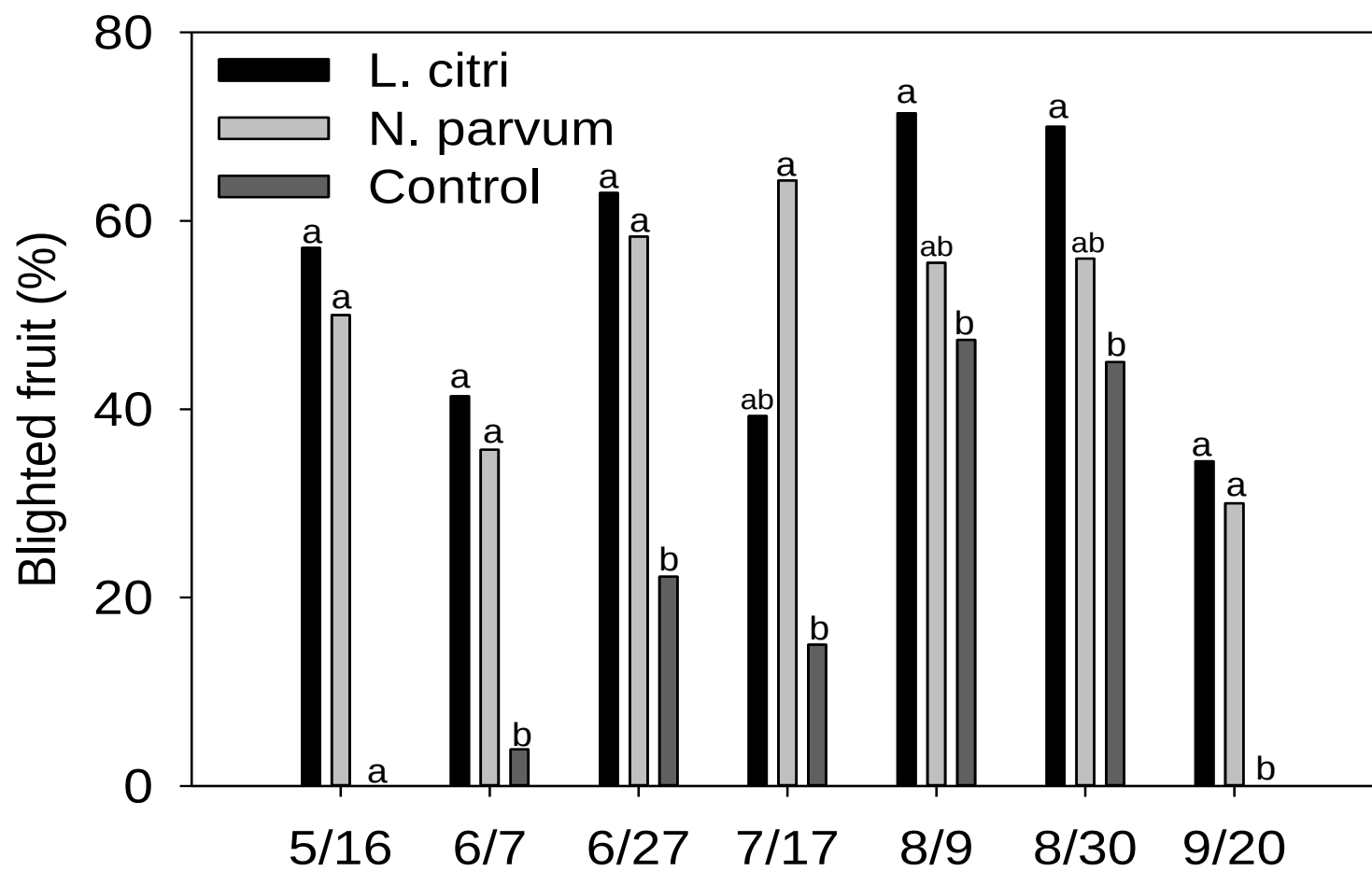
The pathogen

"BOTRYOSPHERA"

"PHOMOPSIS"



Periodic inoculations of walnut fruit with *Lasiodiplodia citricola* or *Neofusicoccum parvum* - 2013



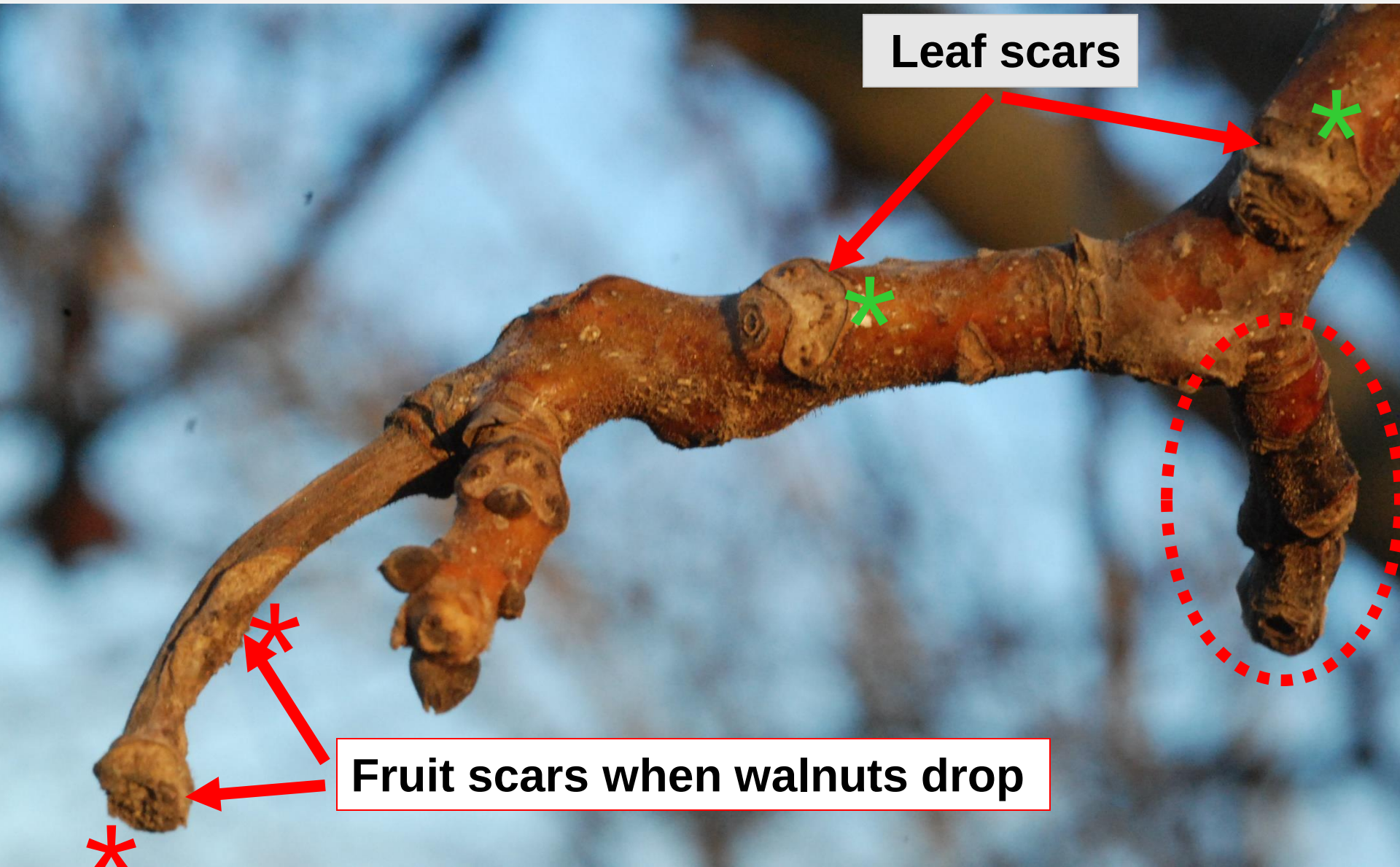
... after wounding...

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

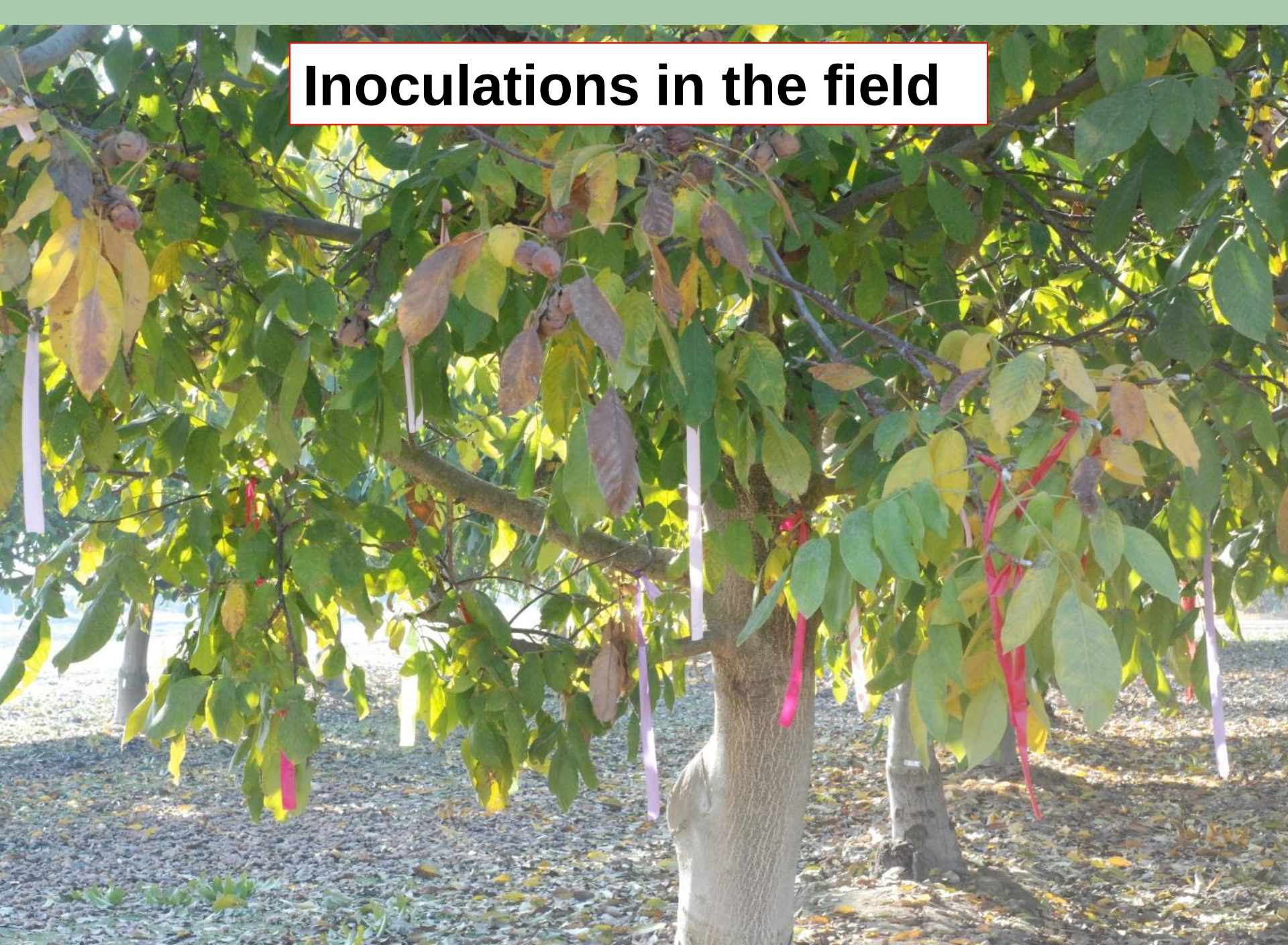
Orchard	Fruit collection from:	Walnut blight	Botryosph. /Phom (%)	Other fungi (%)
1	Tree	+	20	68
2	Tree	–	12	84
3	Tree	+	11	63
4	Tree	ND	80	20
1	Ground	+	67	100
4	Ground	–	50	75

It seems that walnut blight can serve as an entry for *Botryosphaeria* infections

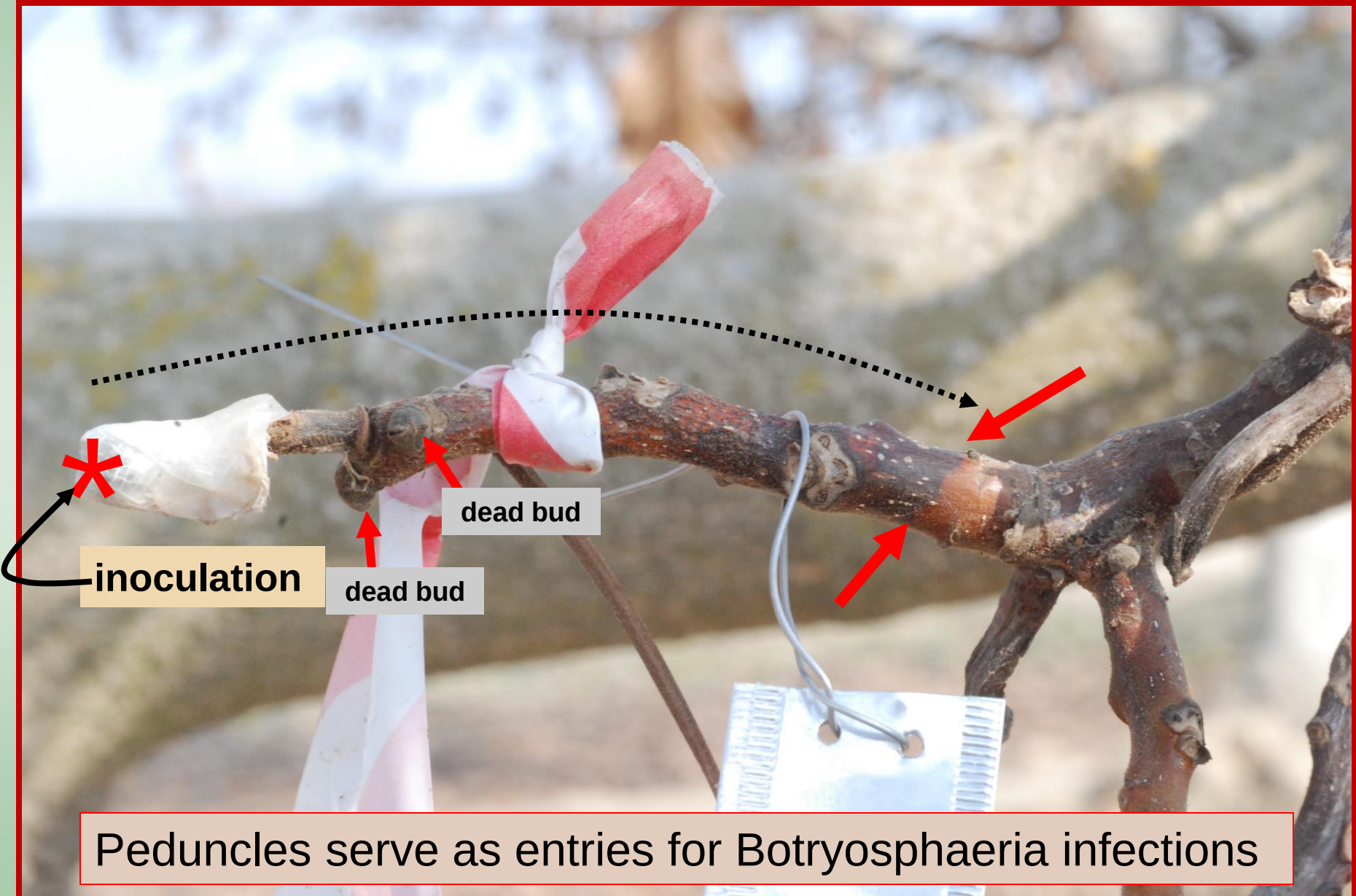
Natural wounds in the field during a) the season,
b) at harvest and c) postharvest



Inoculations in the field



Inoculation of peduncles with Botryosphaeria



Peduncles serve as entries for Botryosphaeria infections

Healthy peduncle



Infection of husks by Botryosphaeriaceae

Inoculation
of husks



Results of husk inoculations **in the field** will be recorded in April 2014

Effects of walnut scales on *Botryosphaeria*



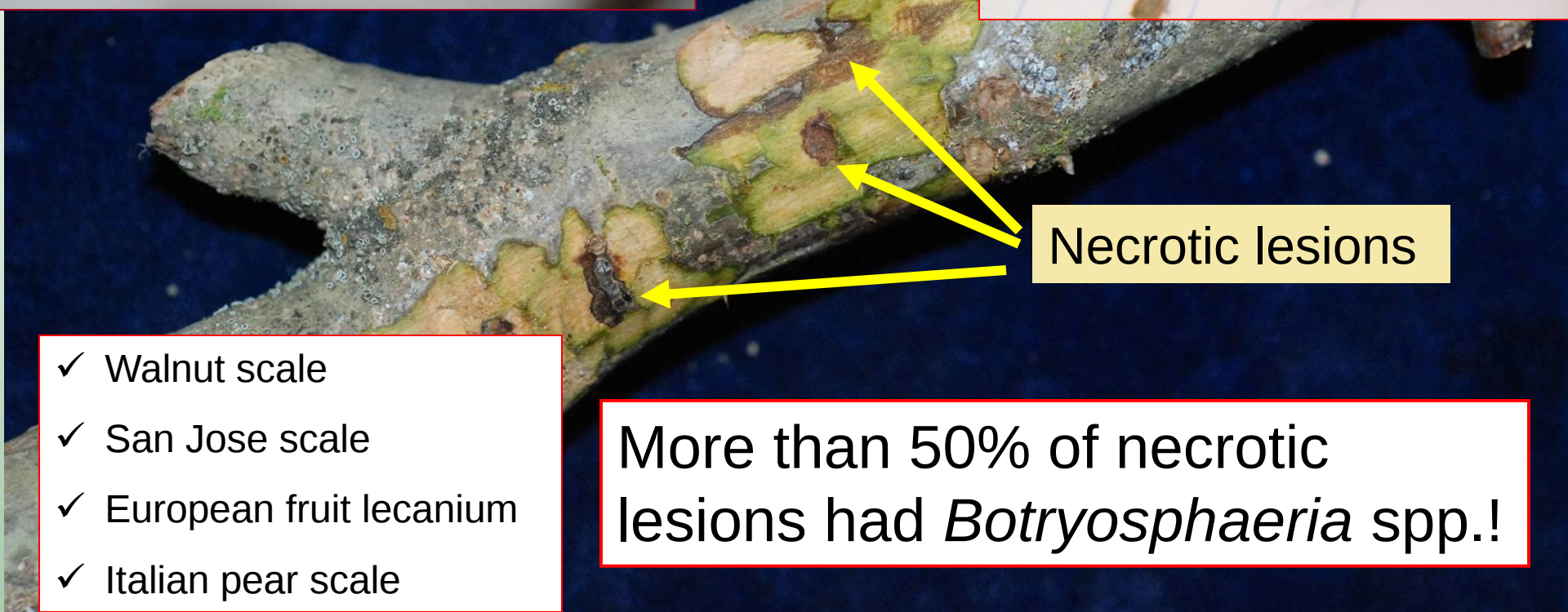
walnut scales

A close-up photograph of a dark brown, woody branch. The surface is covered with numerous small, light brown, oval-shaped scales. A red arrow points from the text label to the scales.



Injuries from scales

A photograph of a green, woody branch. The surface shows several small, dark, irregular lesions. A red arrow points from the text label to these lesions.



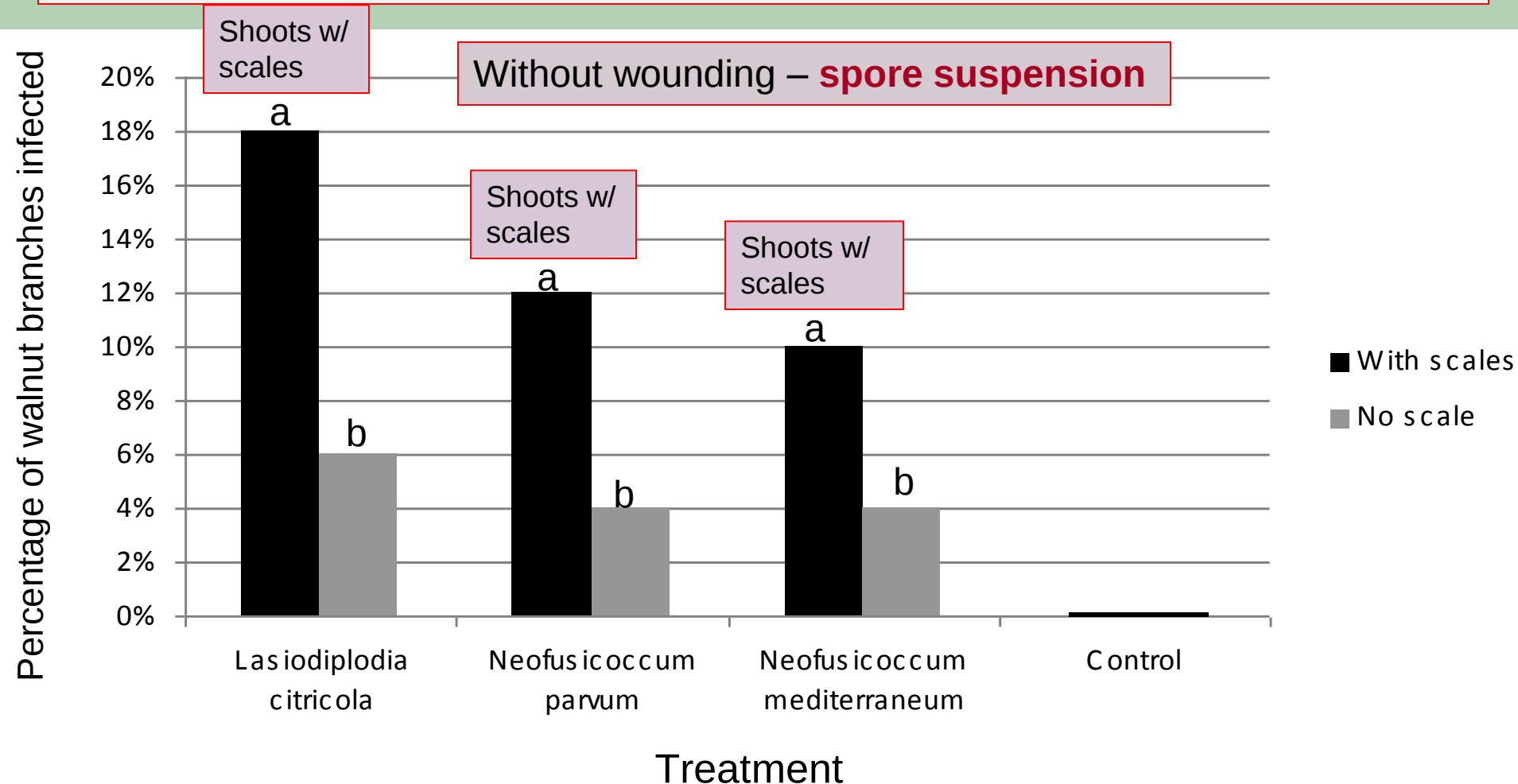
Necrotic lesions

A photograph of a branch with a large, irregular, necrotic lesion. The lesion is light brown and shows signs of decay. Three yellow arrows point from the text label to different parts of the lesion.

- ✓ Walnut scale
- ✓ San Jose scale
- ✓ European fruit lecanium
- ✓ Italian pear scale

More than 50% of necrotic lesions had *Botryosphaeria* spp.!

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

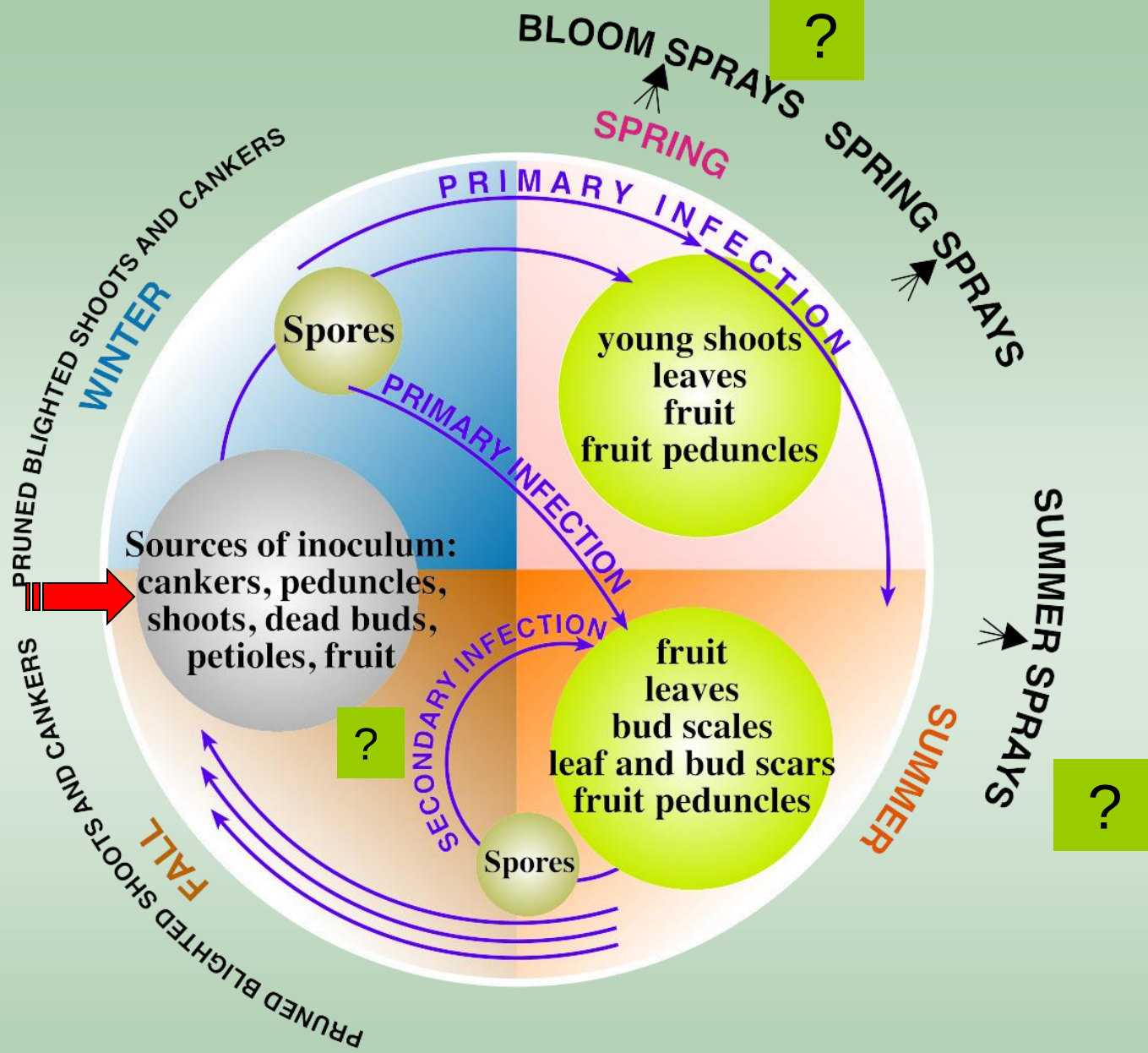


✓ 60-75% more shoots were infected when scales were present than when scales were not present

Infection Courts of *Botryosphaeria* and *Phomopsis*

- ✓ **Fruit** scars
- ✓ **Peduncle** scars
- ✓ **Leaf** scars
- ✓ **Pruning** wounds
- ✓ **Any** wounds
- ✓ **Walnut blight** lesions
- ✓ **Scale** injuries

Management of Botryosphaeria and Phomopsis blight and canker



Botryosphaeria/Phomopsis blight & canker disease cycle & management



Sanitation by pruning

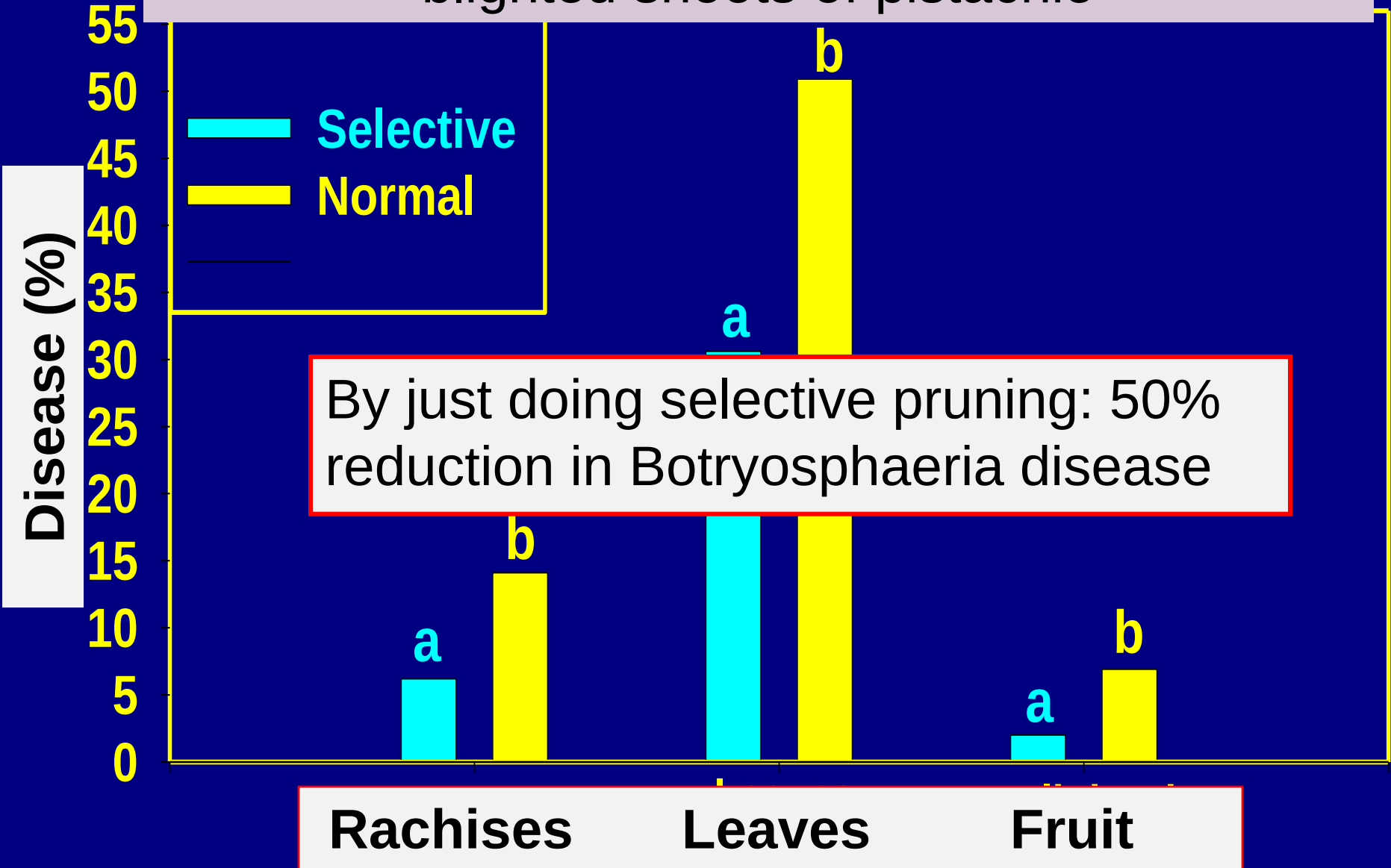
Disinfectants for pruning equipment:

Clorox, 1:10 dilution

Lysol, 1:10 dilution

Pine sol, 1:10 dilution

Selective pruning of Botryosphaeria cankers & blighted shoots of pistachio



Walnut Prunings

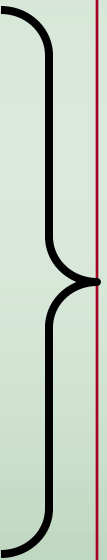
- ✓ *Botryosphaeria* can survive in shredded pruning for 1.5 years (i. e. pistachio)
- ✓ Not known how long Bot/Phomopsis can survive in walnut prunings (suspect shorter time...softer wood?)
- ✓ Better to remove (or burn) the prunings because the walnut *Botryosphaeria* has also airborne spores

Best Control by Intergrading Cultural and Chemical Control Practices

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

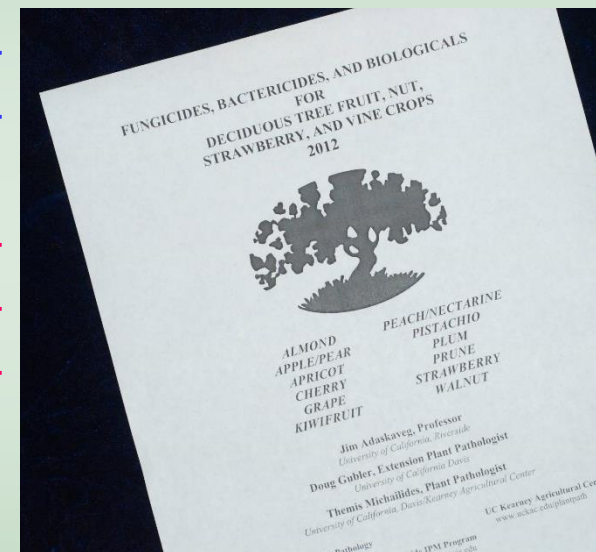
+

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



Fungicides registered for Botryosphaeria blight in pistachio

Fungicide	Active ingredient	Efficacy
Adament.....	trifloxystrobin+tebuconazole	+++
Abound	azoxystrobin	++++
Bravo.....	chlorothalonil	++
Bumper/Tilt.....	propiconazole	++
Cabrio.....	pyraclostrobin	++++
Gem	trifloxystrobin	++++
Quash.....	metconazole	+++
Inspire Super...	difenoconazole + cyprodinil	++++
Pristine	boscalid + pyraclostrobin	++++
Quilt-Xcel.....	azoxystrobin + propiconazole	++++
Scala.....	pyrimethanil	+++
Switch.....	cyprodinil + fludioxonil	++
Tebuzol.....	tebuconazole	+++
Topsin-M.....	thiophanate-methyl	++
Copper.....	copper	+/-
Luna Experience	fluopyram + tebuconazole	++++
Luna Sensation	fluopyram + trifloxystrobin	++++
Fontelis	penthiopyrad	++++



<http://www.ipm.ucdavis.edu>

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

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

On 25 October 2013 collected:

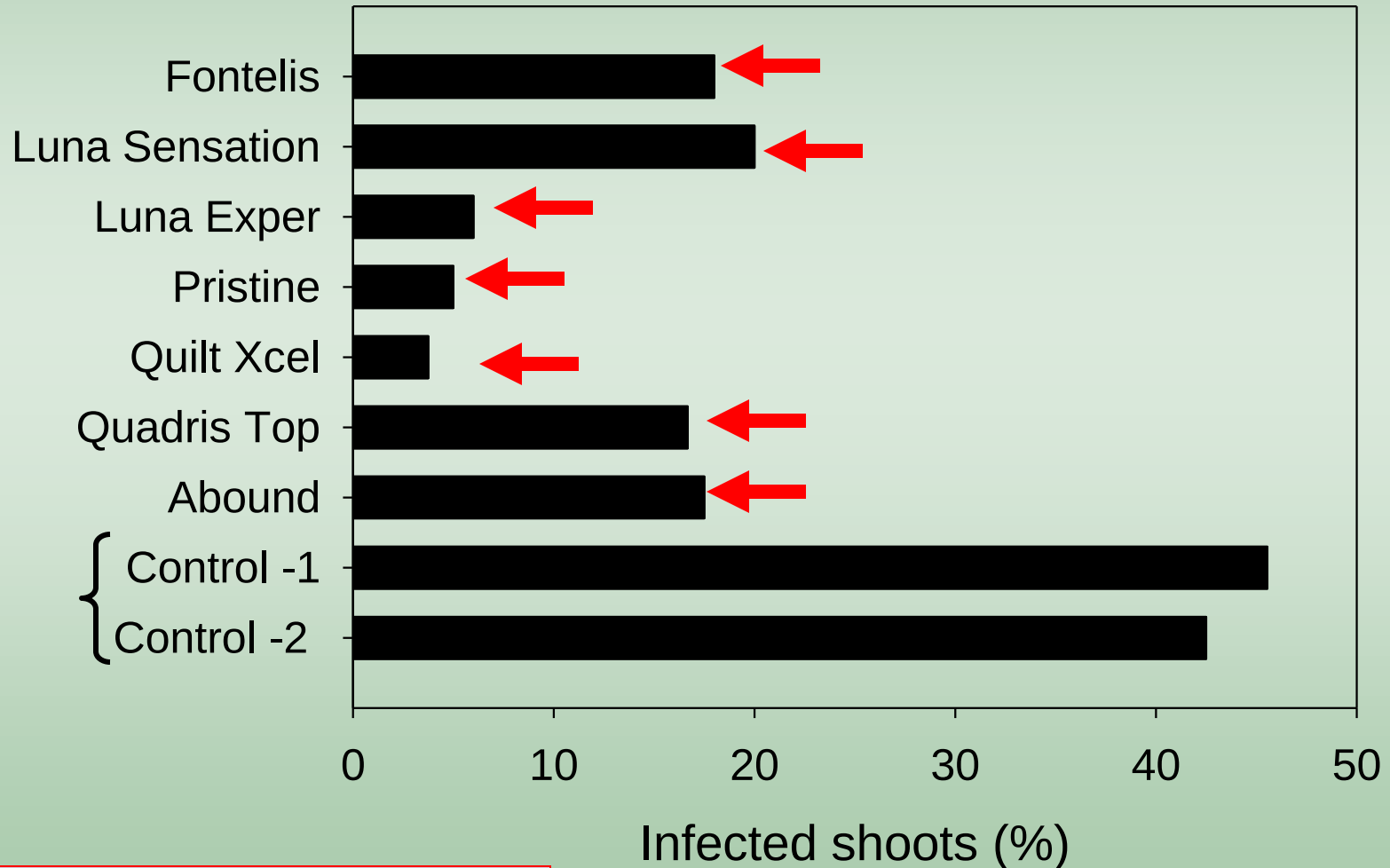
- peduncles
- current growth shoots

Partial infection of peduncles; some may be natural senescence

Infections that have moved from the peduncles into the sustaining shoot

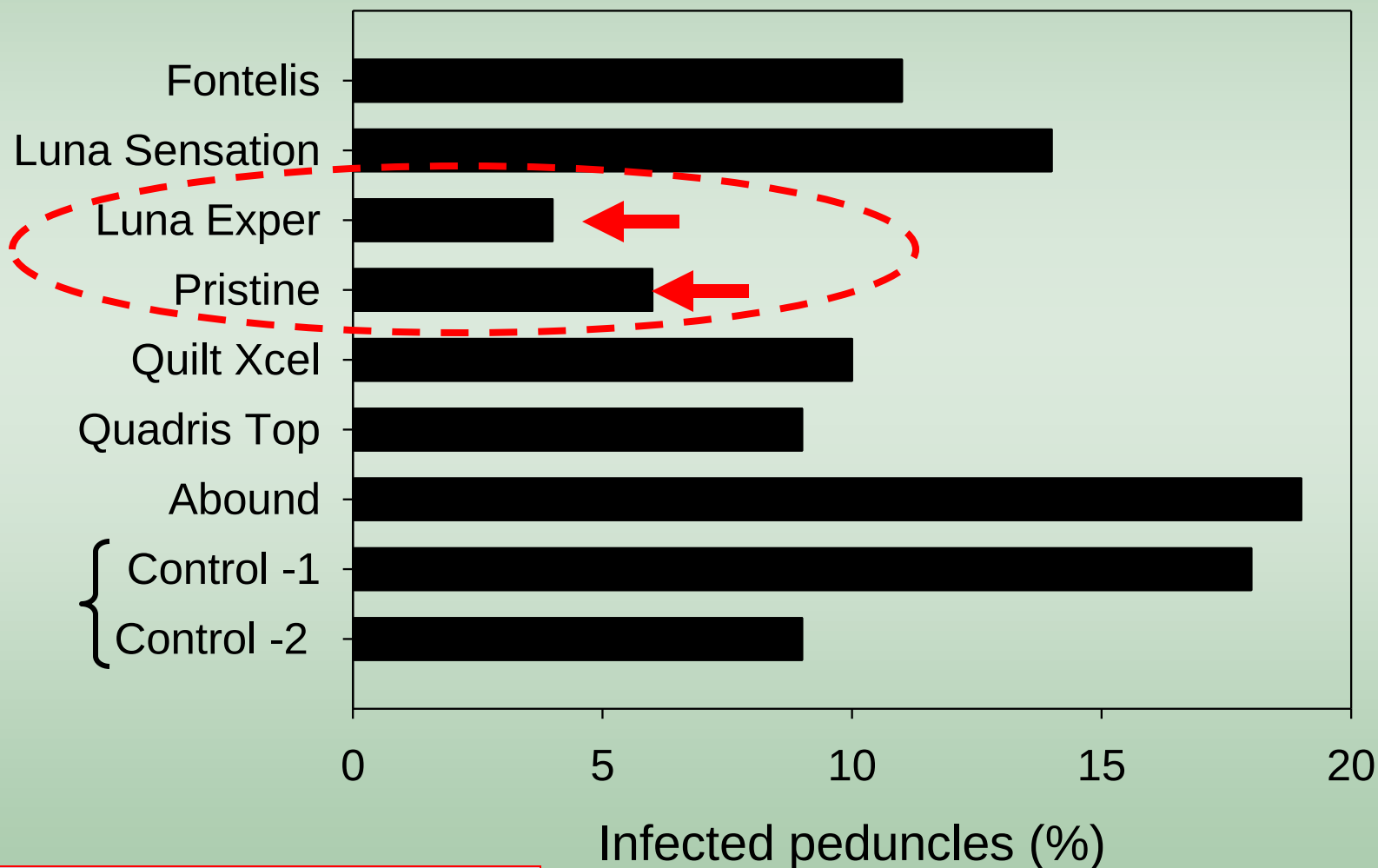


Effects of fungicides on Botryosphaeria in walnut **shoots** (Butte Co.; MM grower)



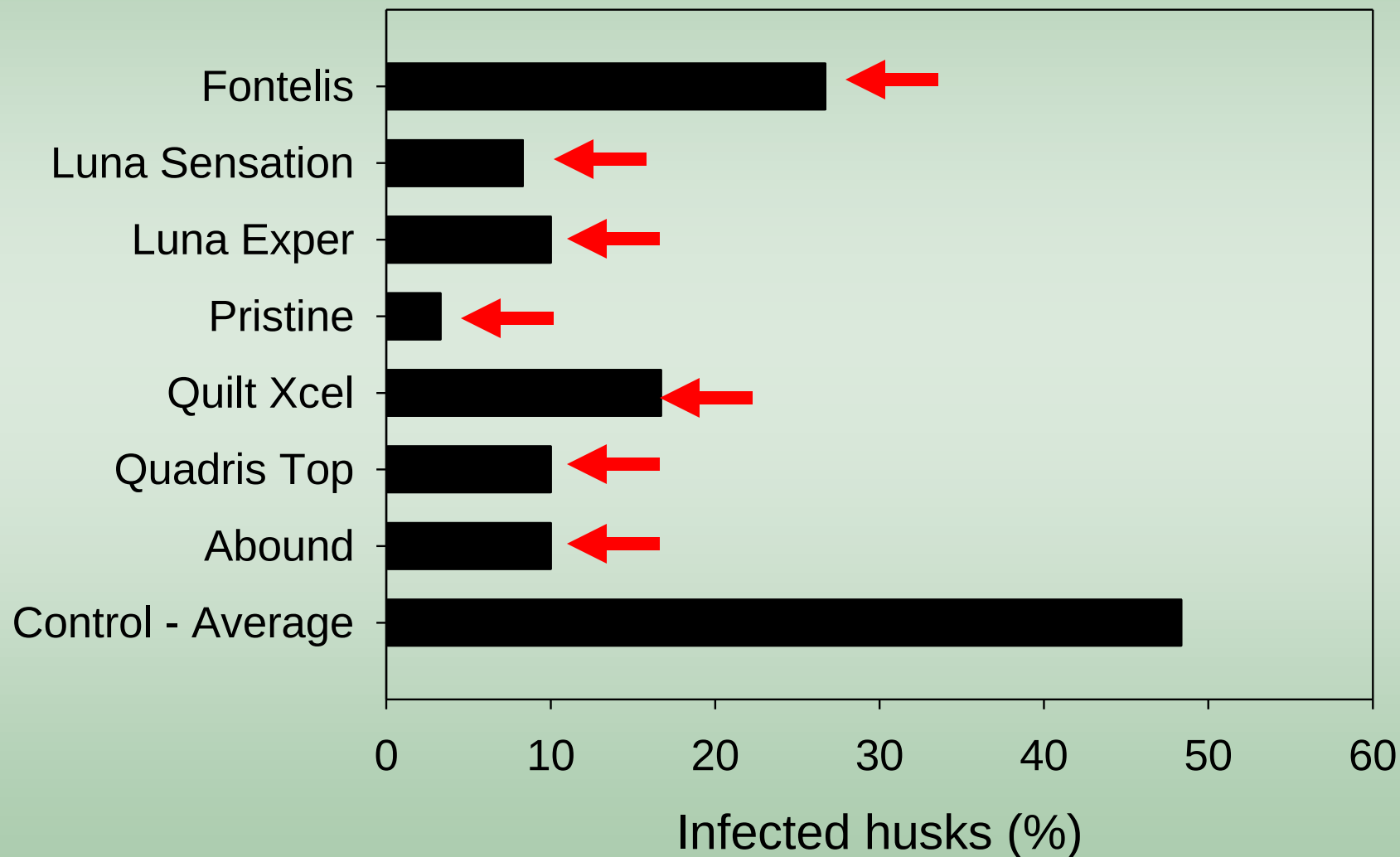
Spray dates: 17 May; mid June; & mid July

Effects of fungicides on Botryosphaeria in peduncles (Butte Co.; MM grower)

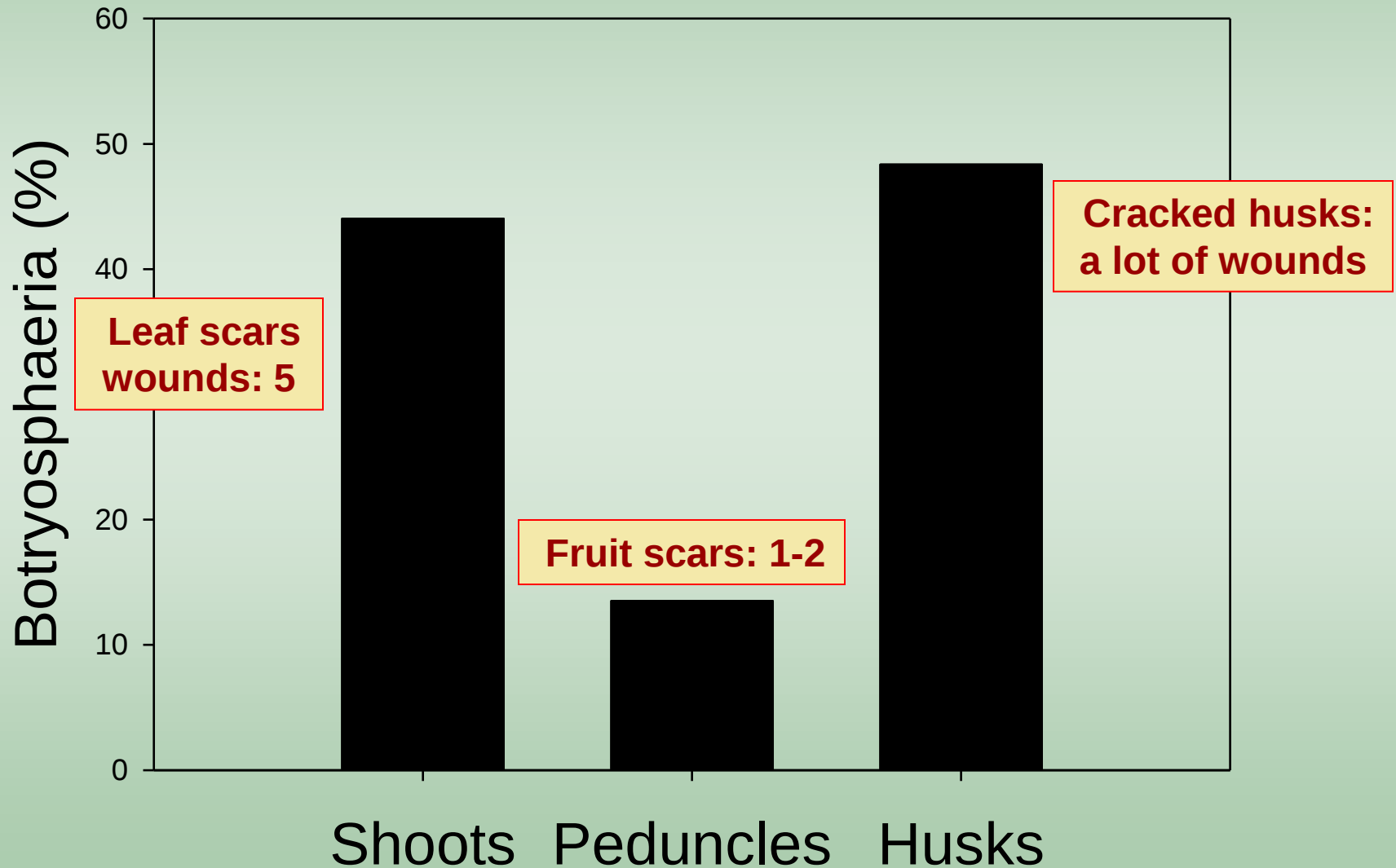


Spray dates: 17 May; mid June; & mid July

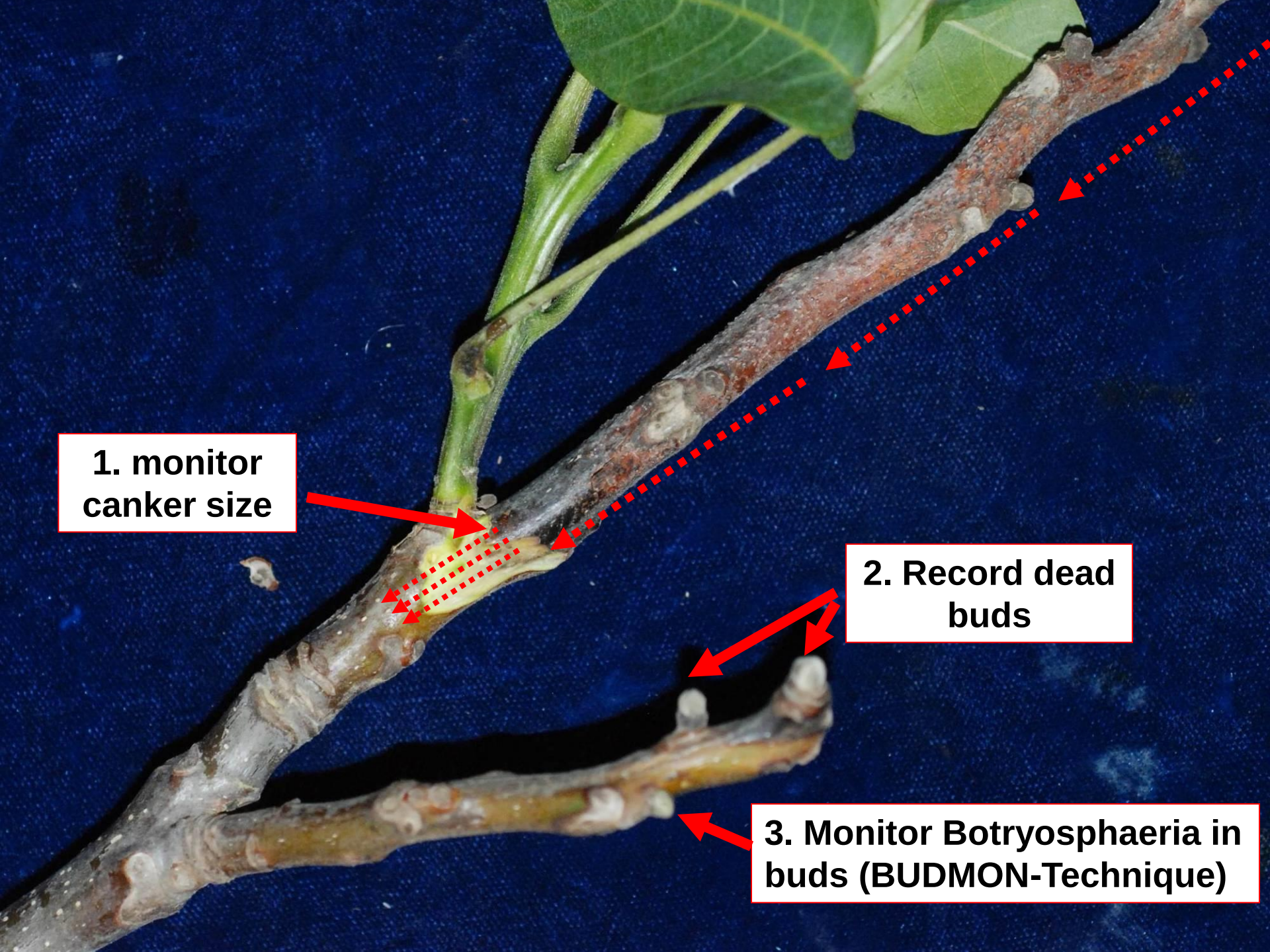
Effects of fungicides on Botryosphaeria in **husks** (Butte Co.; MM grower)



Botryosphaeria in untreated tissues (Butte Co.; MM grower)



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



**1. monitor
canker size**

**2. Record dead
buds**

**3. Monitor Botryosphaeria in
buds (BUDMON-Technique)**

CONCLUSIONS

- ✓ Multiple species of Botryosphaeriaceae and *Phomopsis* cause cankers and blights in walnut.
- ✓ Some of them are aggressive and infect shoots directly; all can infect walnut fruit; & all through the fruit can infect shoots.
- ✓ These plant pathogens produce both water-spread spores and spores spread by air.
- ✓ Infection courts include fruit, peduncle, and leaf scars, pruning wounds, lesions caused by walnut blight, injuries caused by scales, other types of injuries.

CONCLUSIONS

- ✓ Disease symptoms seem to develop later in season (harvest & postharvest).
- ✓ Some fungicides sprays during May through July seem to reduce Botryosphaeria infections.
- ✓ Future research: Emphasis on **latent infections on green fruit**, the **postharvest disease development**, and **disease management**.

Thank you



The Sleeping Giant