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

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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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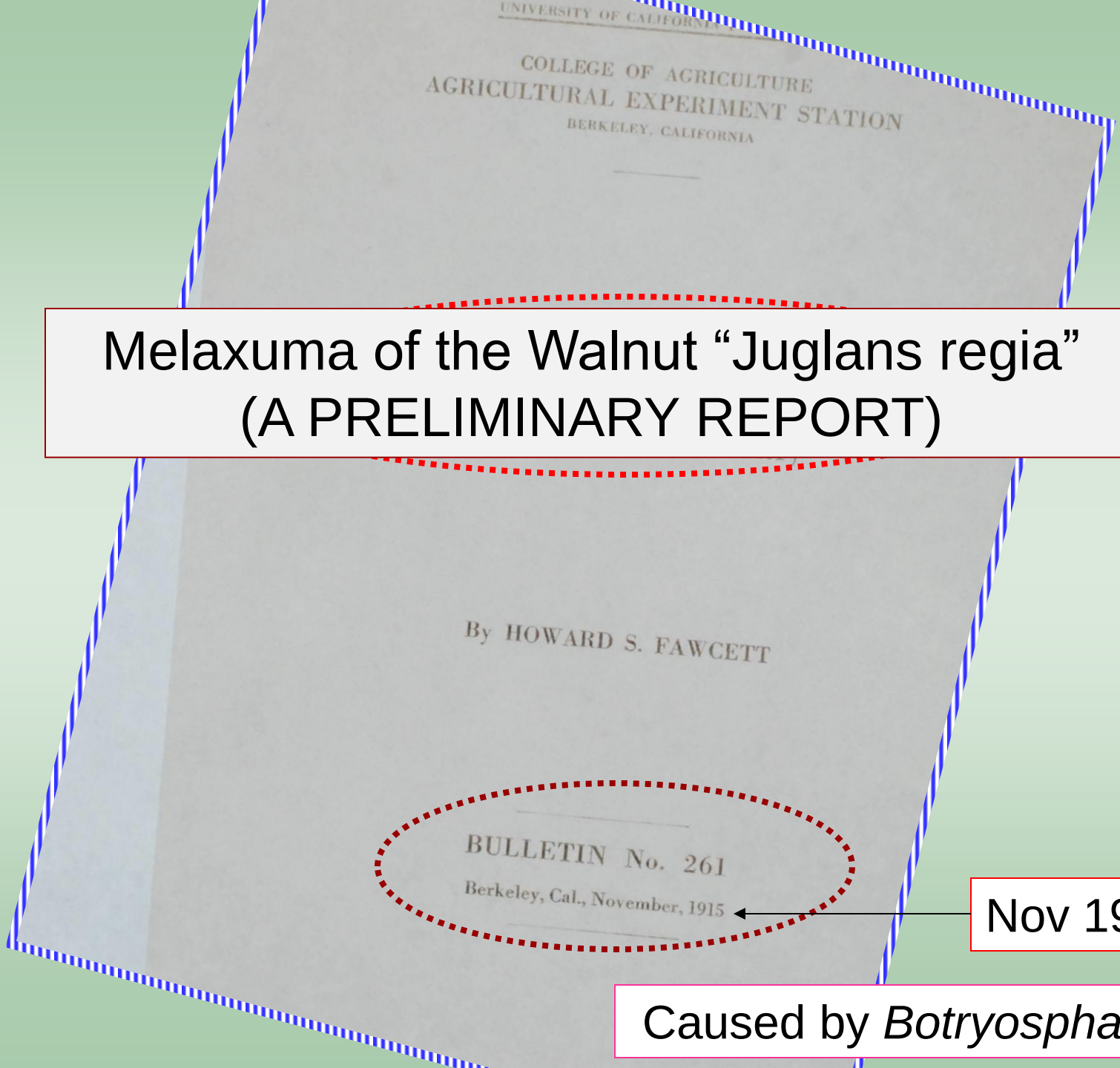


Melaxuma of the Walnut “Juglans regia” (A PRELIMINARY REPORT)

Nov 1915

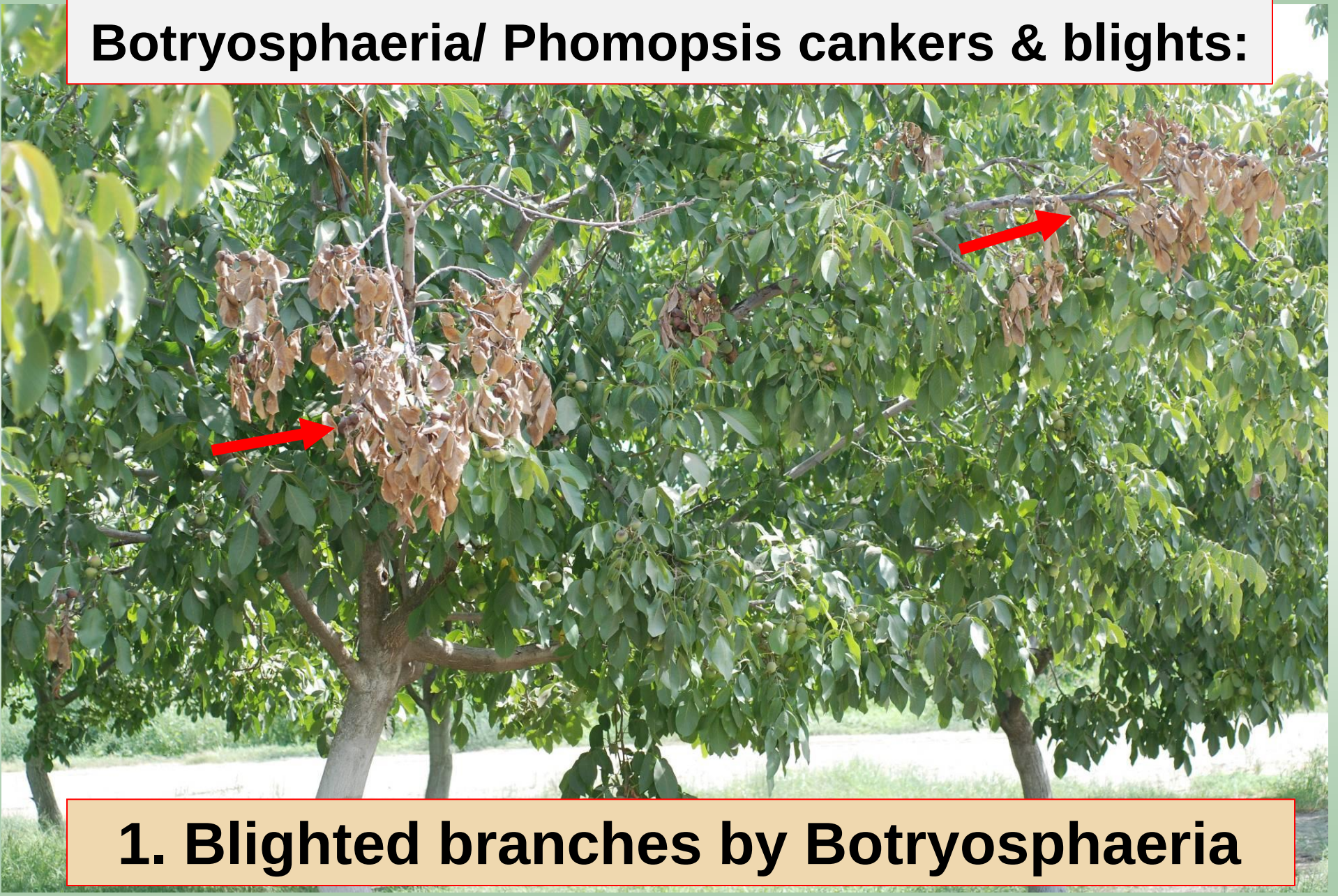
Caused by *Botryosphaeria ribis*


Are all these branch wilt?

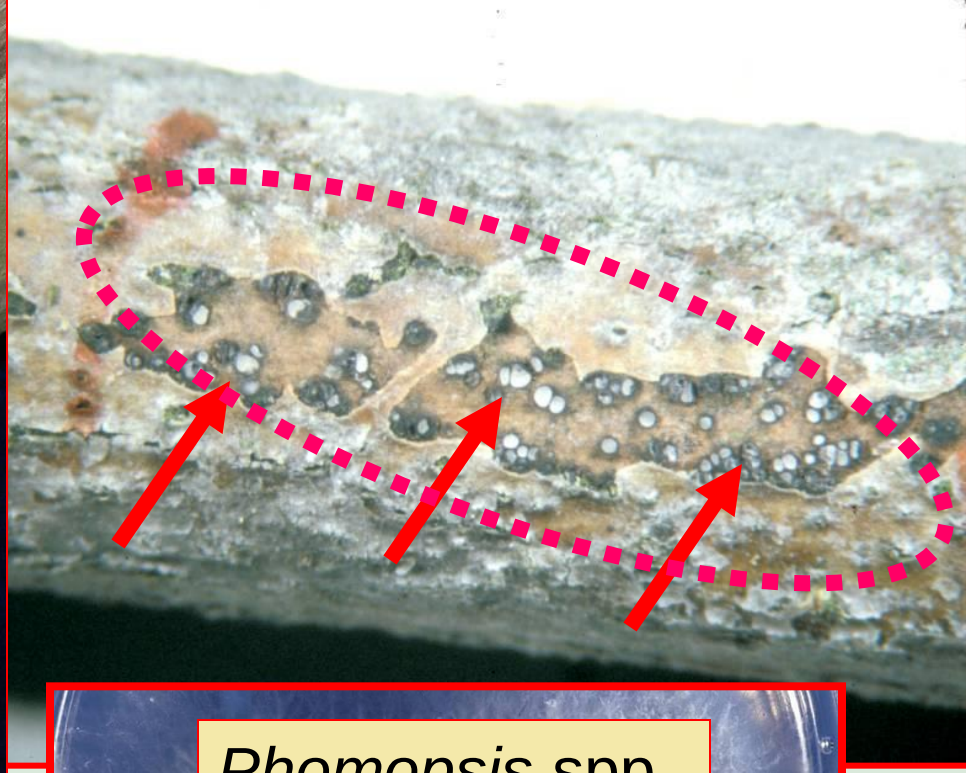
Branch wilt is caused by *Hendersonula toruloidea*

New name: *Neoscytalidium dimitiatum*

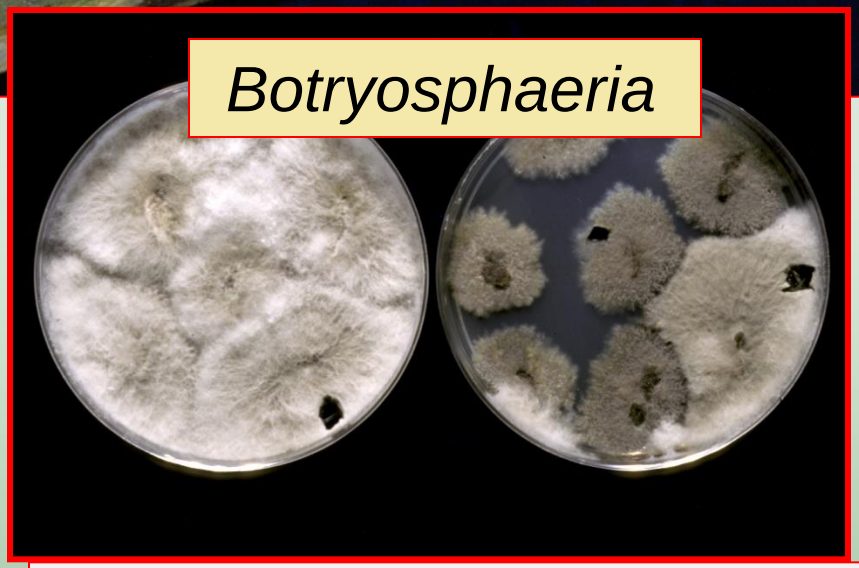
Six types of symptoms associated with Botryosphaeria/ Phomopsis cankers & blights:



1. Blighted branches by Botryosphaeria

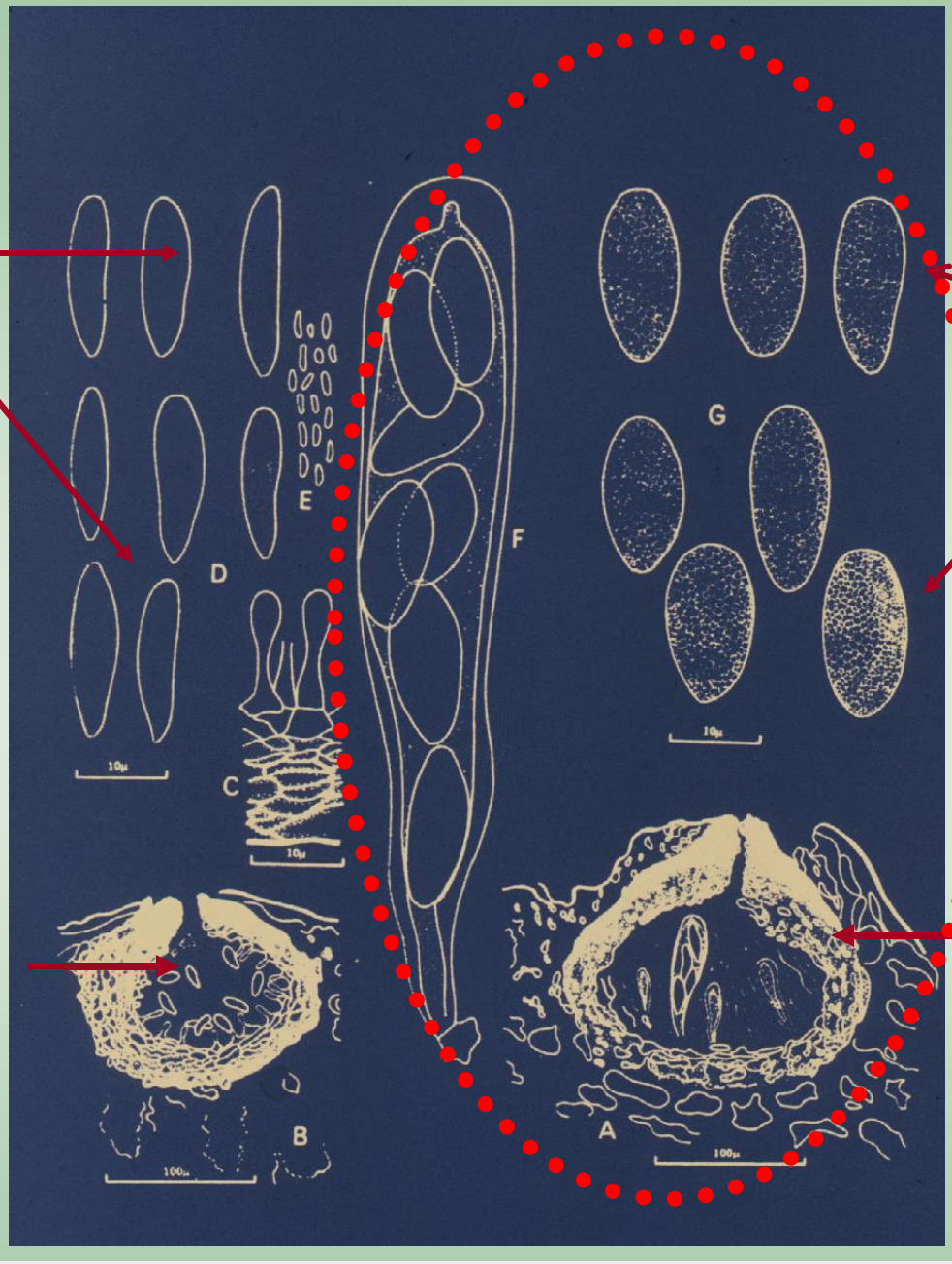


Botryosphaeria



Phomopsis spp.

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



conidia

✓water splashed

✓insect spread

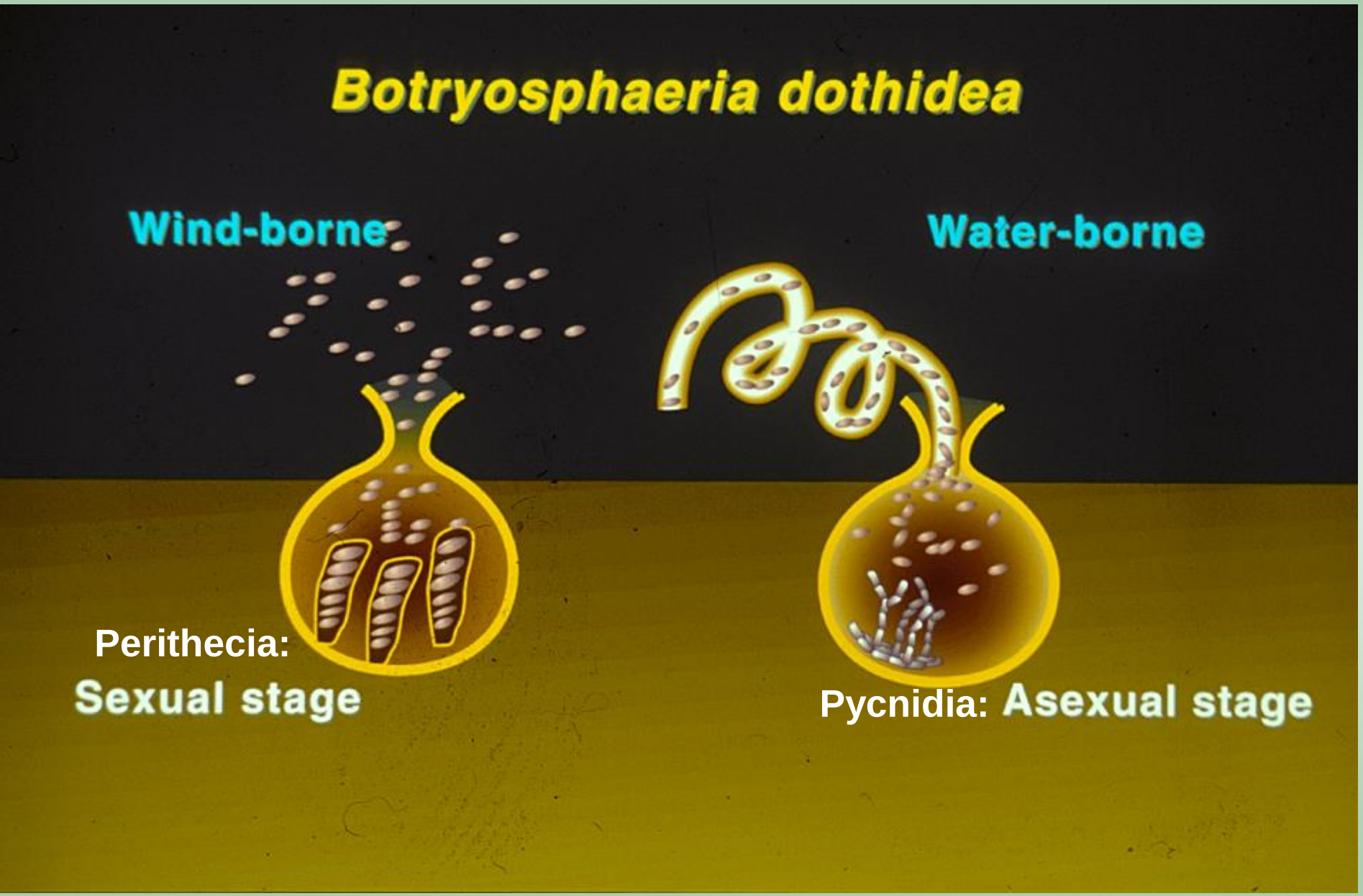
pycnidia

ascospores

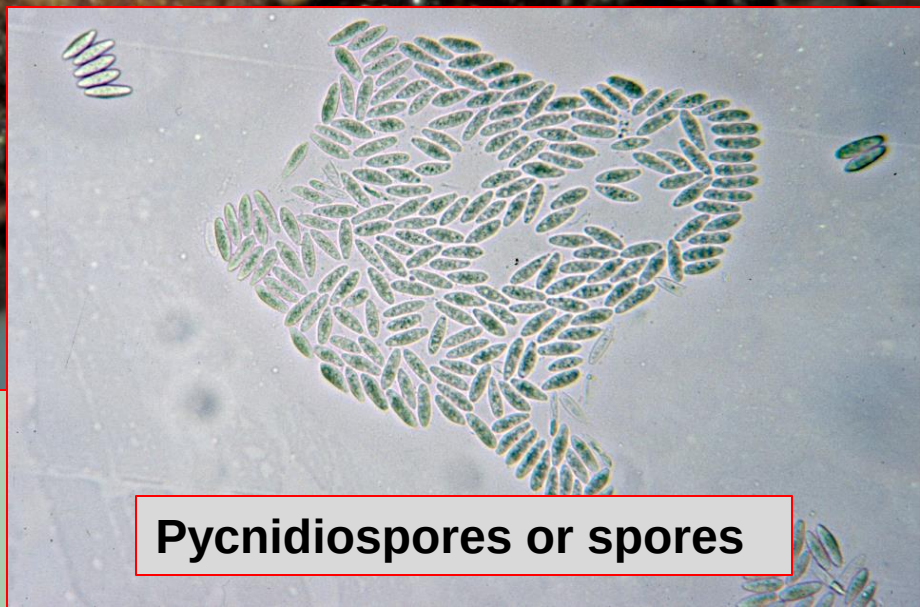
✓airborne

perithecia (ascocarps)

***Botryosphaeria* reproductive structures in walnut**


Botryosphaeria dothidea
Wind-borne
Water-borne
Perithecia:
Sexual stage
Pycnidia: Asexual stage

Oozing pycnidia

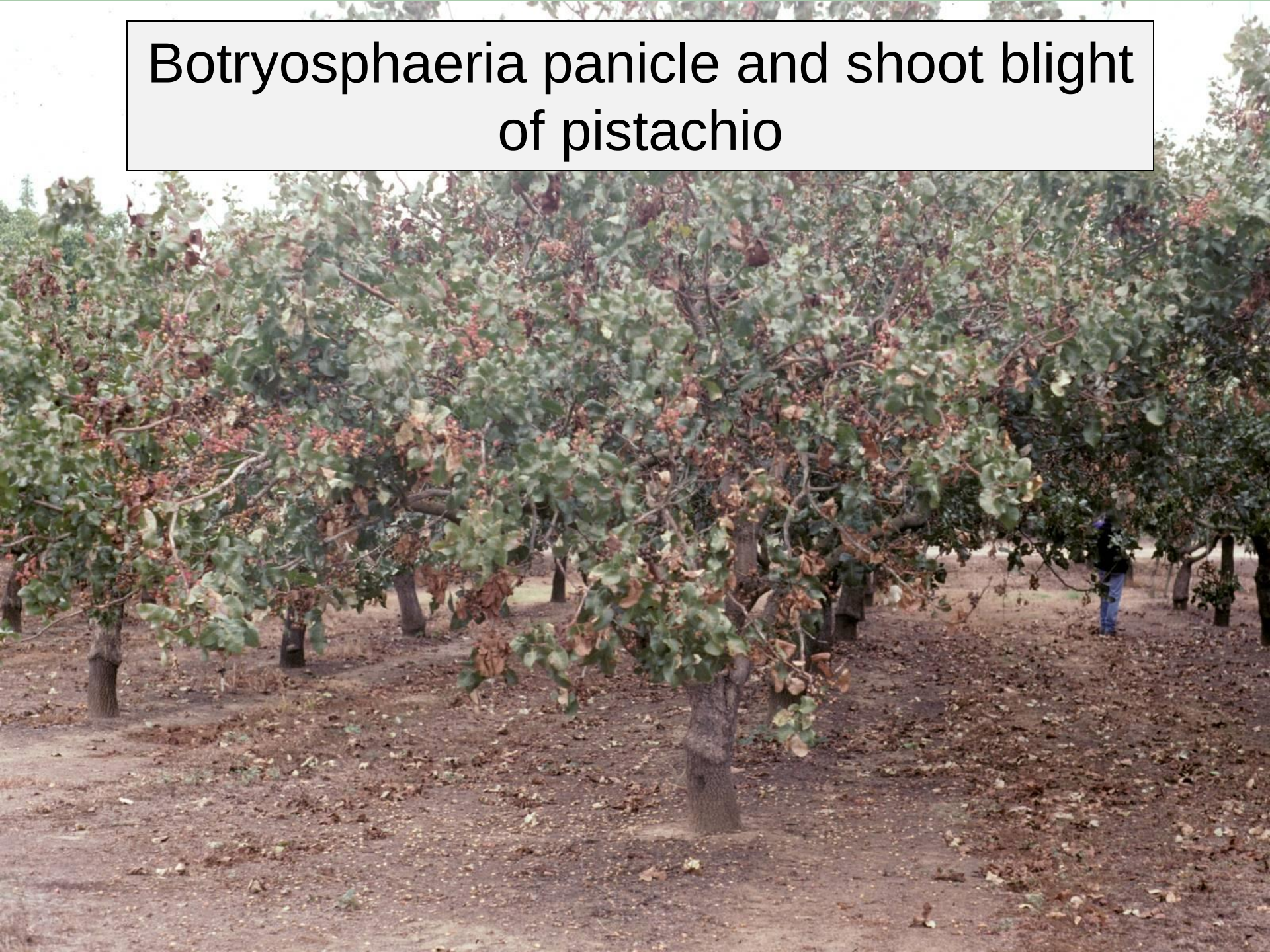


Pycnidiospores or spores

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

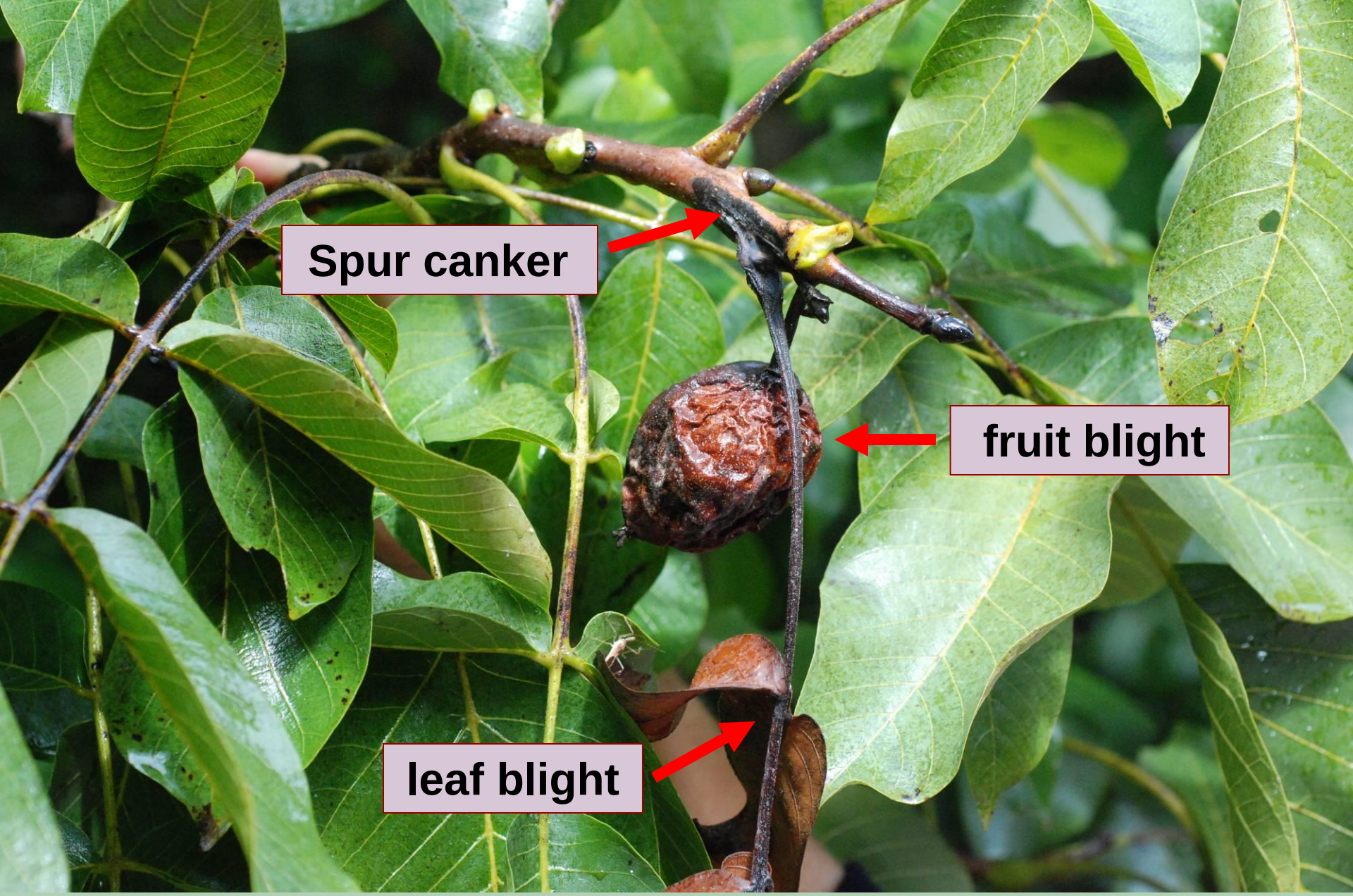
September 15, 2011, Stanislaus Co.

Botryosphaeria panicle and shoot blight of pistachio

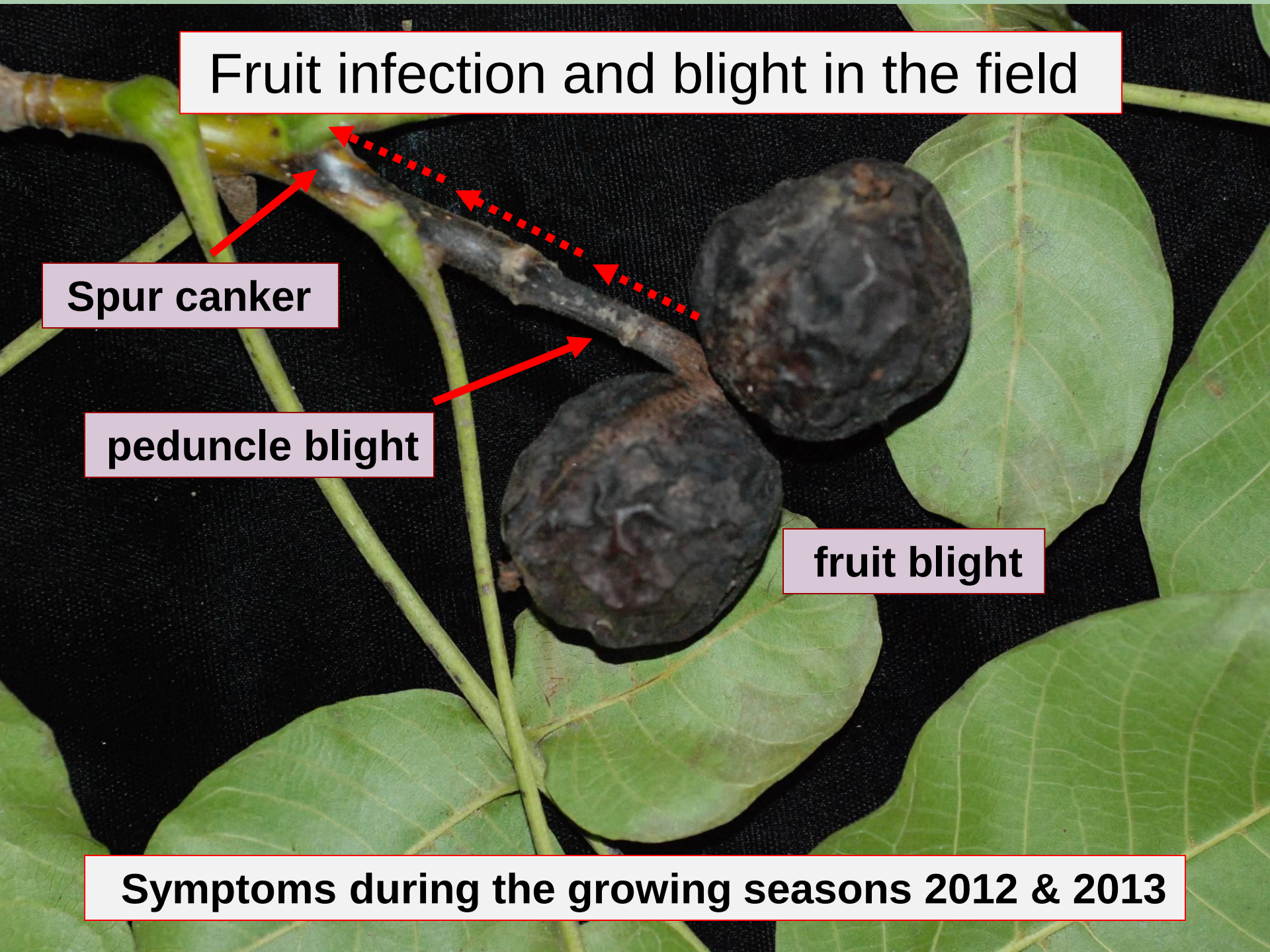


Botryosphaeria panicle and shoot blight of pistachio

Very devastating disease

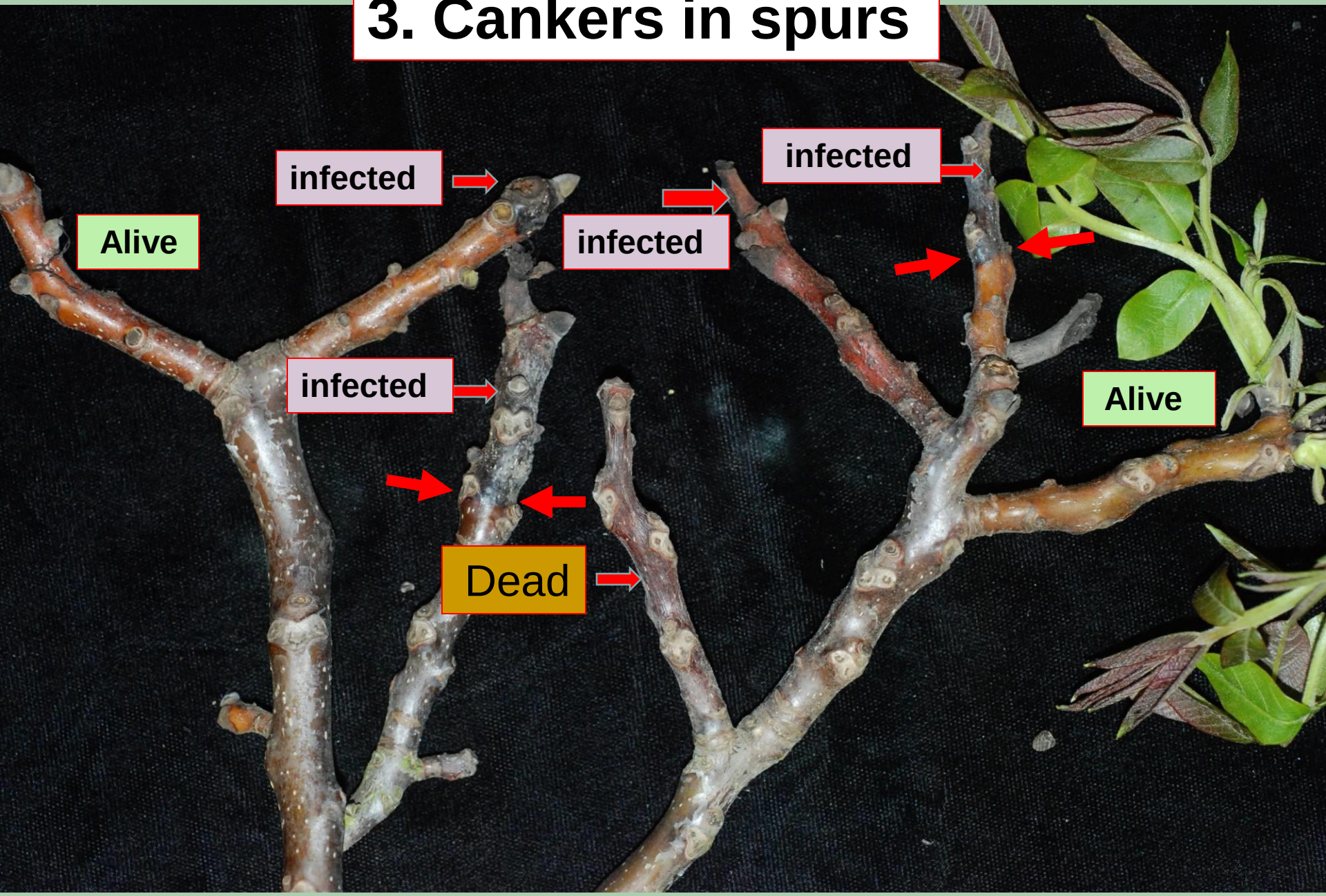


Botryosphaeria blight

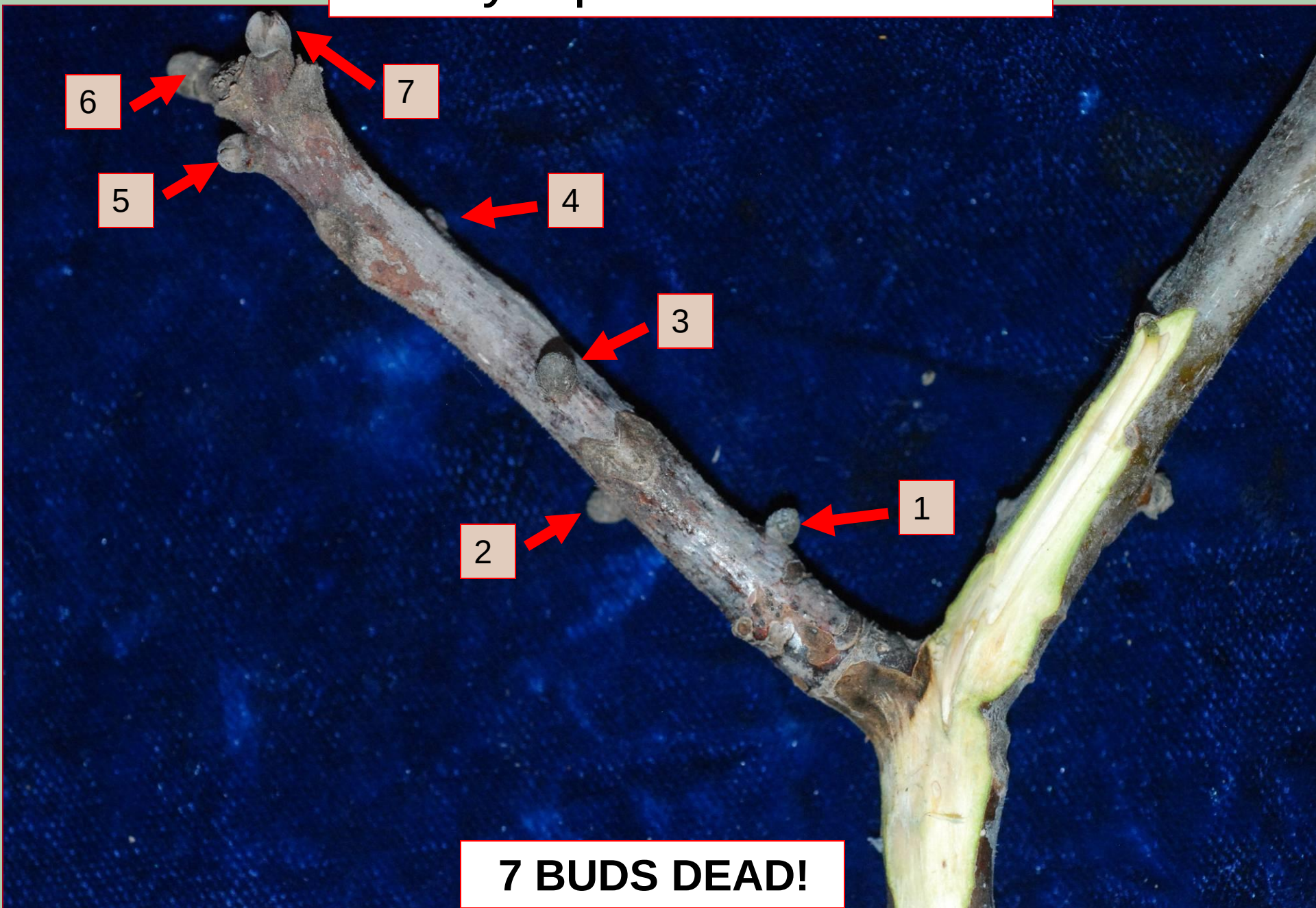

Fruit infection and blight in the field
Spur canker
peduncle blight
fruit blight
Symptoms during the growing seasons 2012 & 2013

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

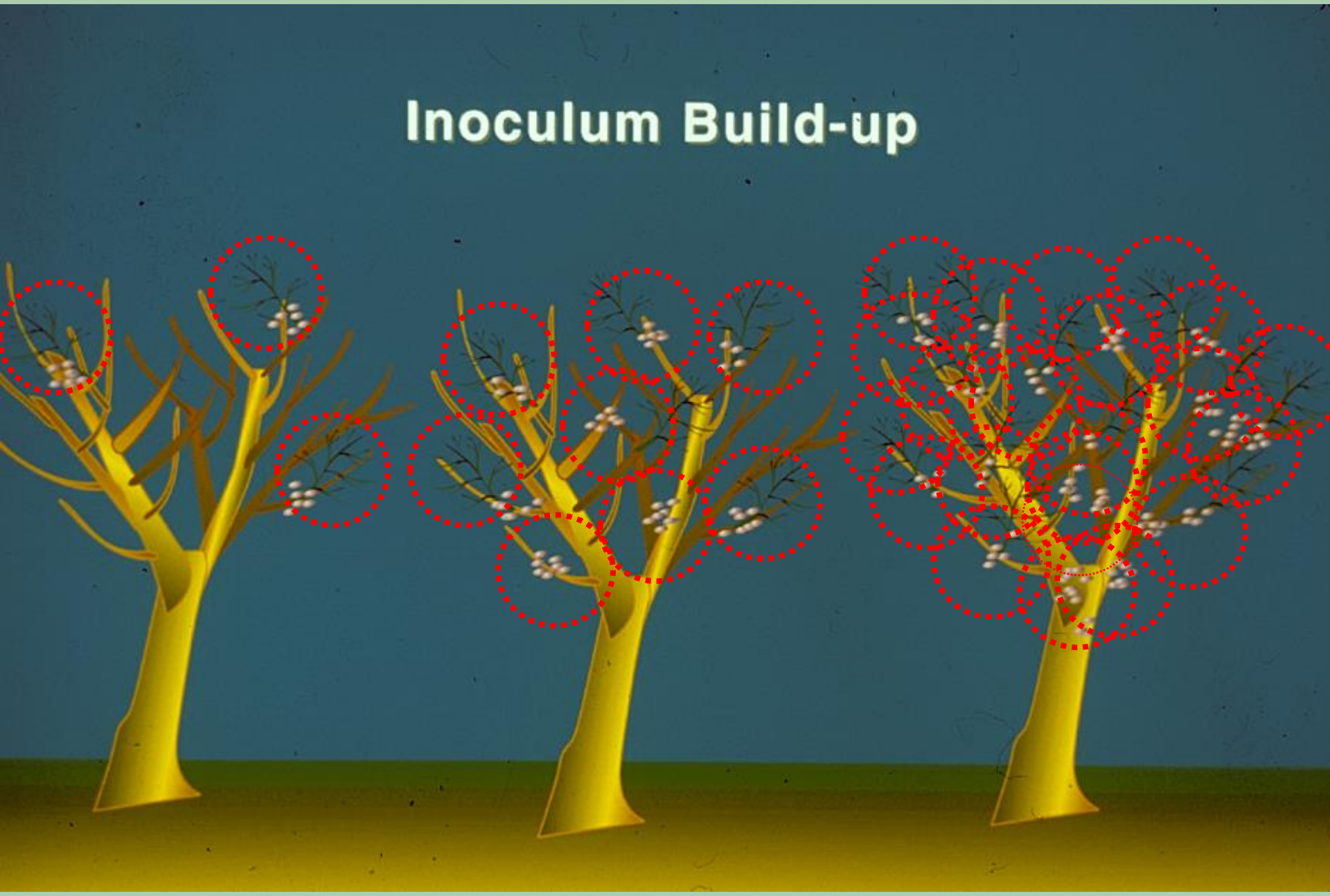
3. Cankers in spurs



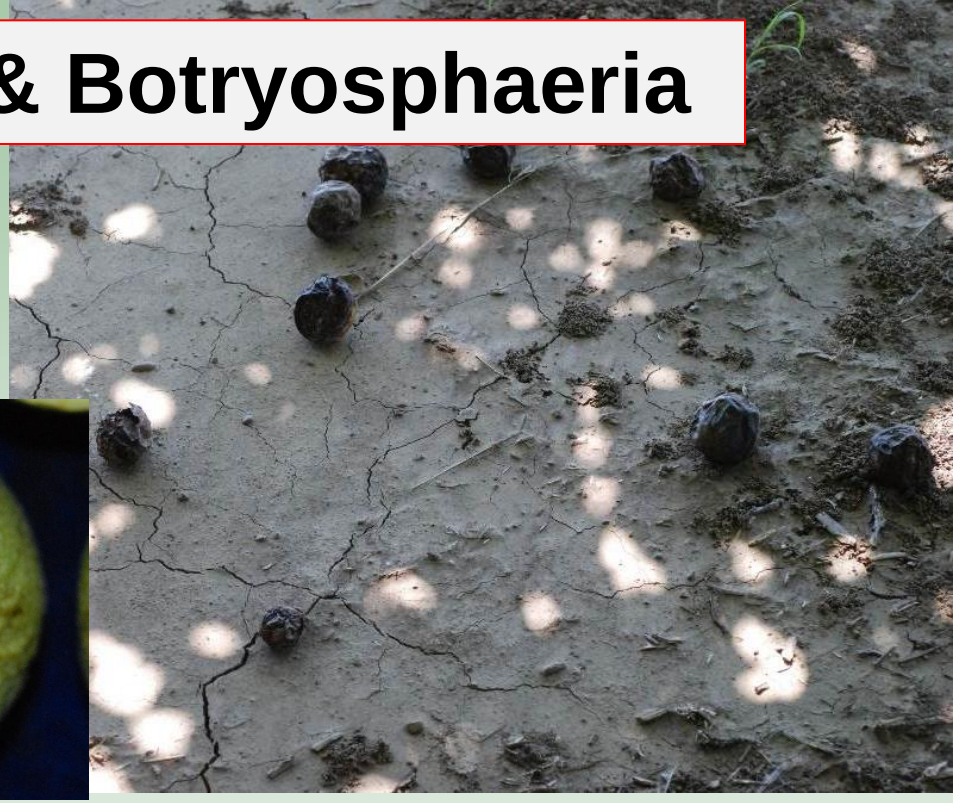
Botryosphaeria kills buds



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	*Botryosphaeria*
2	**Tree**	+10	10	*Phomopsis*
3	**Tree**	+10	20	*Fusarium*
4	**Tree**	+20	30	*Alternaria*
5	**Tree**	–	50	*Gloeosporium*
6	**Tree**	–	0	*Aspergillus niger*
7	**Tree**	+	0	*Epicoccum*
				Colletotrichum

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	
2	**Tree**	–	12	
3	**Tree**	+	11	
4	**Tree**	ND	80	
1	**Ground**	+	67	

Botryosphaeria

Phomopsis

Fusarium

Alternaria

Gloeosporium

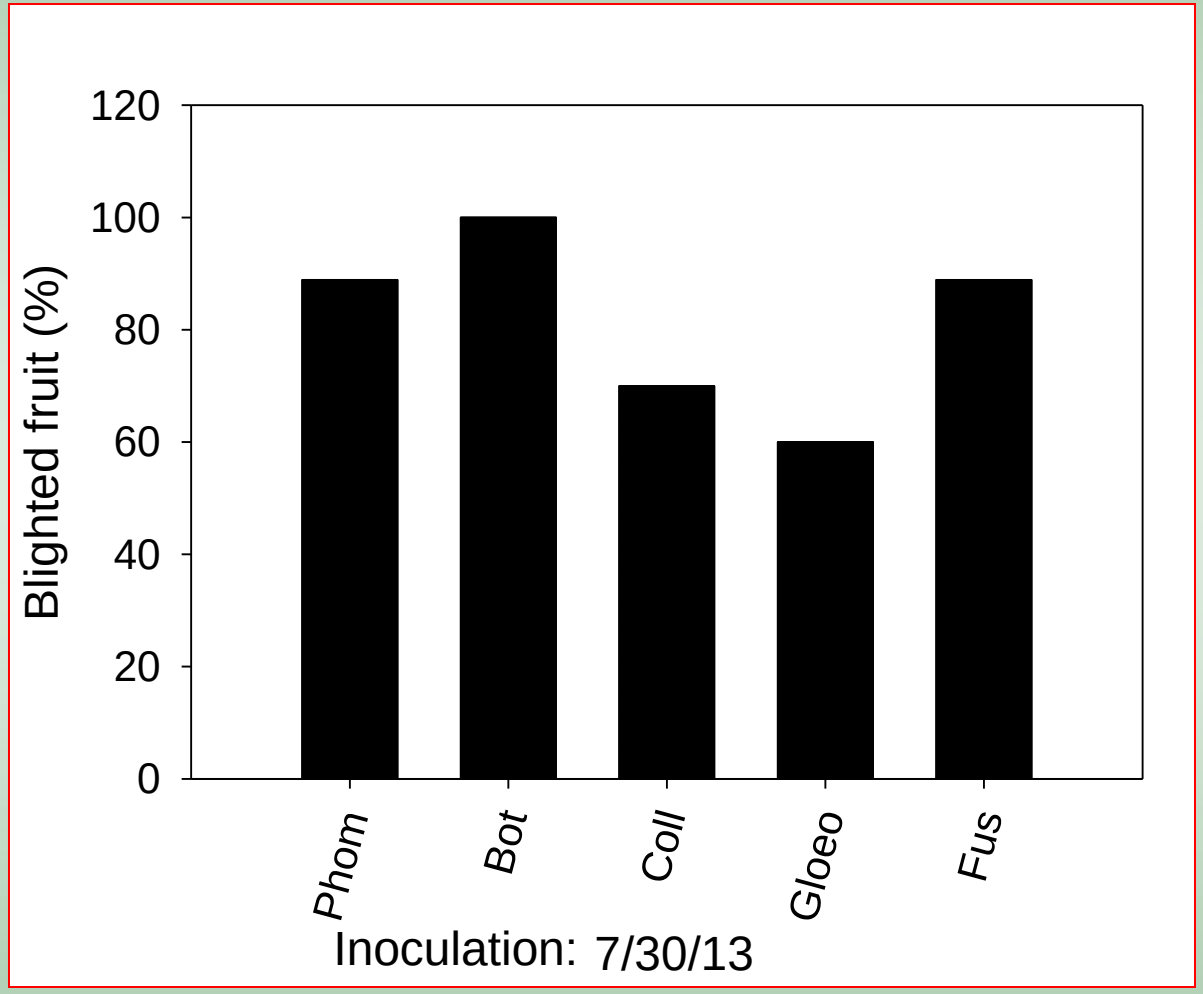
Aspergillus niger

Epicoccum

Colletotrichum

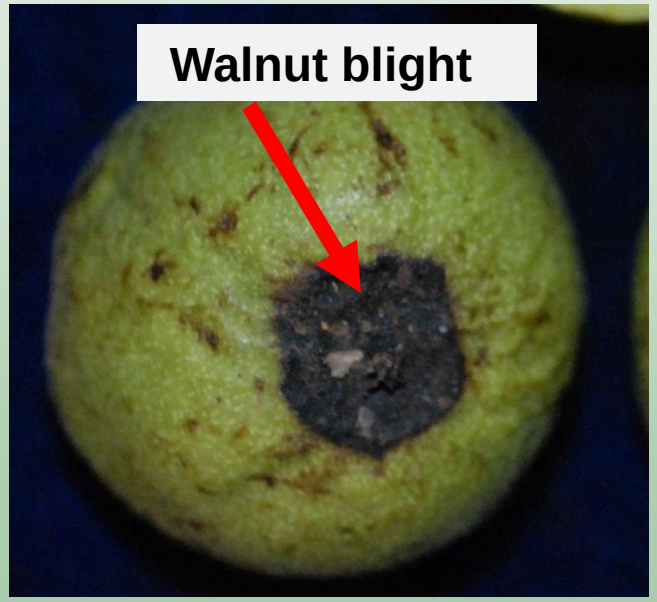
The association of **walnut blight** with **Botryosphaeria** & **other fungi** needs to be studied in detail…

Inoculation of walnut fruit with various fungi recovered from walnuts



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

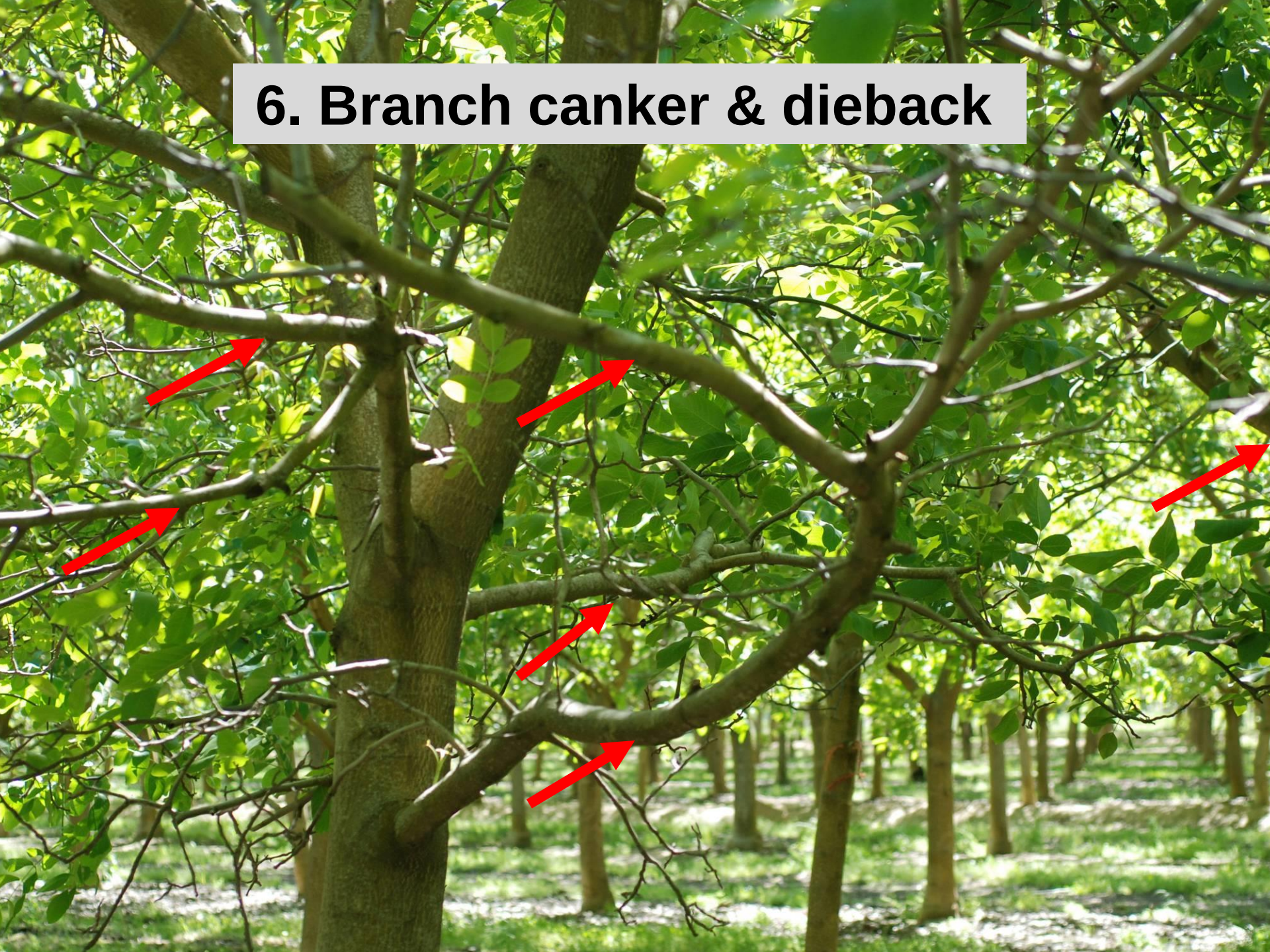
Brown Apical Necrosis

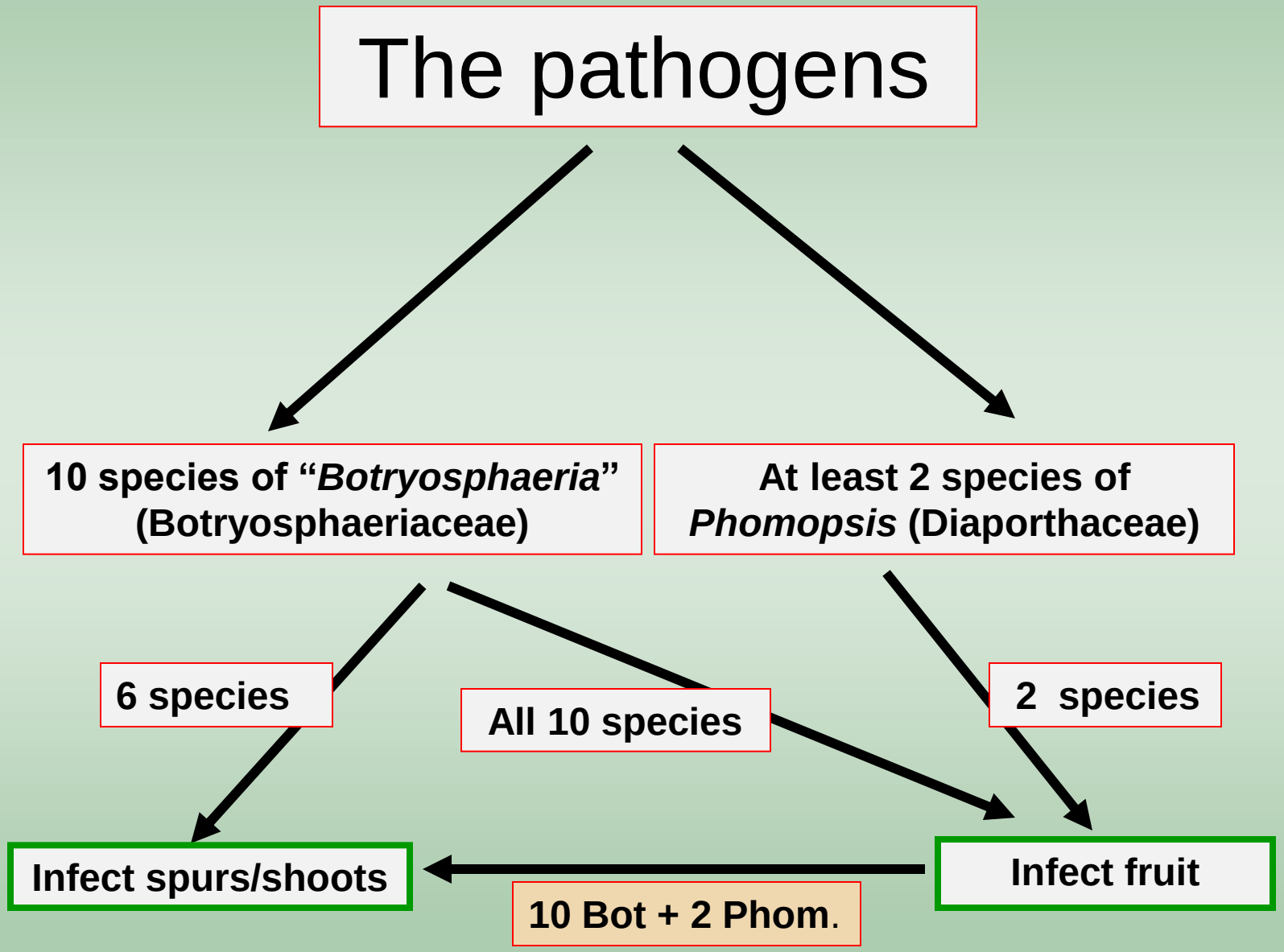


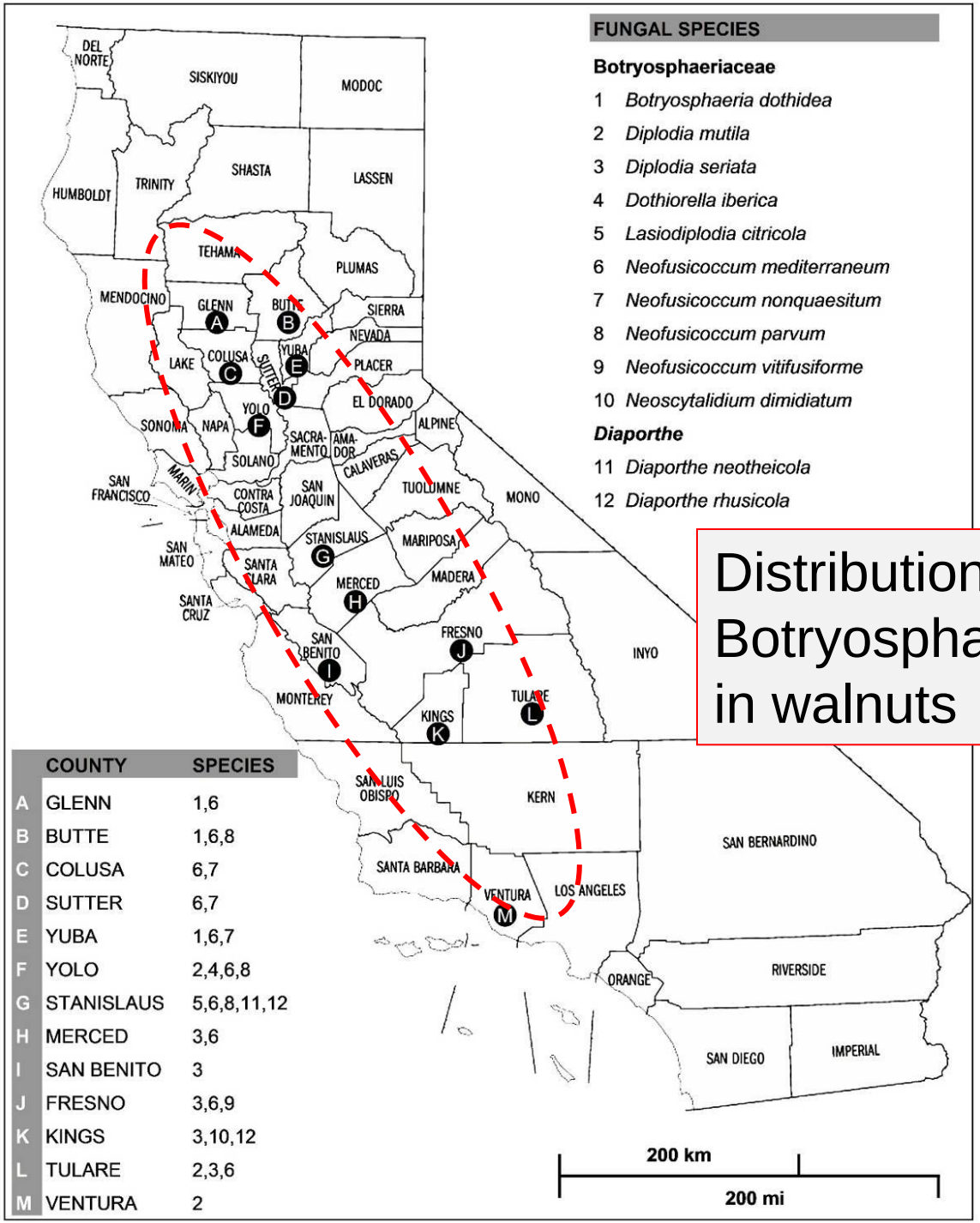
5. Cankers associated with pruning wounds

Cultivar: Howard

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


6. Branch canker & dieback

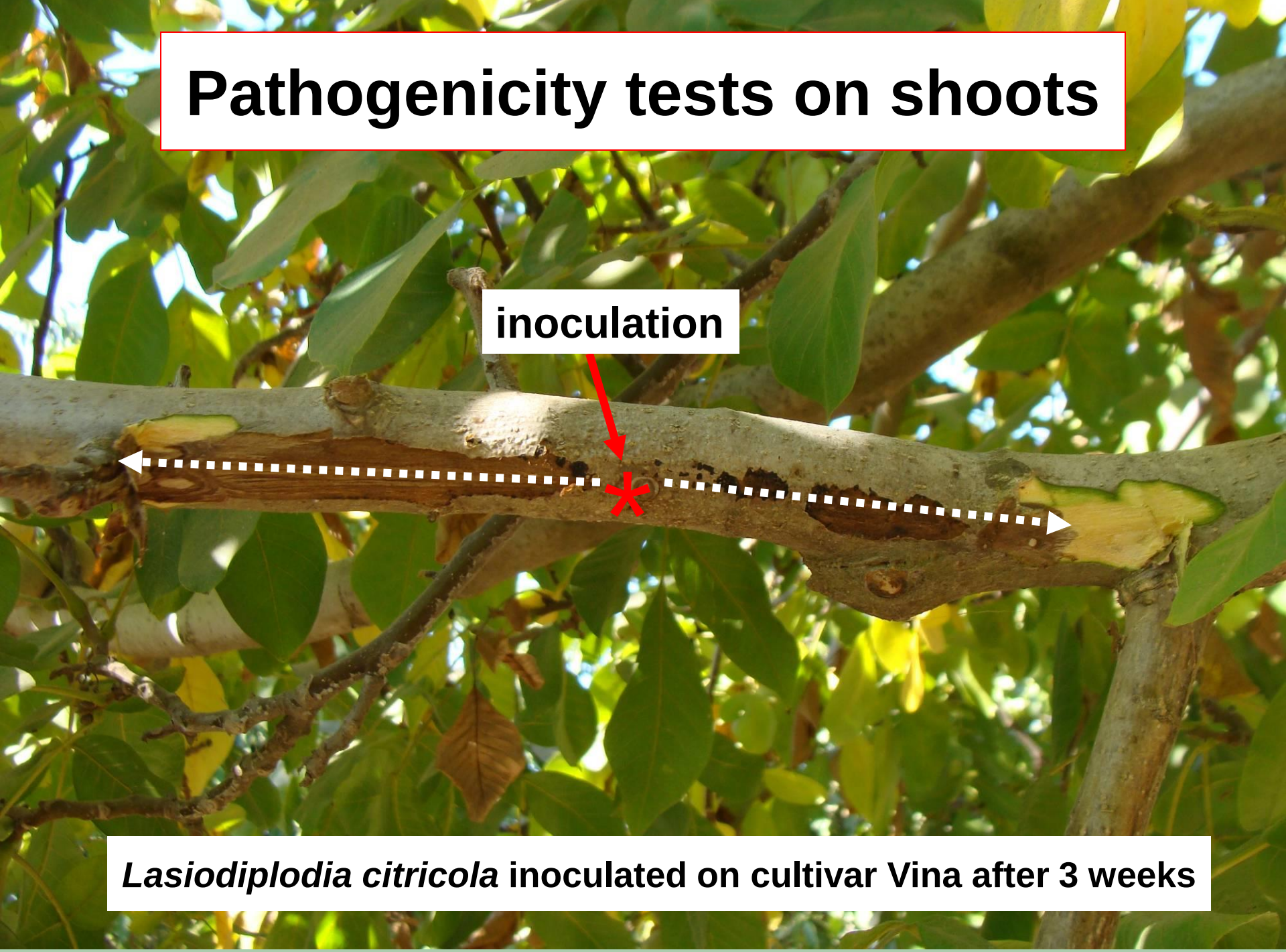

The pathogens
10 species of "*Botryosphaeria*" (Botryosphaeriaceae)
At least 2 species of *Phomopsis* (Diaporthaceae)
6 species
All 10 species
2 species
Infect spurs/shoots
Infect fruit
10 Bot + 2 Phom.



	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

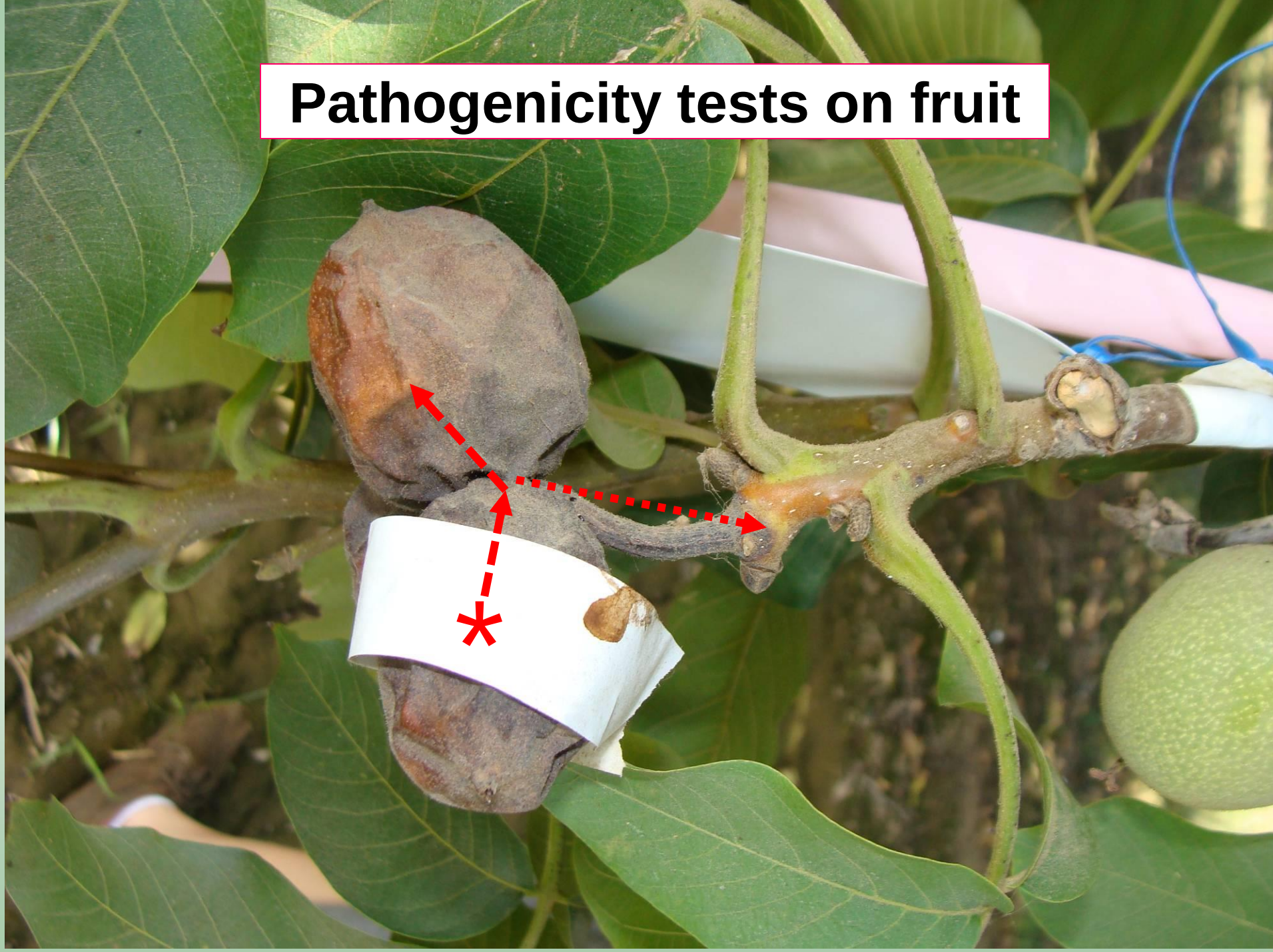
Distribution of Botryosphaeriaceae in walnuts

Pathogenicity tests on shoots



Lasiodiplodia citricola **inoculated on cultivar Vina after 3 weeks**

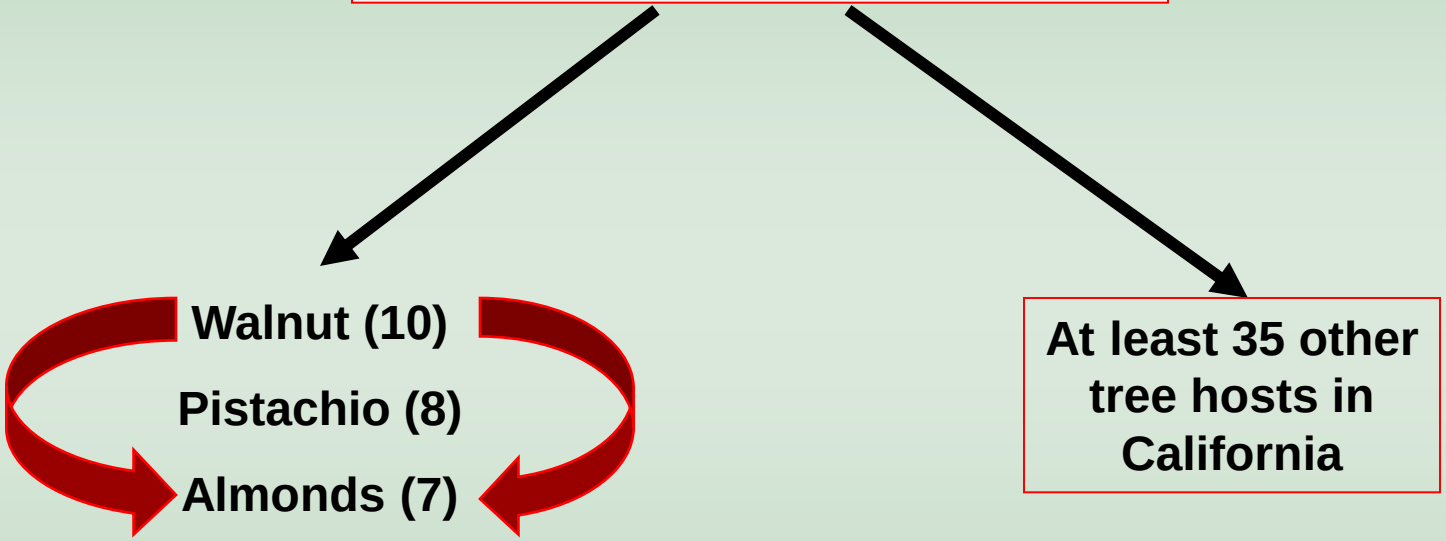
Pathogenicity tests on fruit



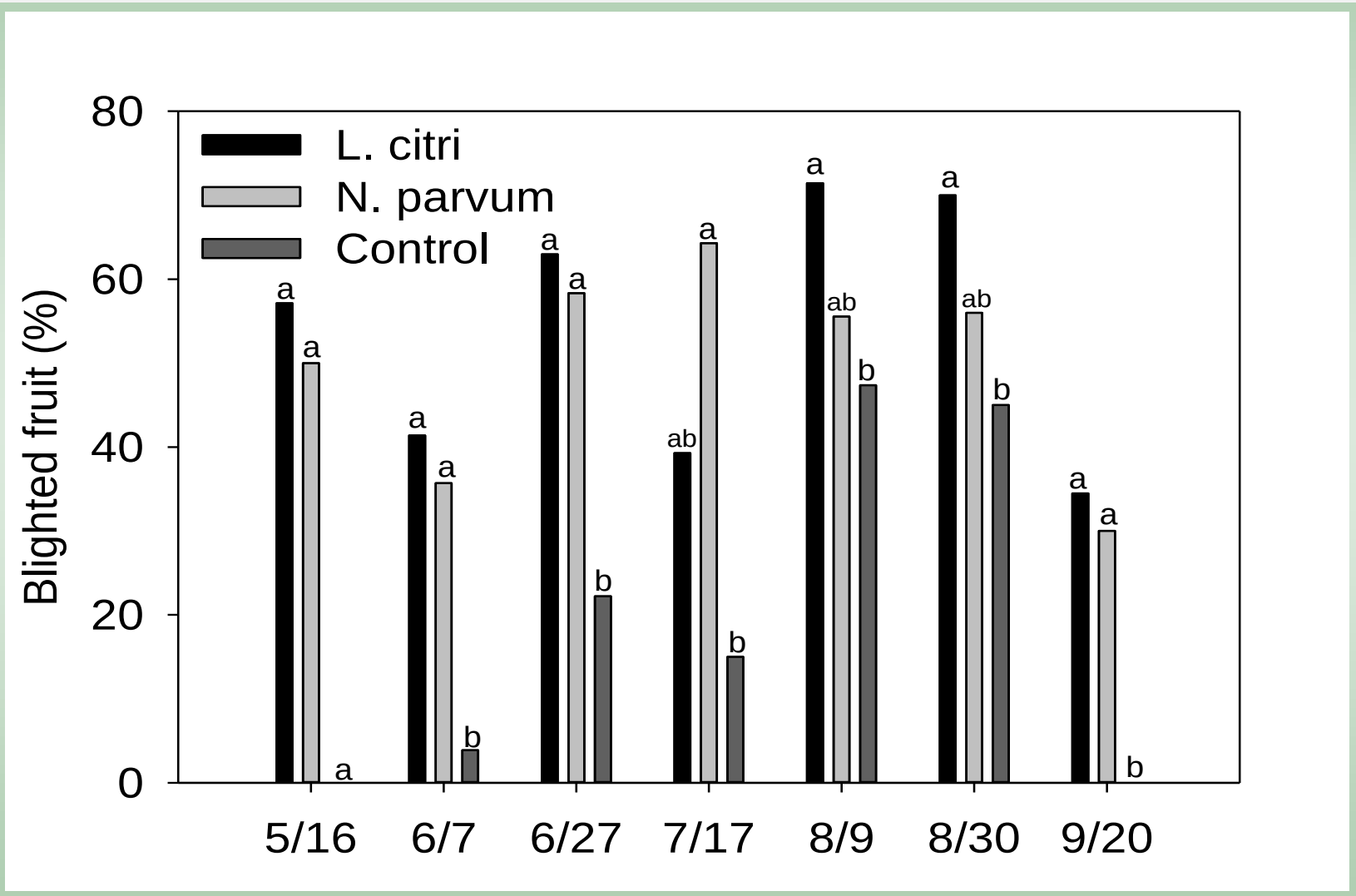
After artificial inoculation

The pathogen

"BOTRYOSPHAERIA"
"PHOMOPSIS"



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



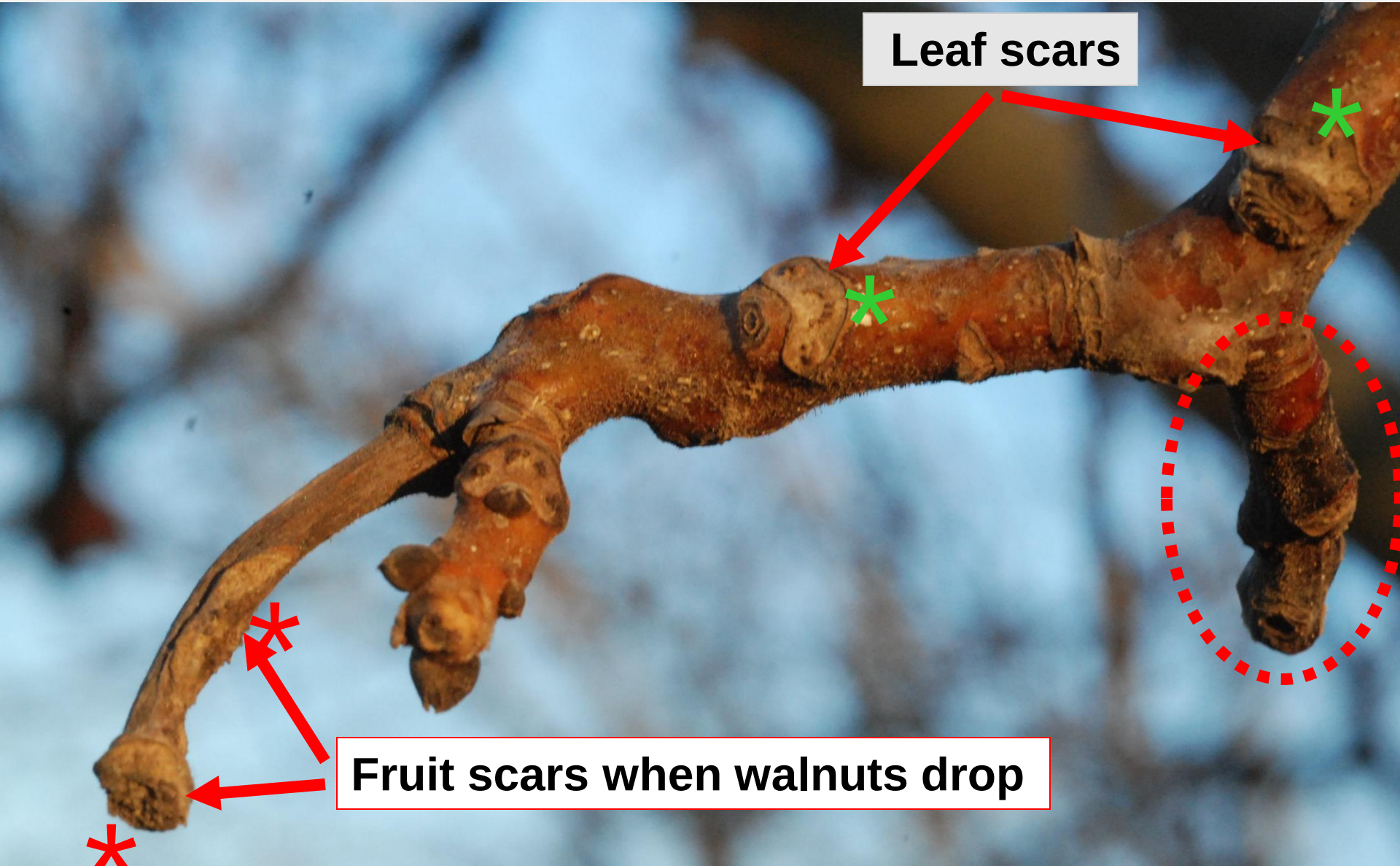
… after wounding…

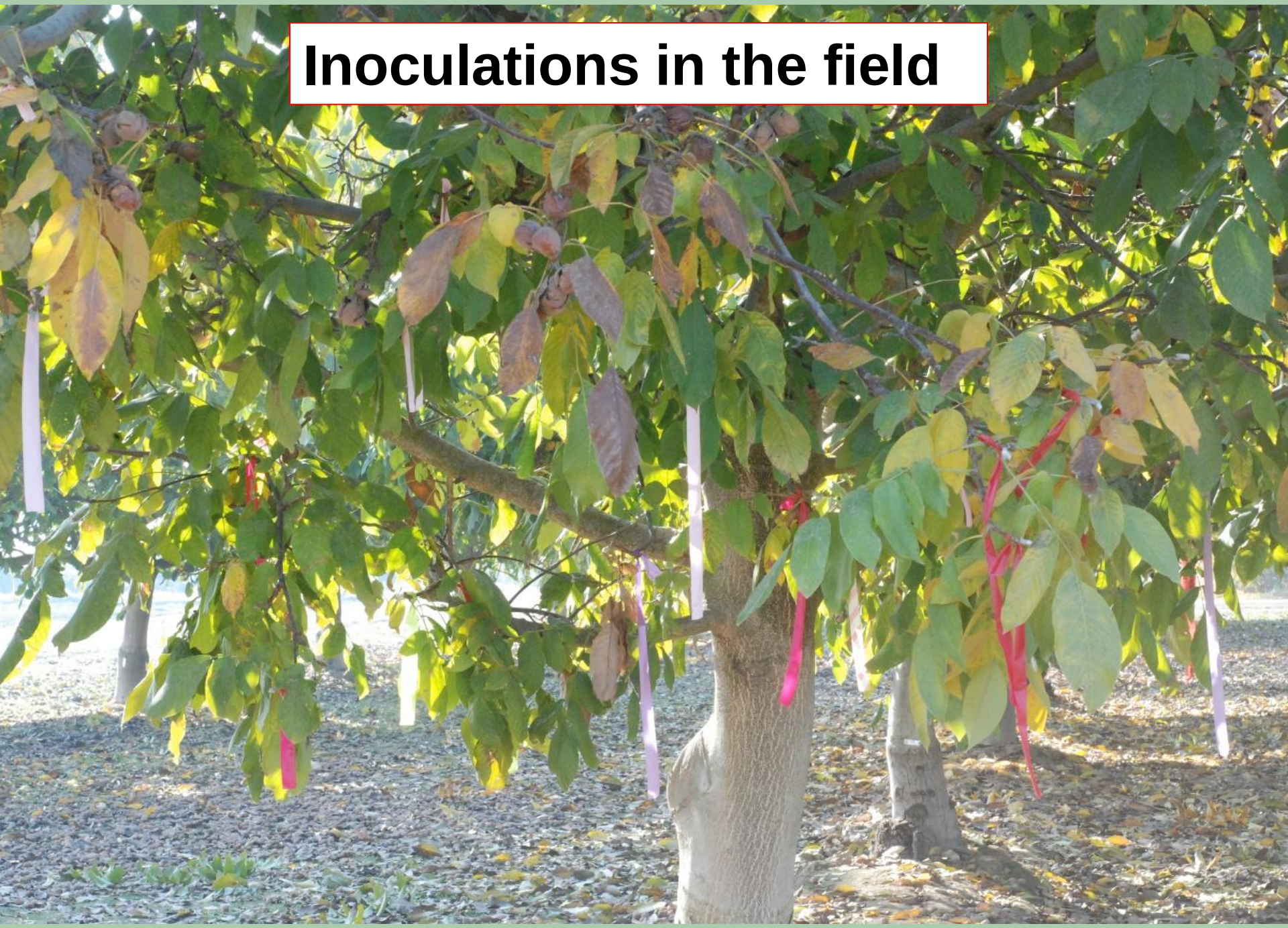
Incidence of fungal pathogens isolated from blighted fruit (collected from trees & ground)

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

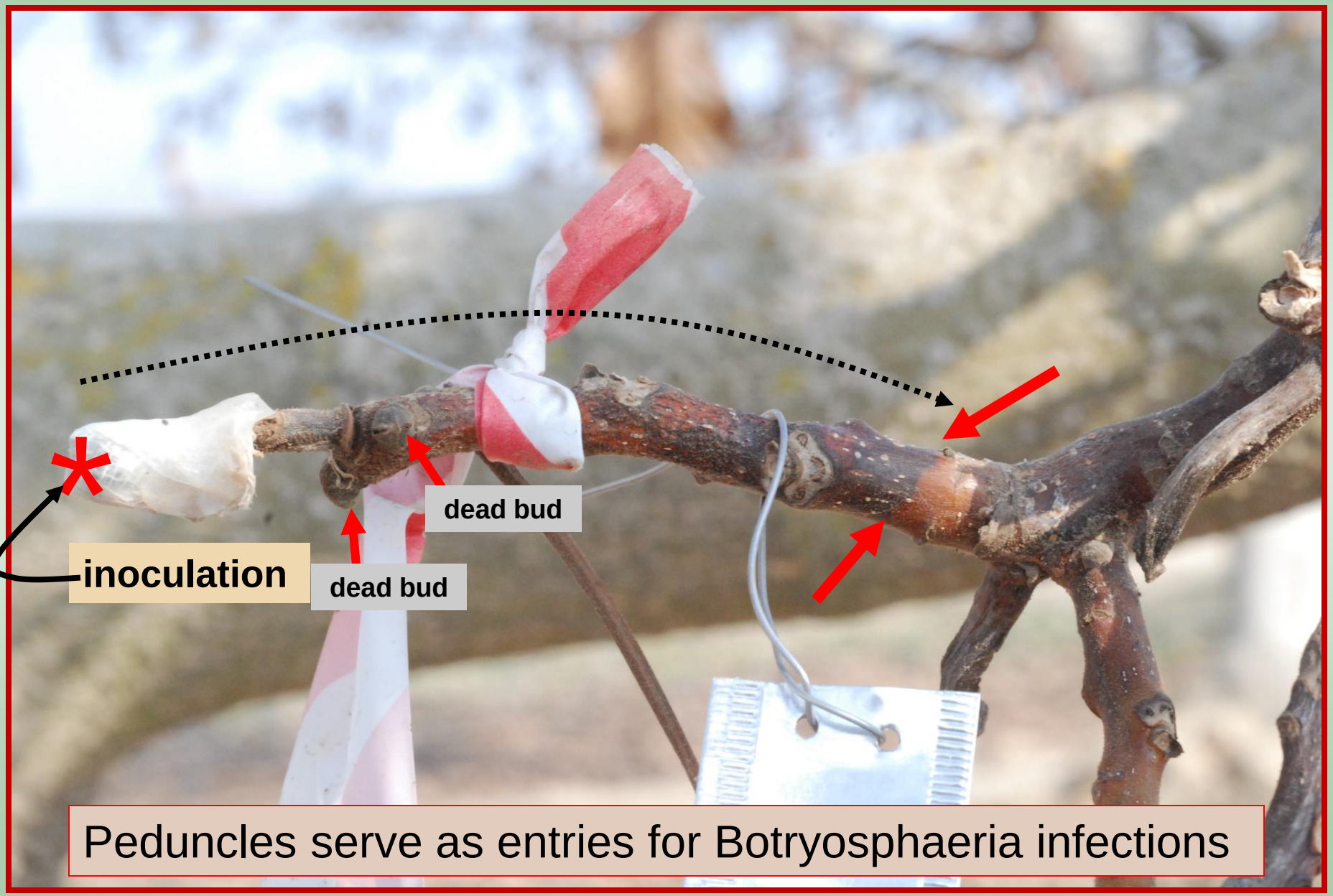
It seems that walnut blight can serve as an entry for *Botryosphaeria* infections

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

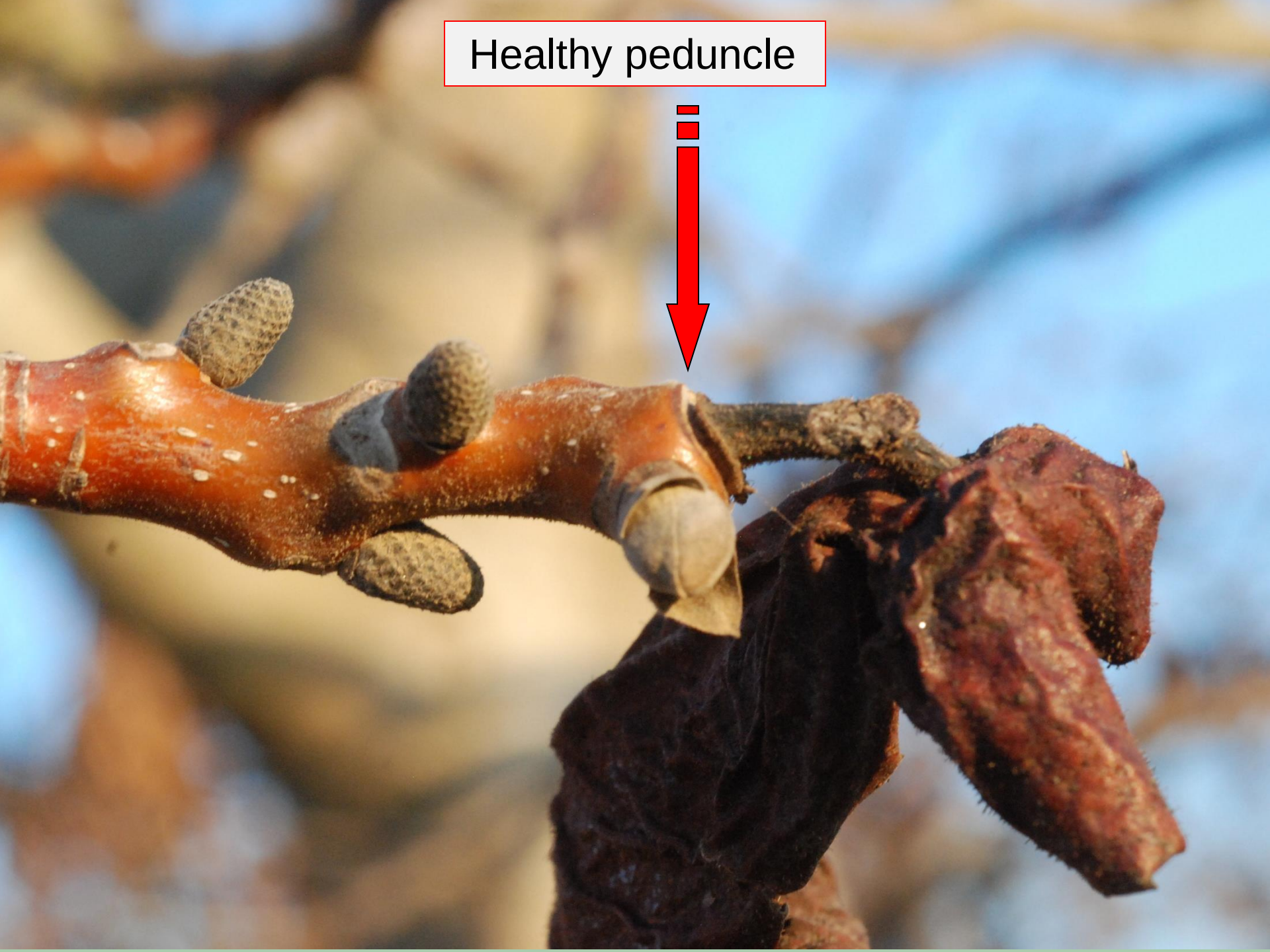



Inoculations in the field

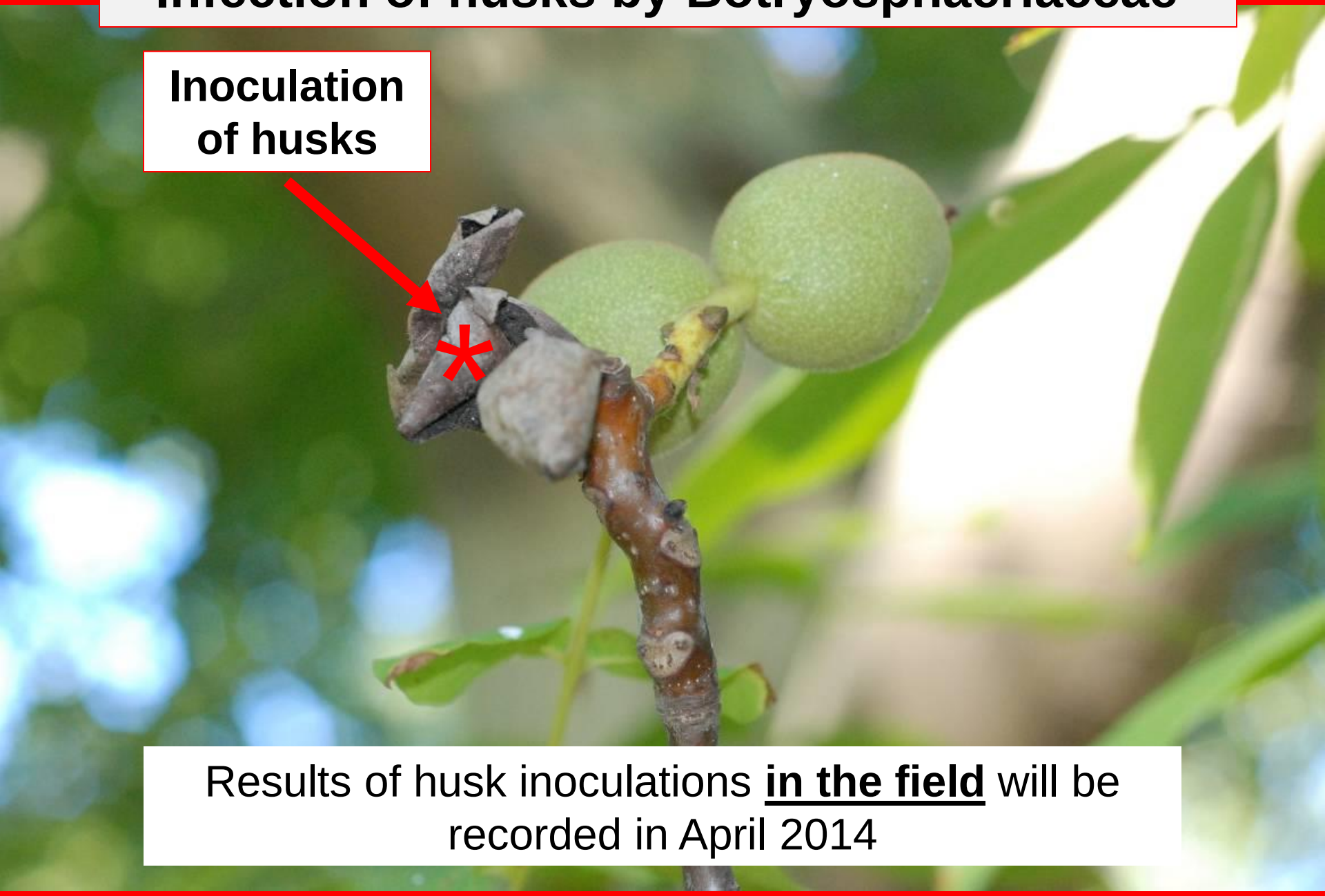
Inoculation of peduncles with Botryosphaeria



Peduncles serve as entries for Botryosphaeria infections


Healthy peduncle

Infection of husks by Botryosphaeriaceae



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

Effects of walnut scales on Botryosphaeria

walnut scales

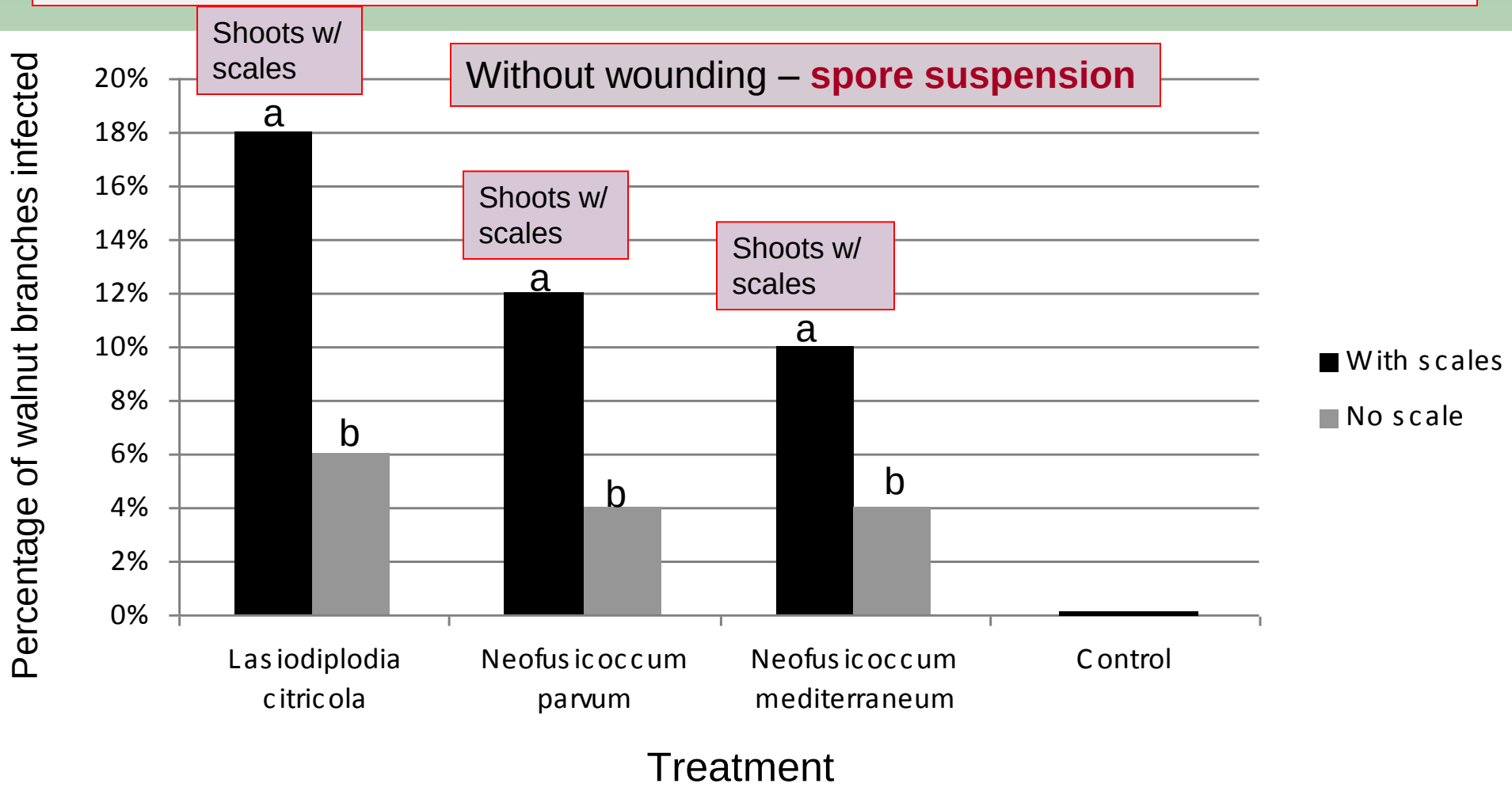
Injuries from scales

Necrotic lesions

- ✓ 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)

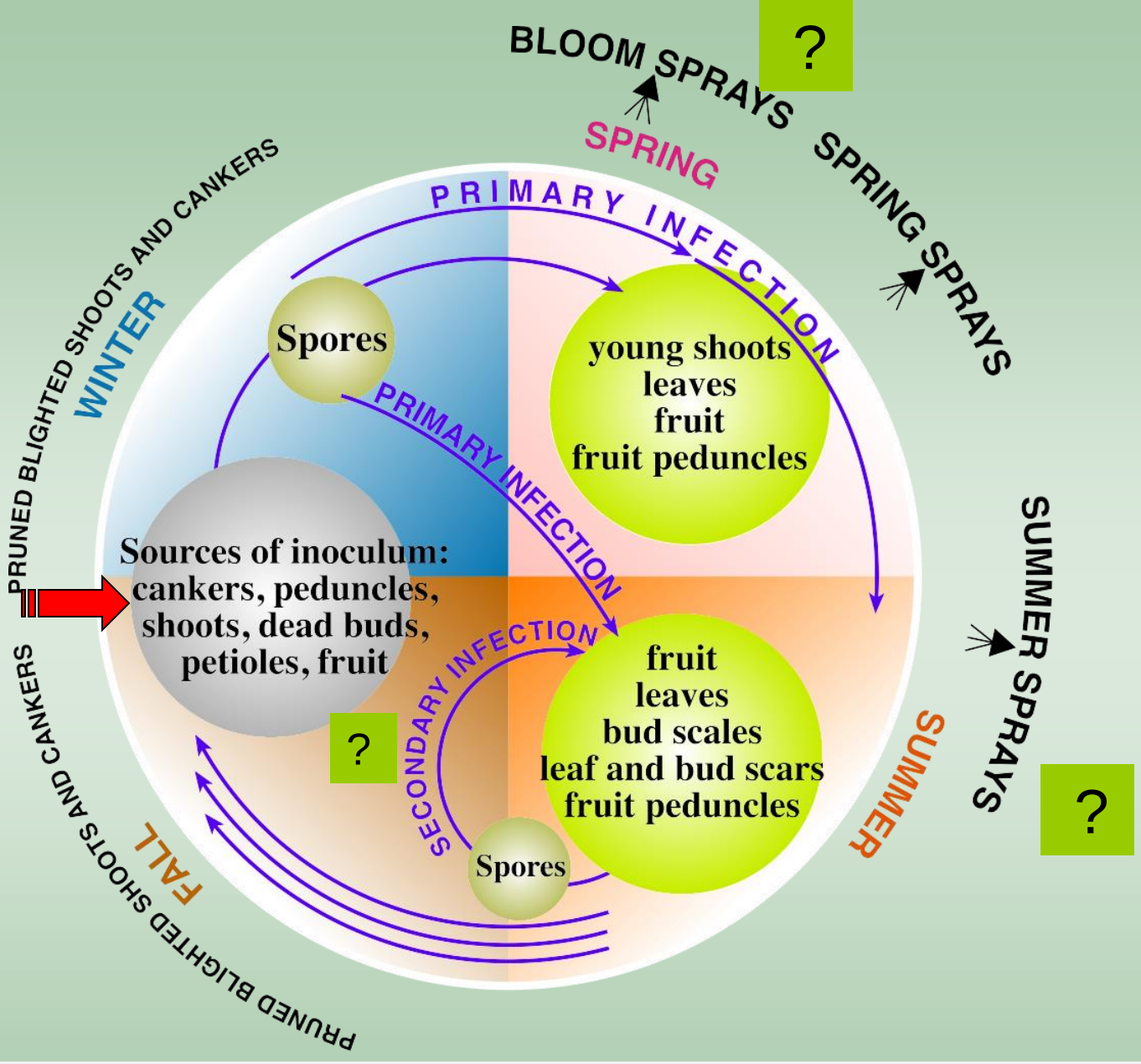


✓**60-75% more shoots were infected when scales were present than when scales were not present**

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



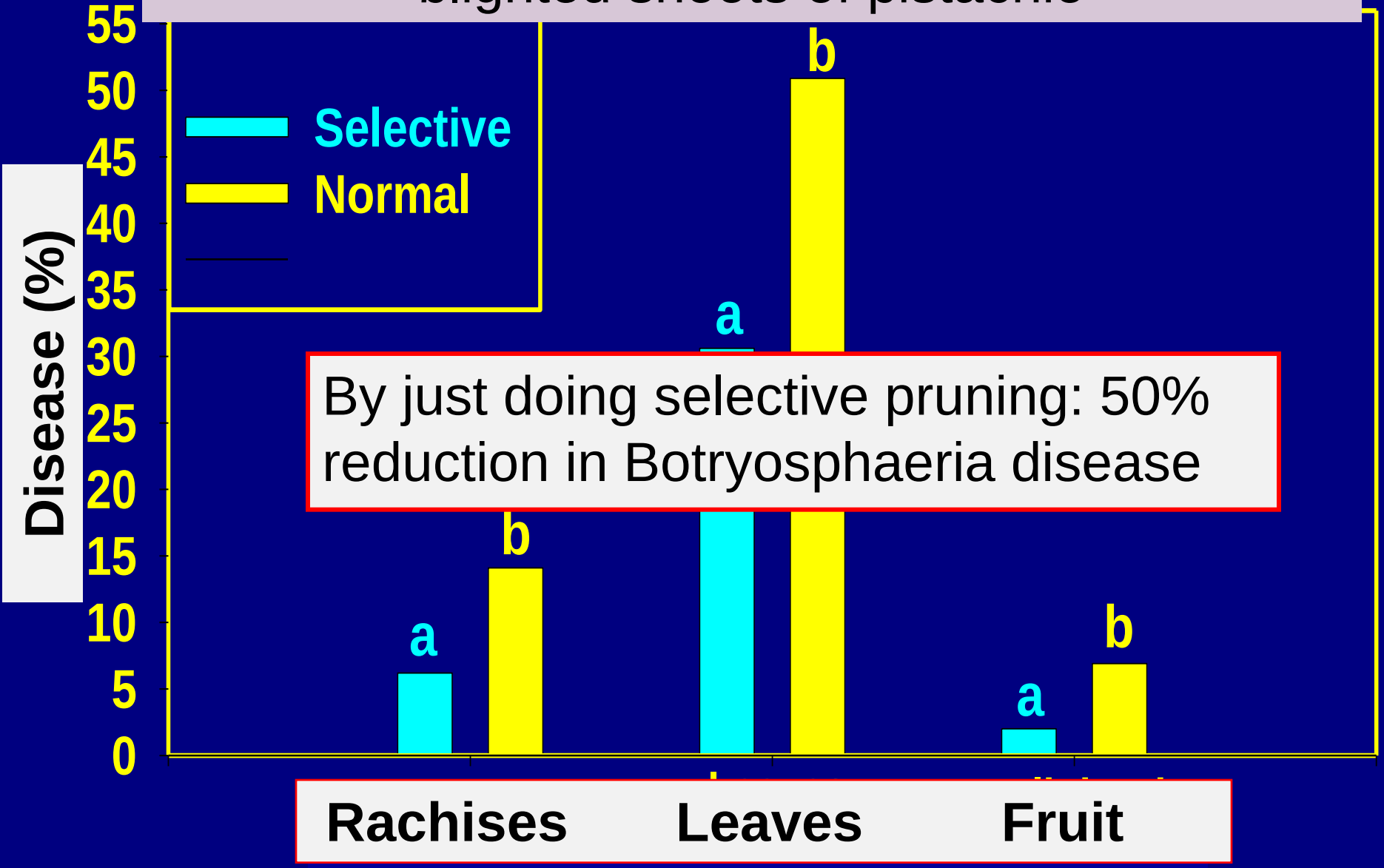
Botryosphaeria/Phomopsis blight & canker disease cycle & management

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



By just doing selective pruning: 50% reduction in Botryosphaeria disease

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	---	

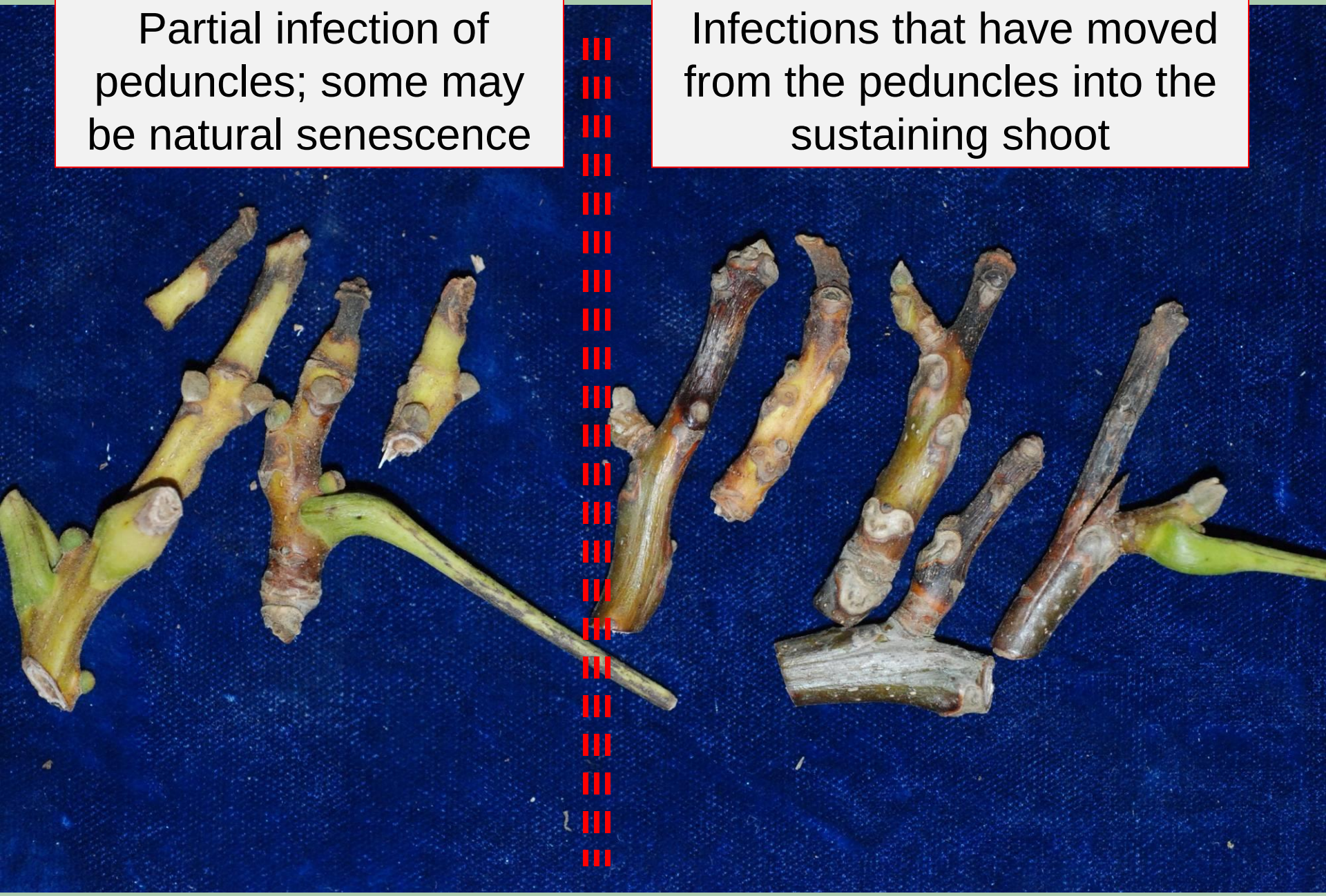
Spray dates: 17 May; mid June; & mid July

On 25 October 2013 collected:

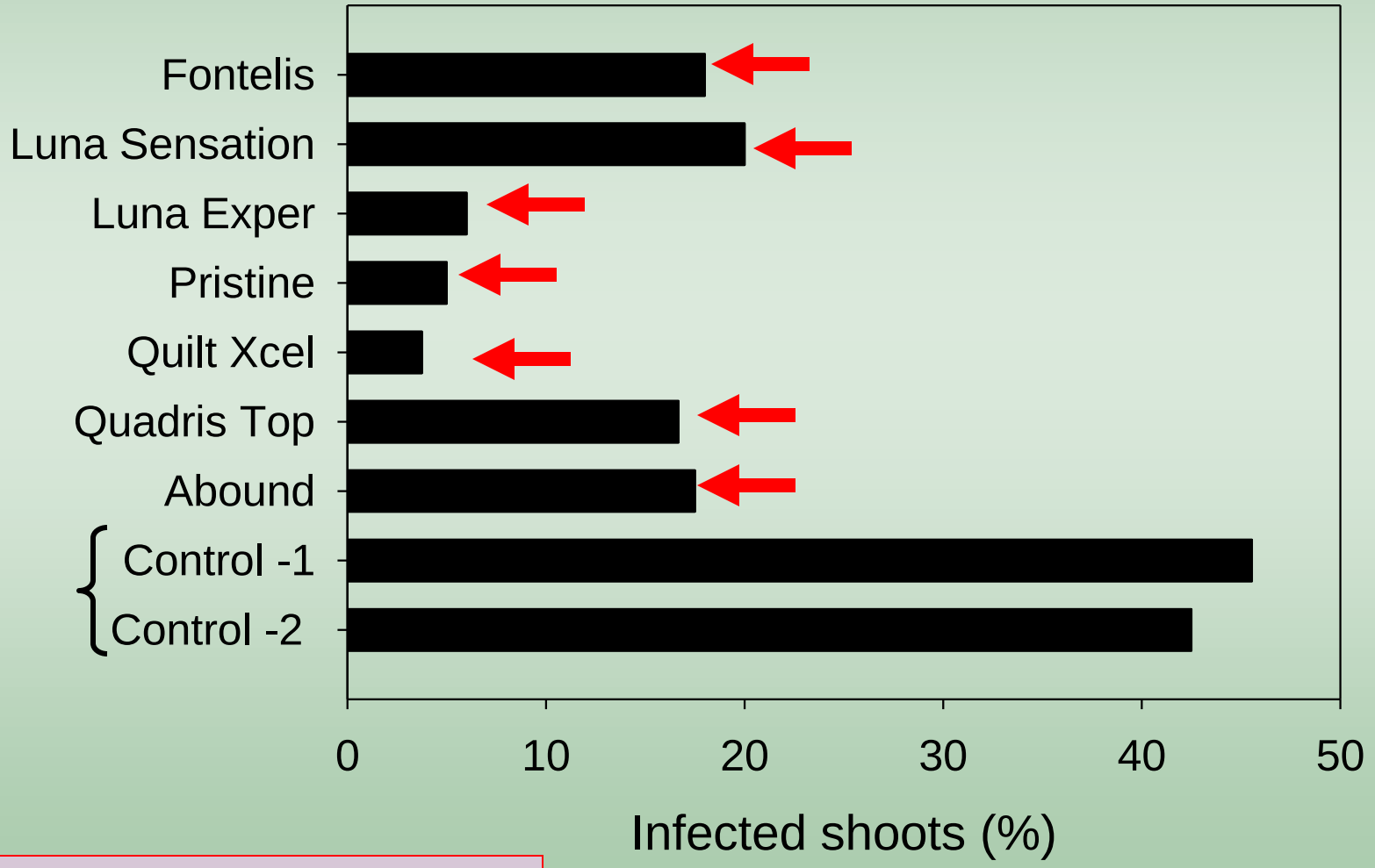
- peduncles
- current growth shoots

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)



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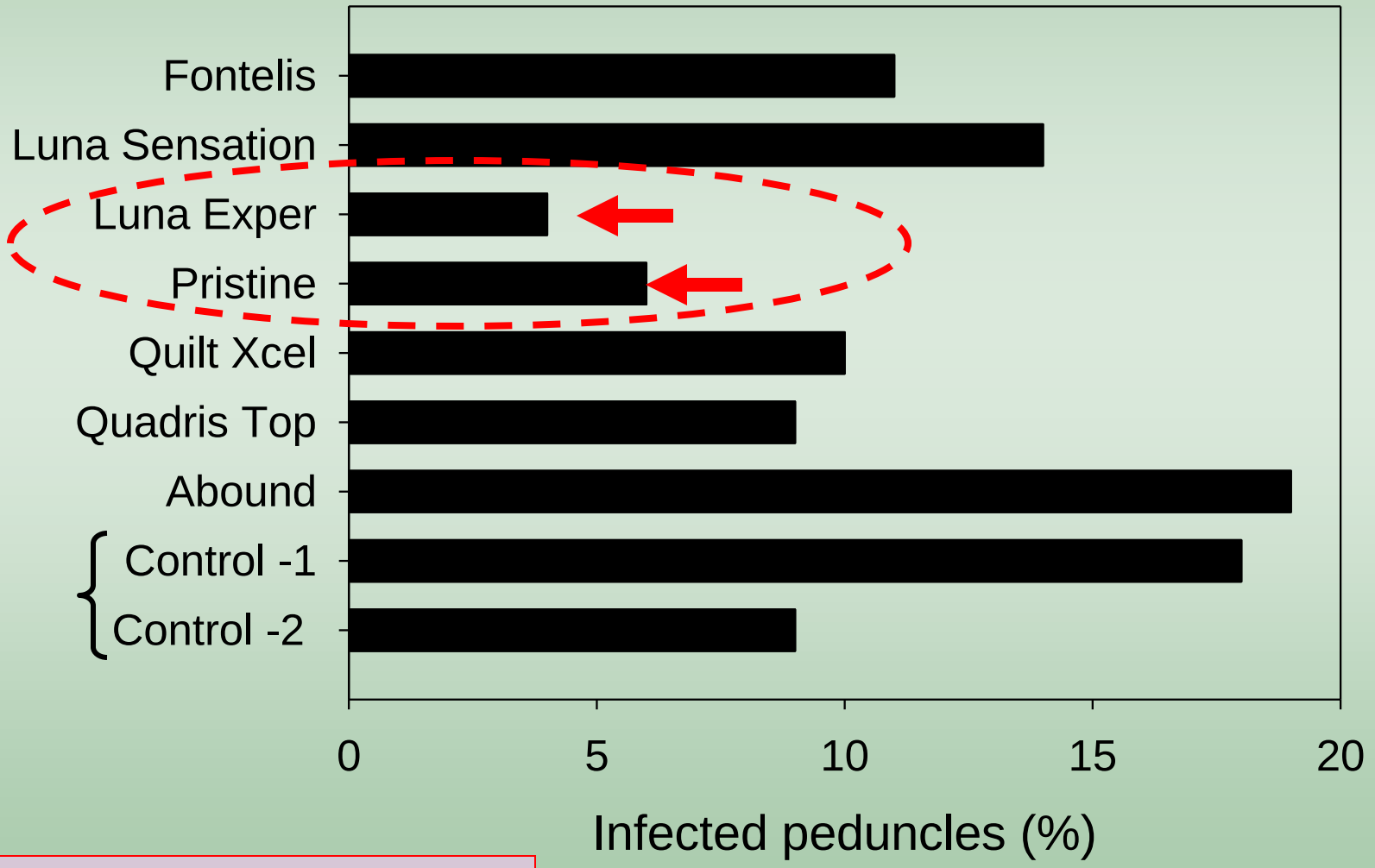
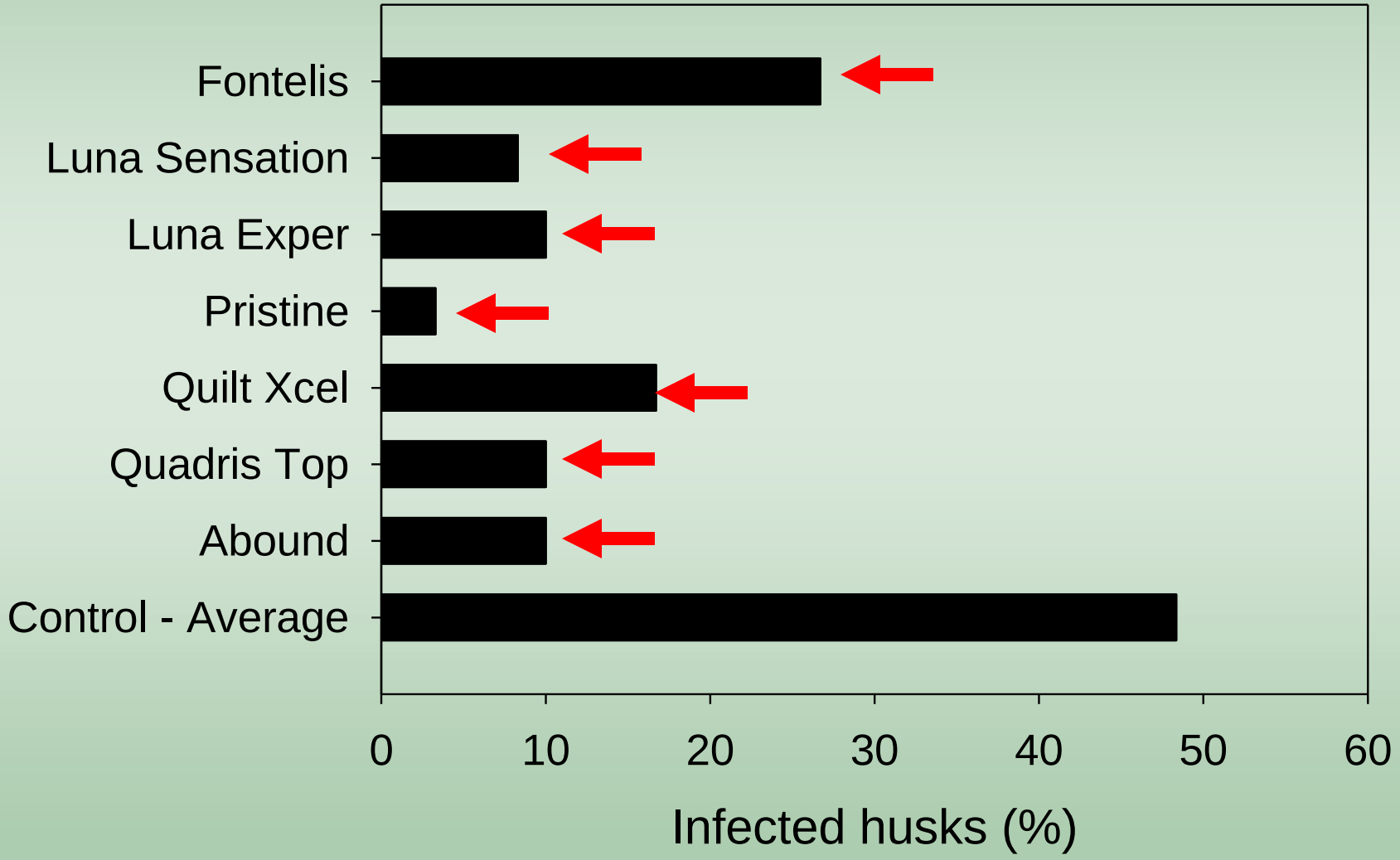
Effects of fungicides on Botryosphaeria in peduncles (Butte Co.; MM grower)

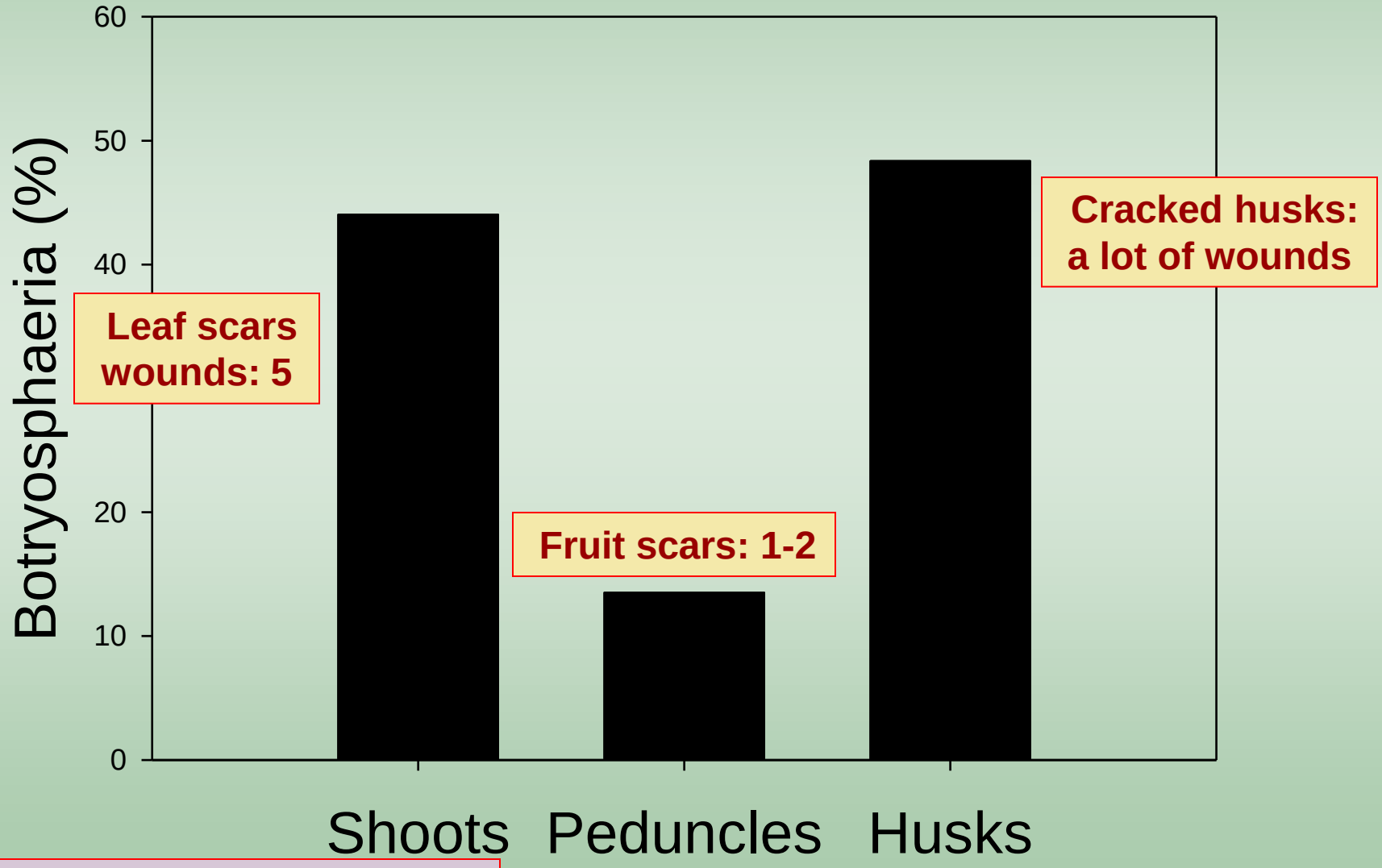


Spray dates: 17 May; mid June; & mid July

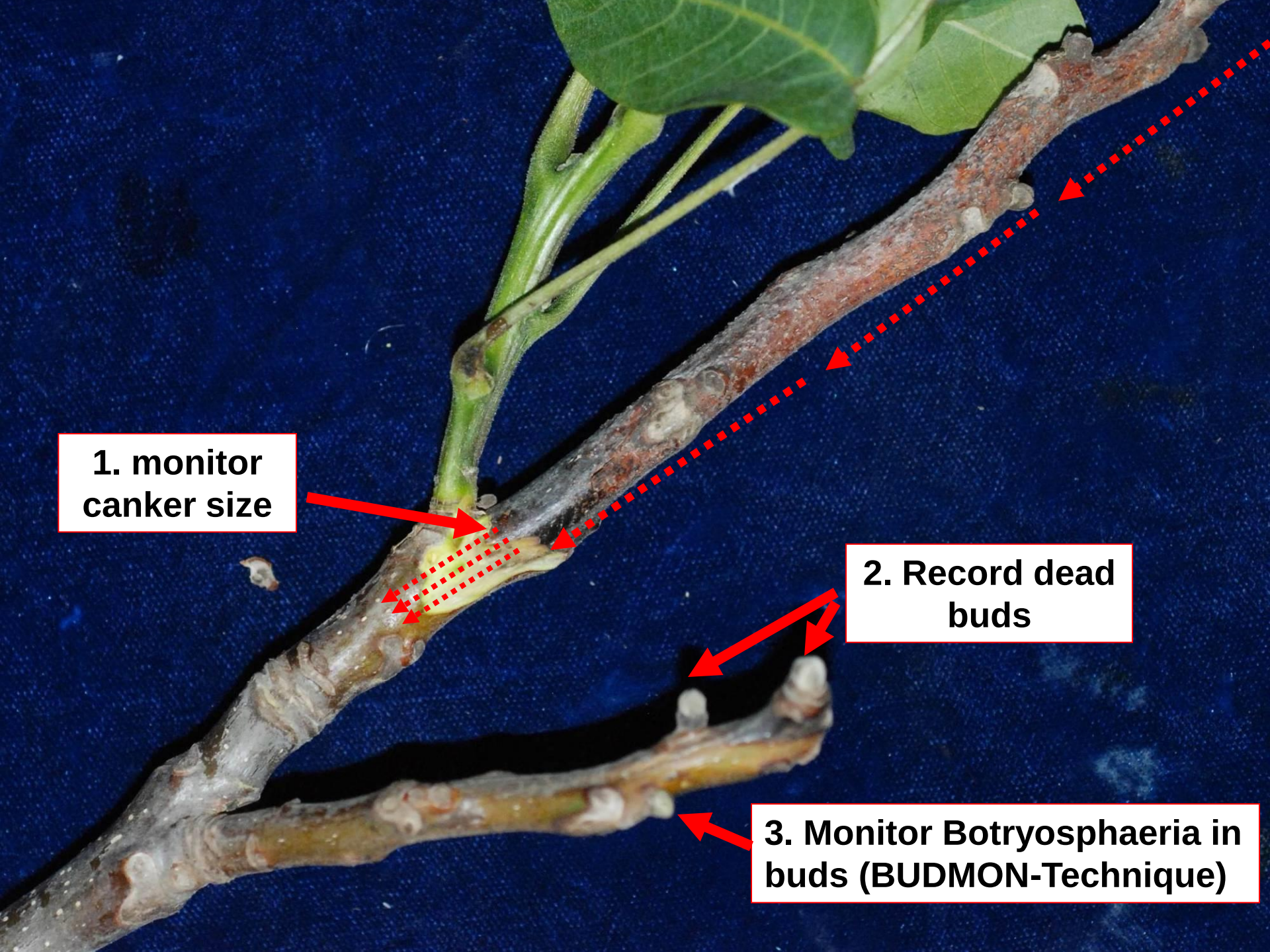
Effects of fungicides on Botryosphaeria in husks (Butte Co.; MM grower)



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)

CONLCUSIONS

- ✓ 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.

CONLCUSIONS

- ✓ 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