Managing Botryosphaeria and Phomopsis Cankers of Walnut

Themis J. Michailides

David Morgan

Dan Felts

Ryan Puckett

Michael Luna

Lorene Doster

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

Kearney Agricultural Research and Extension Center
&
University of California Cooperative Extension

Cooperating Farm Advisors and IPM Specialist (major)

Janine Hasey, Yuba/Sutter

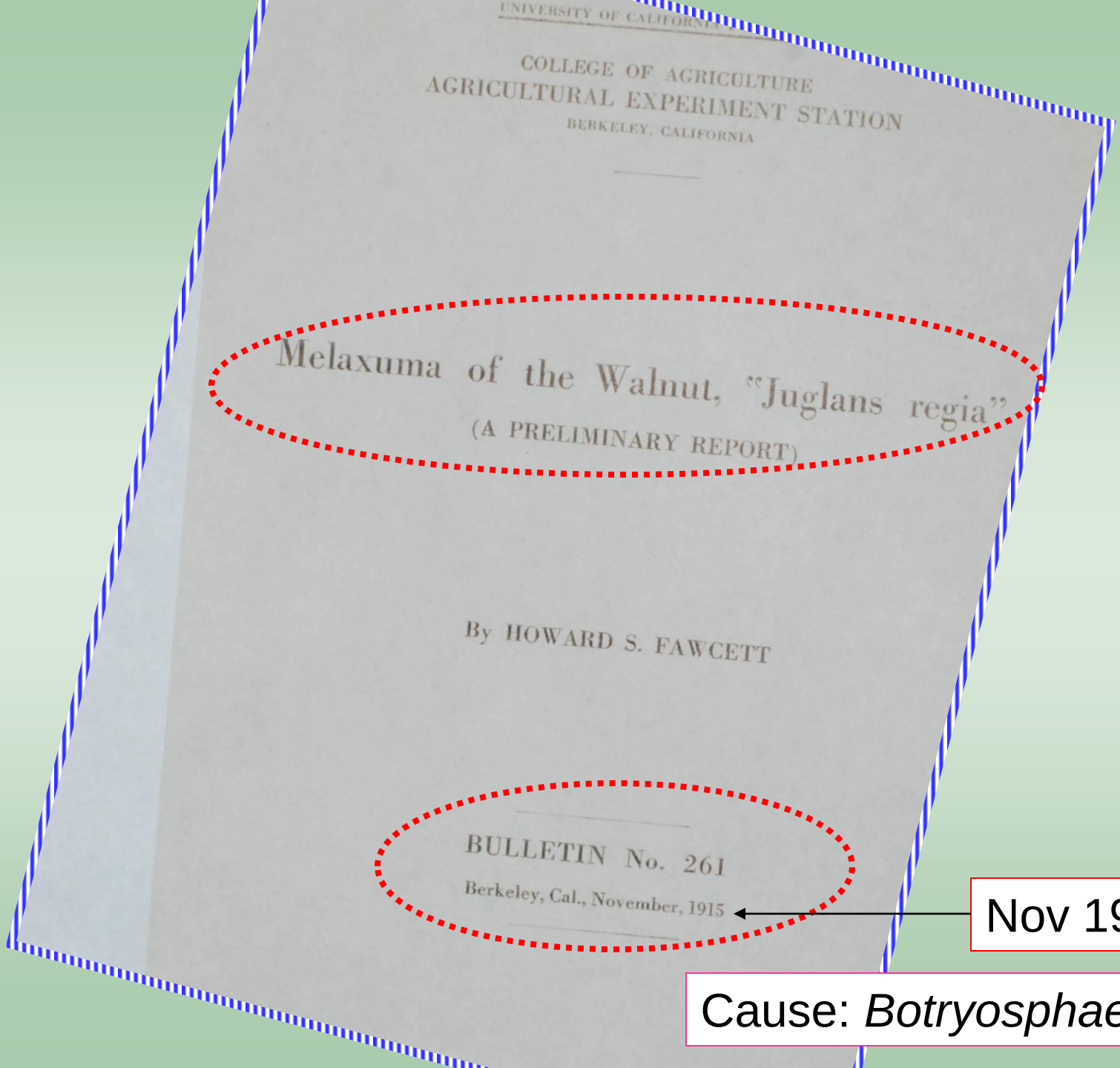
Kathy Anderson, Stanislaus

Rick Buchner, Tehama

Elizabeth Fichtner, Tulare

William Coates, San Benito

Kris Tollerup, Kearney


UNIVERSITY OF CALIFORNIA

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

Melaxuma of the Walnut, "Juglans regia"

(A PRELIMINARY REPORT)

By HOWARD S. FAWCETT

BULLETIN No. 261

Berkeley, Cal., November, 1915

Nov 1915

Cause: *Botryosphaeria ribis*

Branch wilt is caused by *Hendersonula toruloidea*

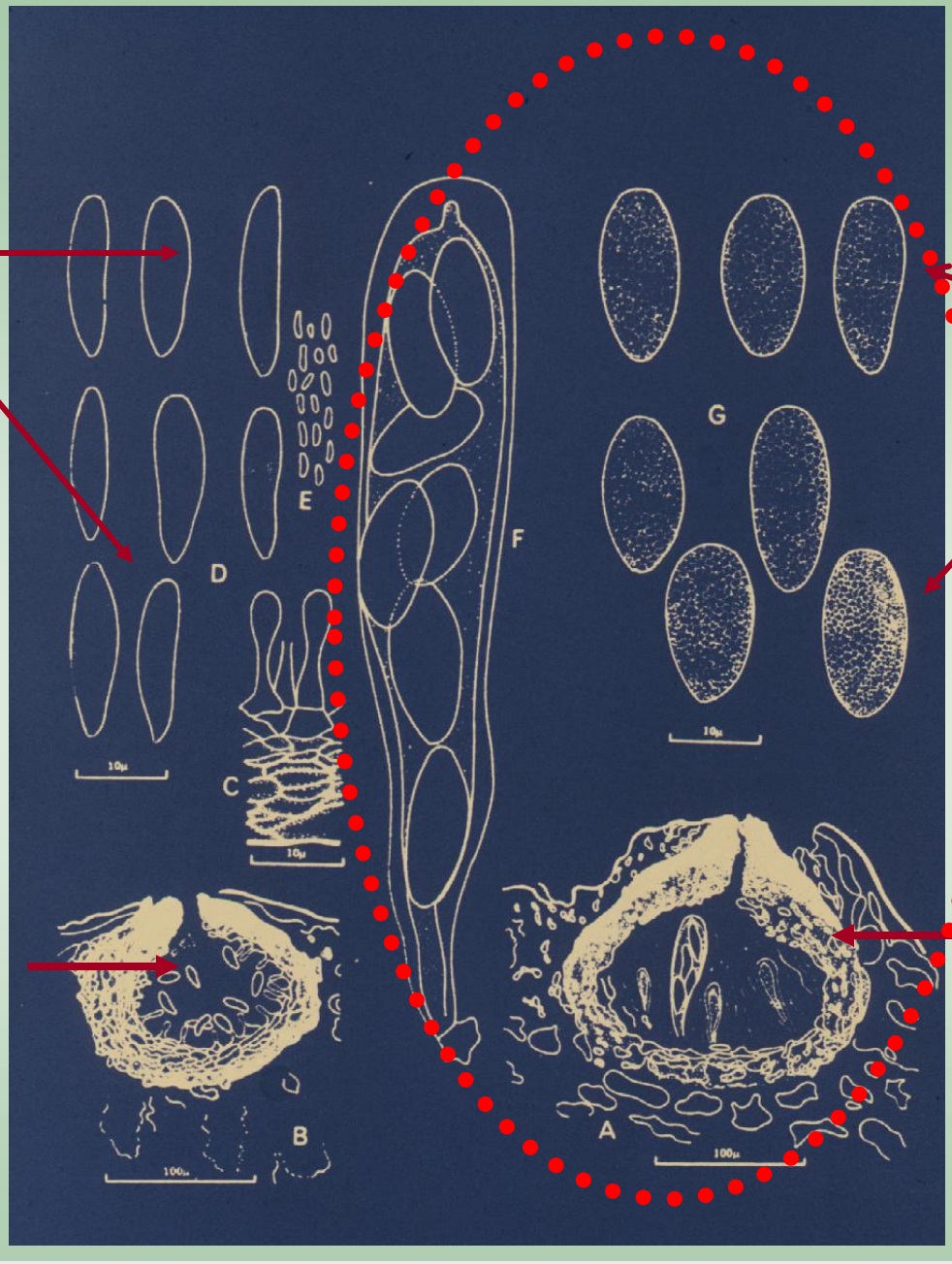
New name: *Neoscytalidium dimitiatum*

It looks very similar to branch wilt

1. Blighted branches by Botryosphaeria

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

Cankers, pycnidia, and *Botryosphaeria* in walnut branches



conidia

ascospores

✓water splashed

✓insect spread

✓airborne

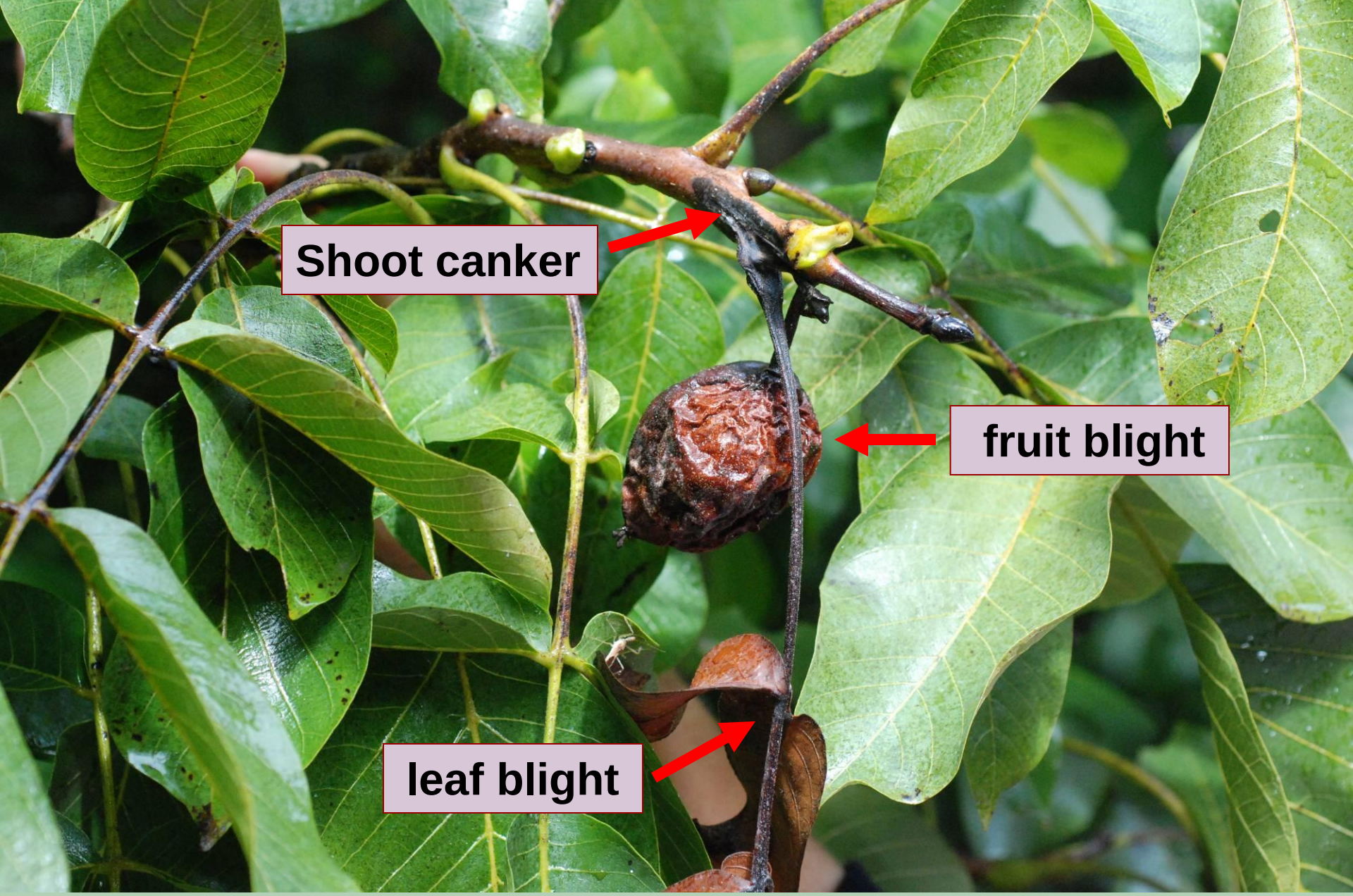
pycnidia

perithecia (ascocarps)

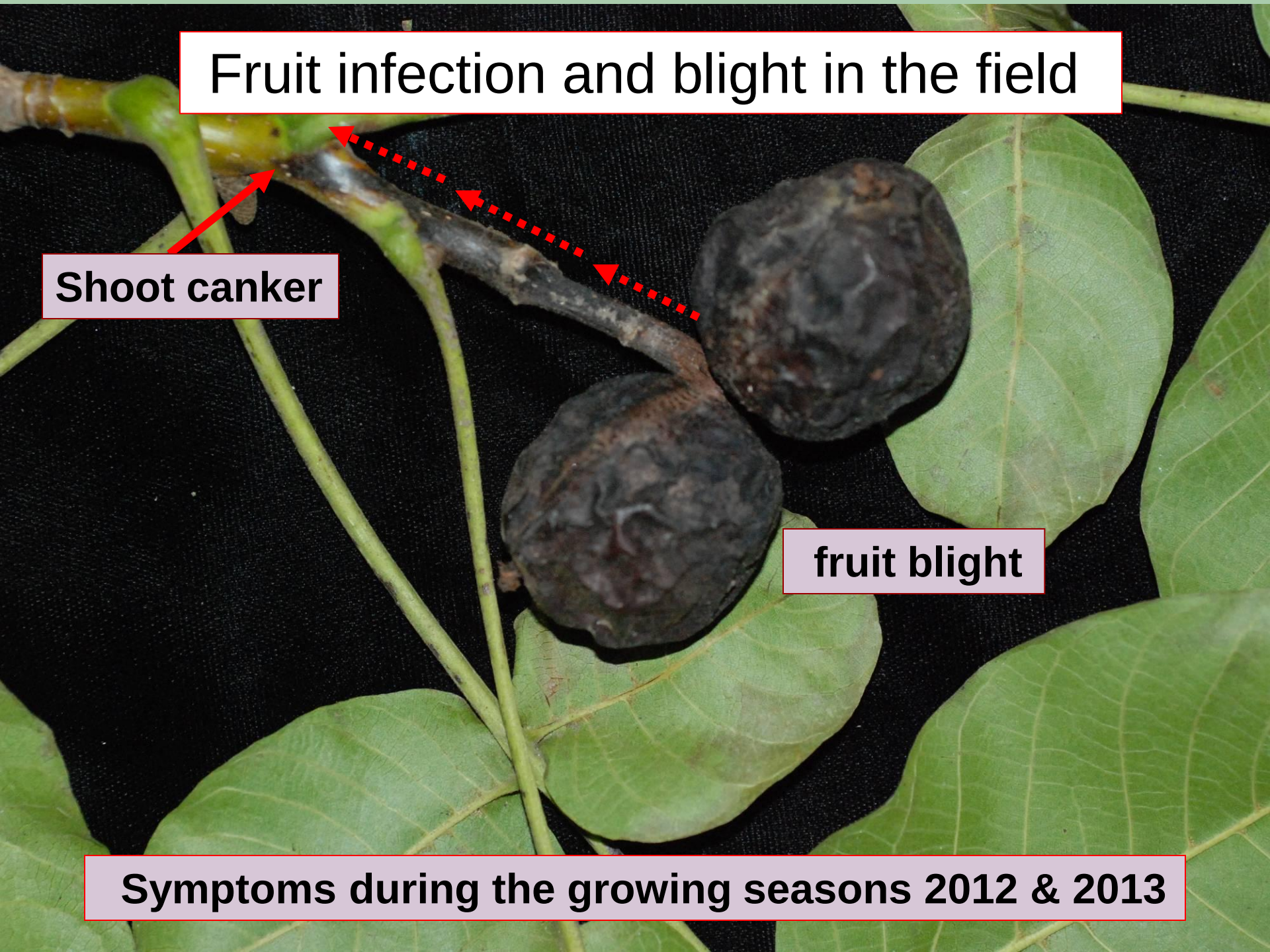
***Botryosphaeria* reproductive structures in walnut**

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

September 15, 2011, Stanislaus Co.

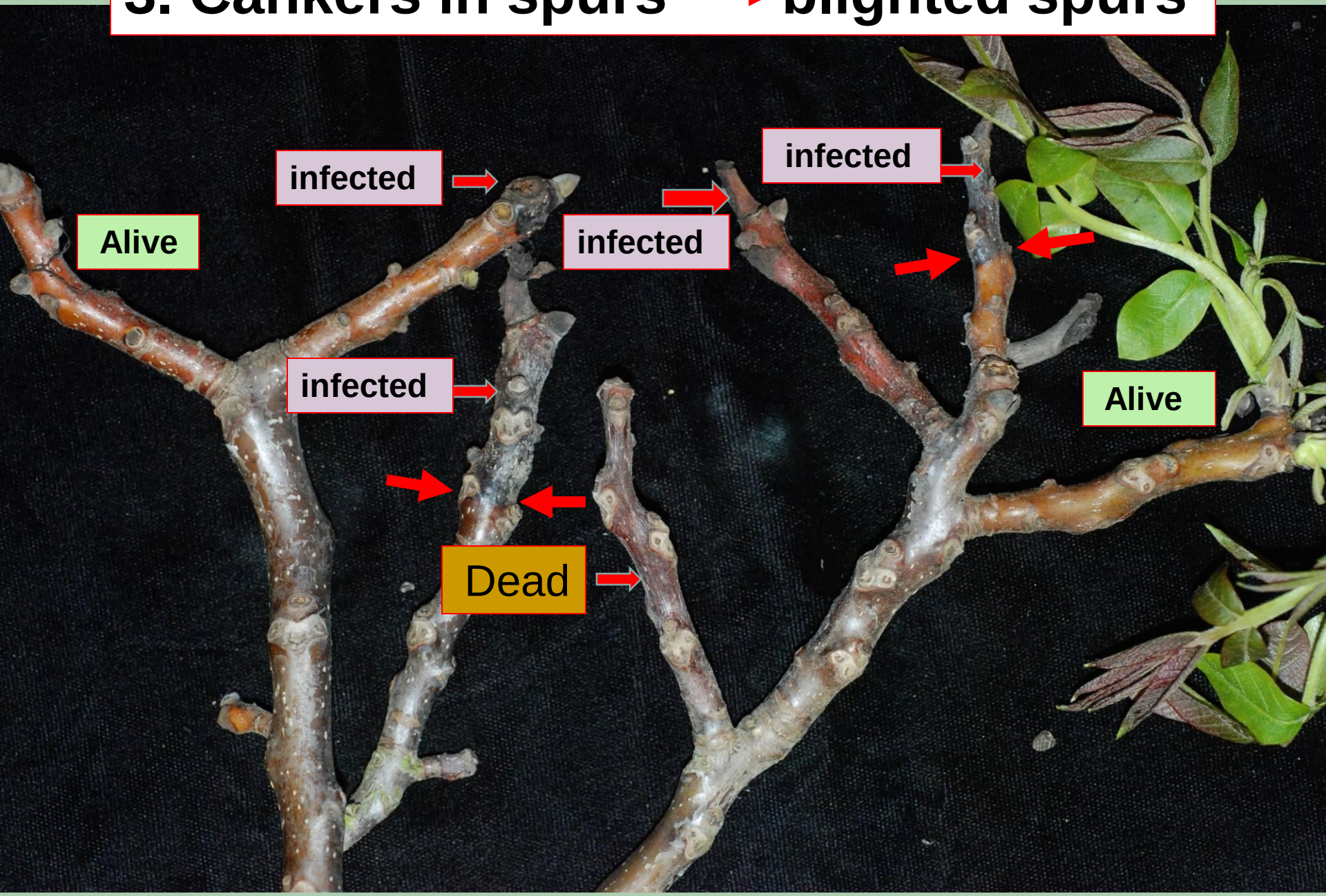


Botryosphaeria blight

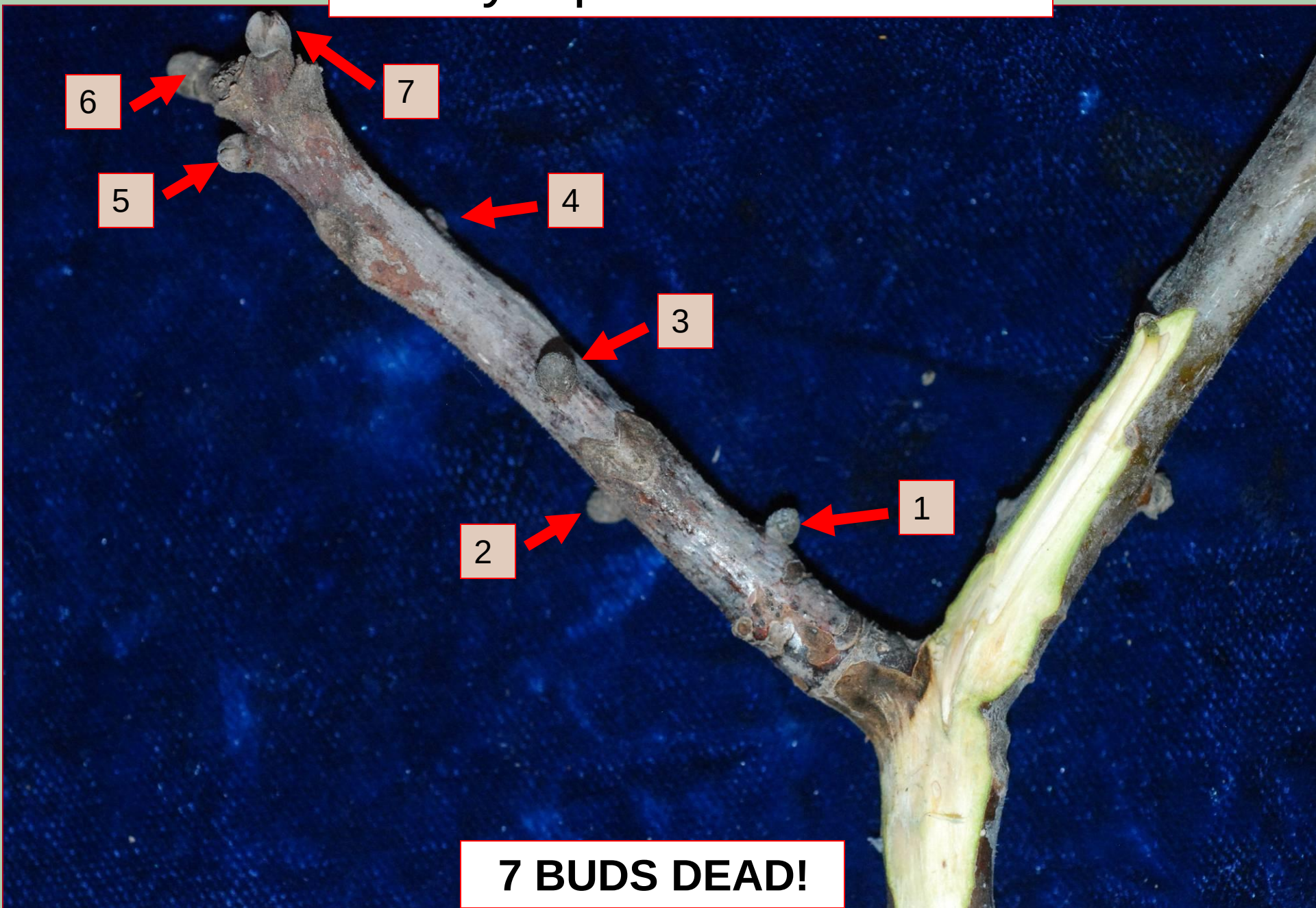

Fruit infection and blight in the field
Shoot canker
fruit blight
Symptoms during the growing seasons 2012 & 2013

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

3. Cankers in spurs → blighted spurs



Botryosphaeria kills buds



7 BUDS DEAD!

4. Walnut Blight & Botryosphaeria

Botryosphaeria

Phomopsis


Fusarium spp.


Alternaria alternata


Gloeosporium.


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	28	---
2	**Tree**	-	12	---	12	72	---
3	**Tree**	+	11	29	34	---	---
4	**Tree**	ND	80	10	10	---	---
1	**Ground**	+	67	67	50	67	33
4	**Ground**	ND	50	50	25	---	---

Incidence of fungal pathogens isolated from blighted fruit collected from trees

Orchard	Collection	Walnut blight (%)	Botryosph. /Phom (%)	Fusarium (%)	Alternaria (%)	Aspergillus/ Penicillium (%)	Gloeosporium & Colletotrichum (%)
1	**Tree**	+20	10	80	60	20	---
2	**Tree**	+10	10	80	30	50	---
3	**Tree**	+10	20	40	60	---	---
4	**Tree**	+20	30	50	30	10	---
5	**Tree**	-	50	10	60	40	
6	**Tree**	-	0	70	30	10	---
7	**Tree**	+	0	80	30	10	---

Is walnut blight an entry for Botryosphaeria infections?

More examples:

Fruit Sample # 13091 (18 Jul 2013)

26%	**Walnut blight**
39%	***Botryosphaeria***
22%	***Botryosphaer.*** *+ Aspergillus*
17%	*Alternaria*
35%	*Fusarium*

Fruit Sample: 1 Aug 2013 (Tehama Co.)

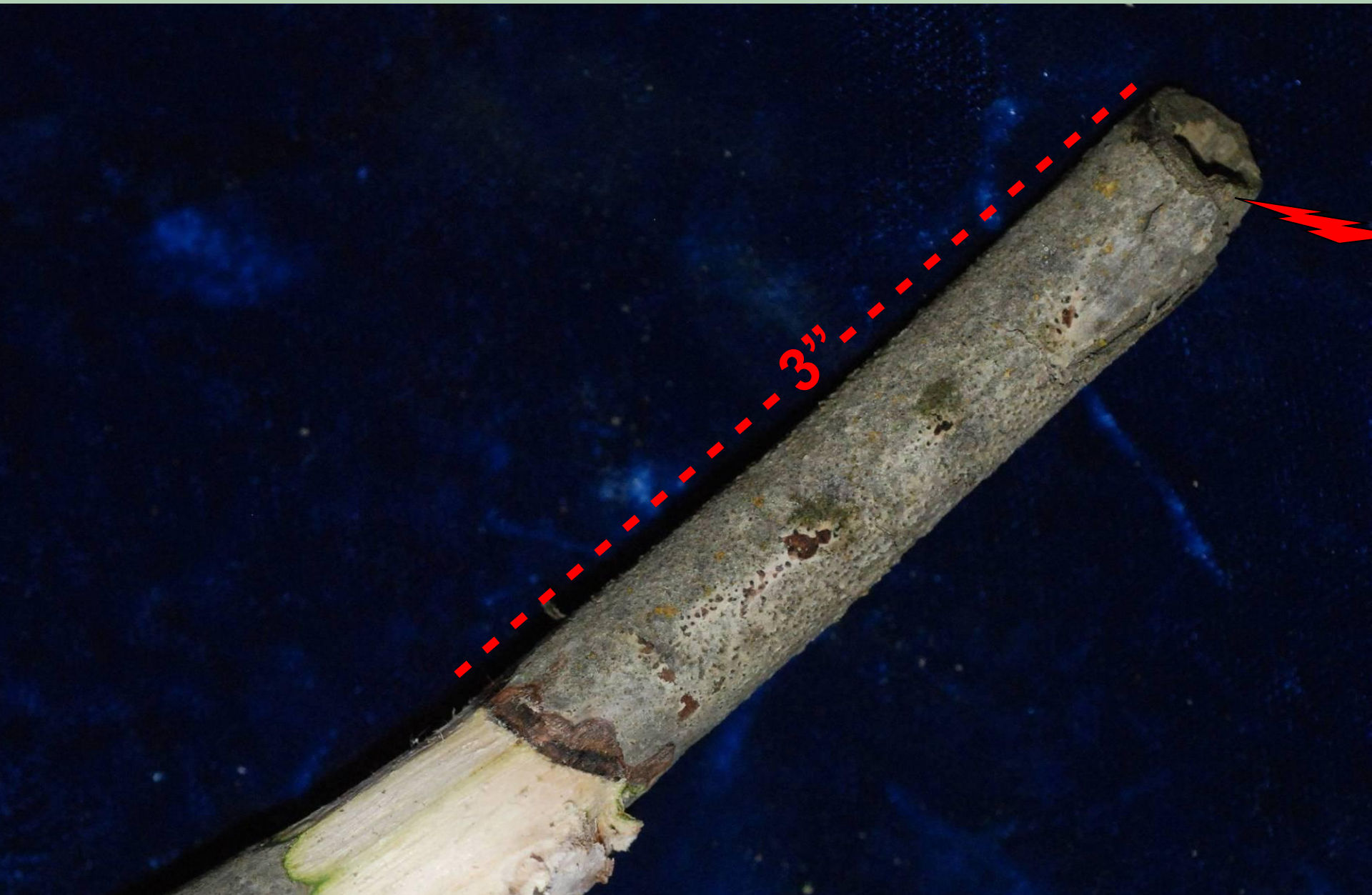
32%	**Walnut blight**
30%	***Botryosphaeria***
40%	*Alternaria*
8%	*Fusarium*
8%	*Aspergillus niger*
4%	*Phomopsis*

Decayed walnut fruit during the season
1. Walnut blight
2. *Botryosphaeria*
3. *Phomopsis*
4. *Fusarium* spp.
5. *Alternaria* spp.
6. *Aspergillus niger*
7. *Gleosporium* spp.; 8. *Colletotrichum acutatum*

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

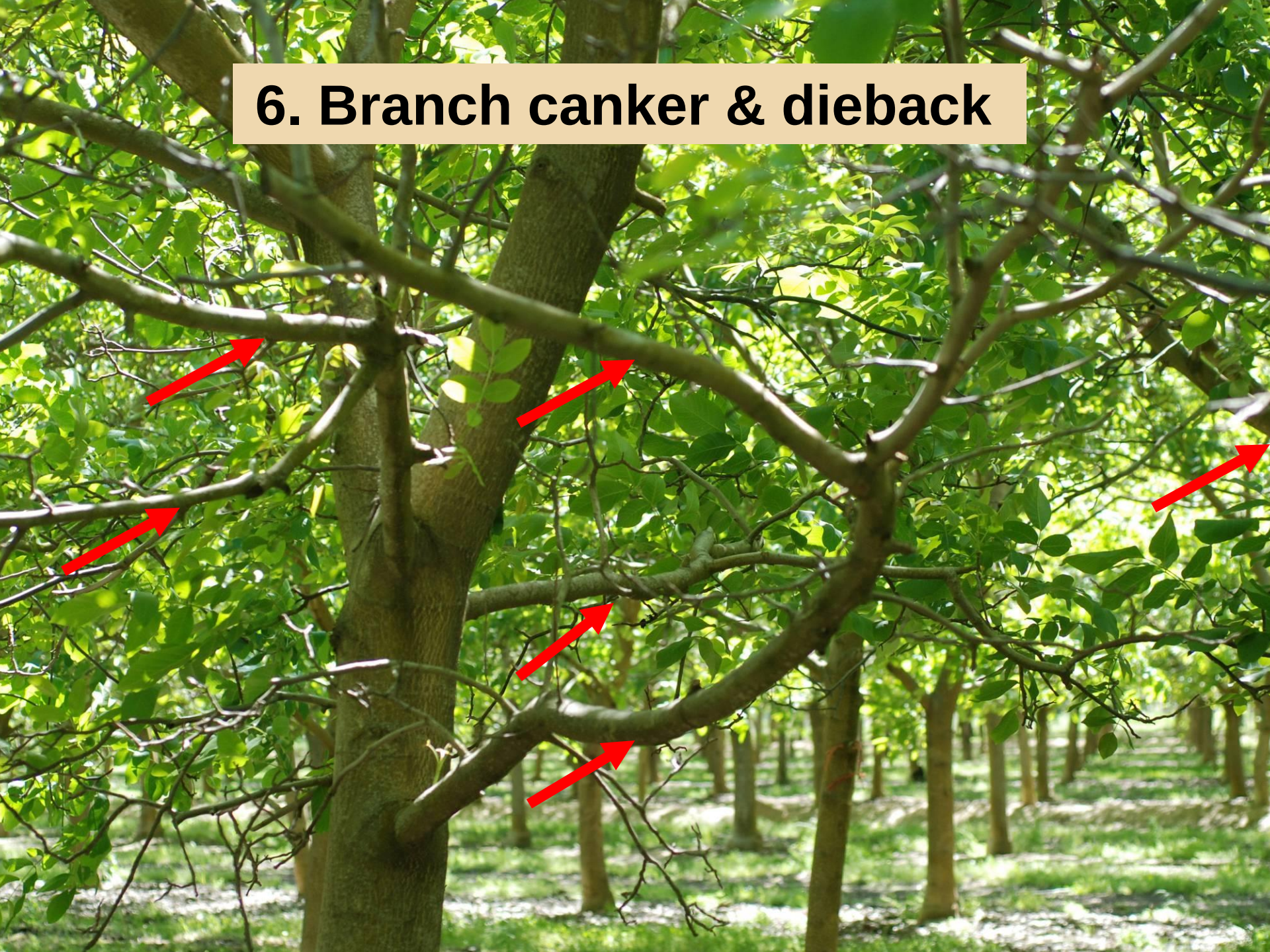

Botryosphaeria sp.
Shell staining and kernel decay

5. Cankers assoc. with pruning wounds



cv. Howard

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


6. Branch canker & dieback

Identification and distribution of Botryosphaeriaceae from California walnuts (2012 & 2013)

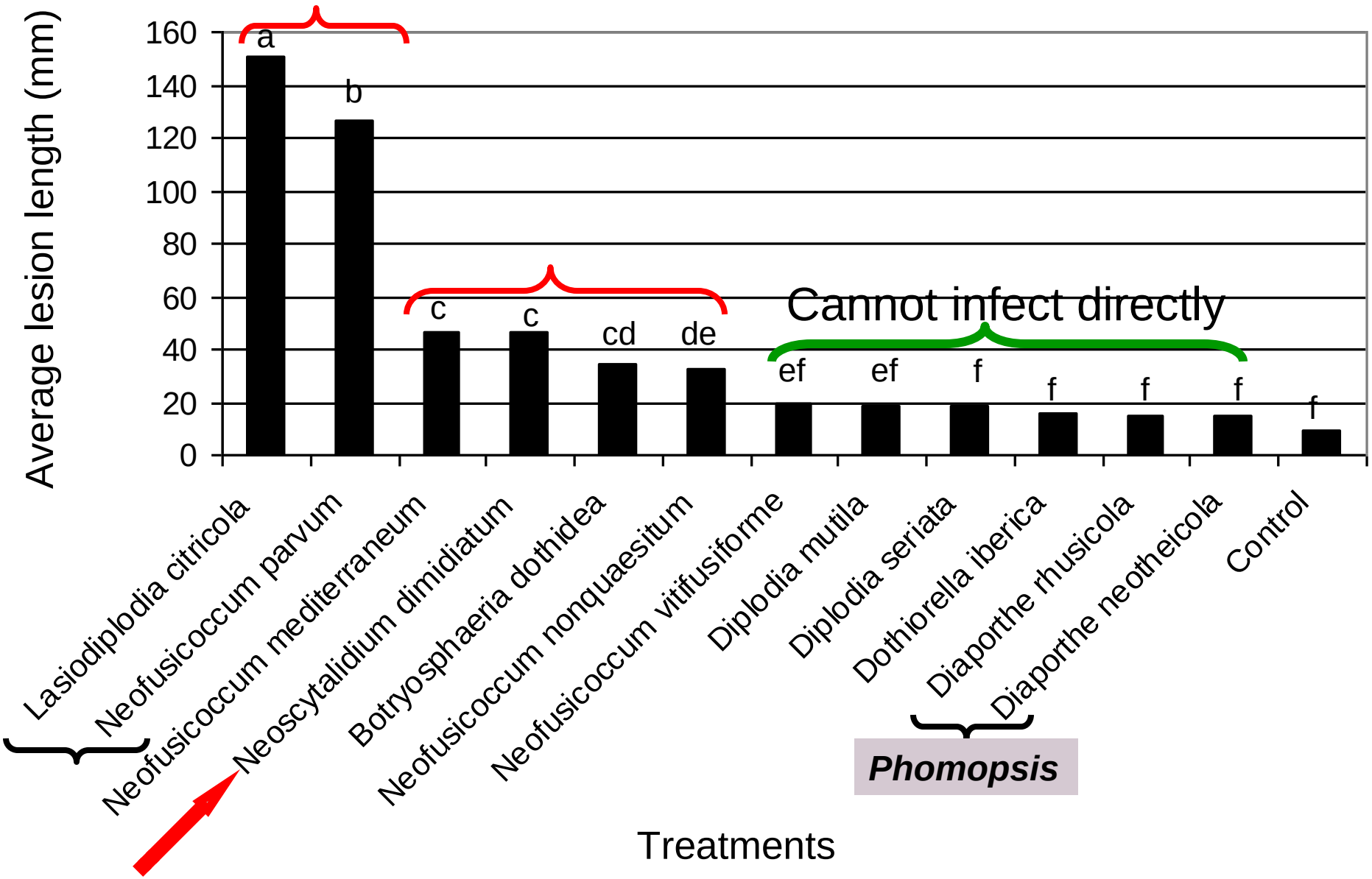
Species name	# isol.	Distribution /County
1. Botryosphaeria dothidea	4	Butte, Glenn, Yuba
2. Neofusicoccum parvum	6	Butte, Stanislaus, Yolo
3. Neofusicoccum mediterraneum	138	Butte, Glenn, Sutter, Yuba, Colusa, Yolo, Merced, San Joaquin, Tulare, Fresno, Stanislaus
4. Diplodia mutila	6	Tulare, Ventura, Yolo
5. Neofusicoccum nonquaesitum	4	Colusa, Sutter, Yuba
6. Neofusicoccum vitifusiforme	3	Fresno
7. Diplodia seriata	13	Fresno, San Benito, Kings, Merced, Tulare
8. Dothiorella iberica	1	Yolo
9. Lasiodiplodia citricola	2	Stanislaus
10. Neoscytalidium dimitiatum (=*Hendersonula toruloidea*)		
1. *Diaporthe rhusicola* (*Phomopsis*)	6	Kings, Stanislaus, Sutter, Butte,
2. *Diaporthe neitheicola*	1	Stanislaus and other counties

The branch wilt fungus

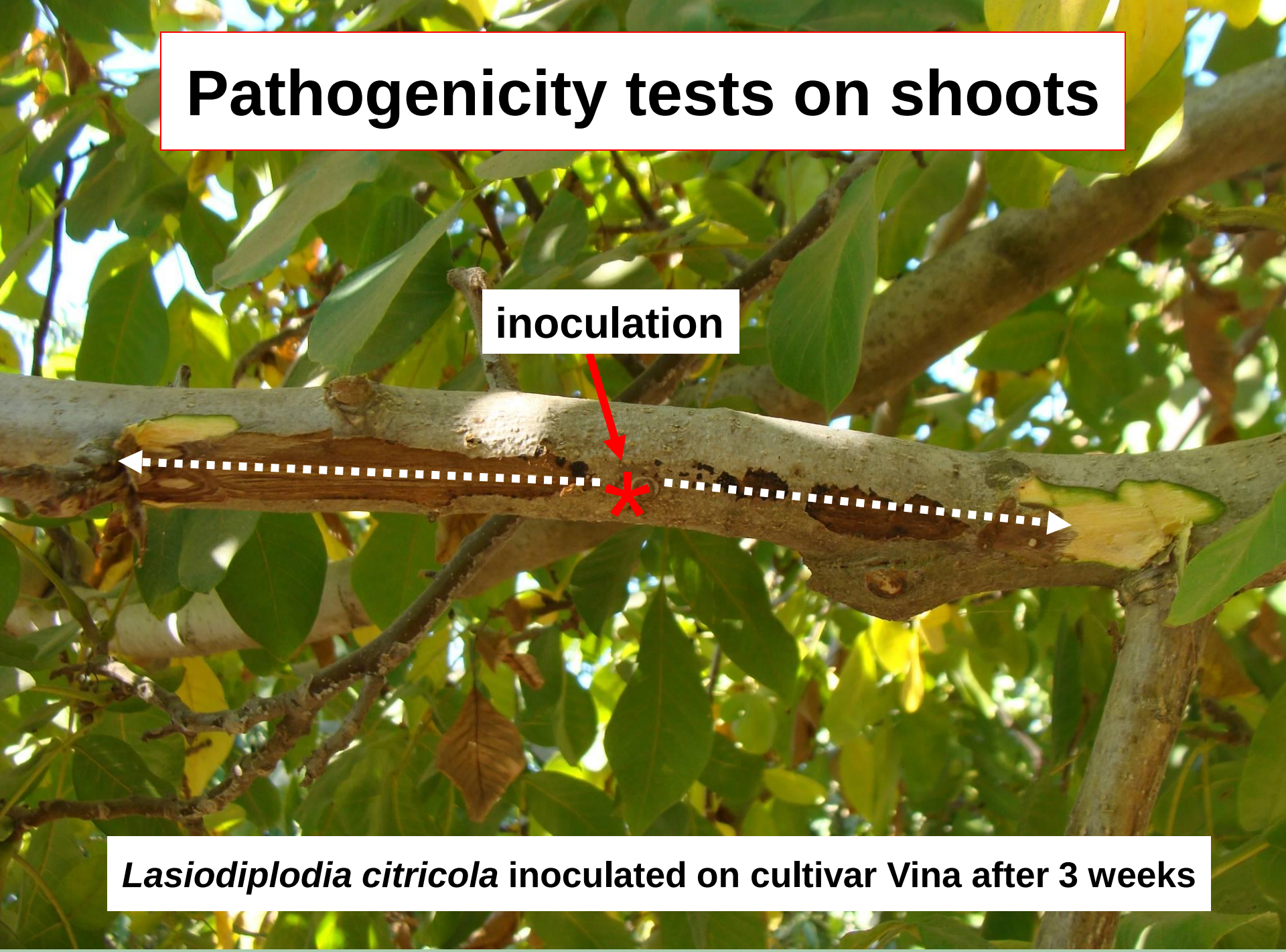
Summary of Botryosphaeriaceae in nut crops – California

Fungal species	Walnut	Pistachio	Almond
Botryosphaeria dothidea	+	+	+
Neofusicoccum parvum	+	+?	+
Neofusicoccum mediterraneum	+	+	+
Diplodia mutila	+	---	---
Neofusicoccum nonquaesitum	+	---	+
Neofusicoccum vitifusiforme	+	+	---
Diplodia seriata	+	+	+
Dothiorella iberica	+	+	+
Lasiodiplodia citricola	+	+	---
Neoscytalidium dimitiatum (*Hendersonula toruloidea*)	+	---	+
Diaporthe rhusicola (*Phomopsis*)	+	+	+
Diaporthe neitheicola (*Phomopsis*)	+	---	---

Pathogenicity tests on shoots



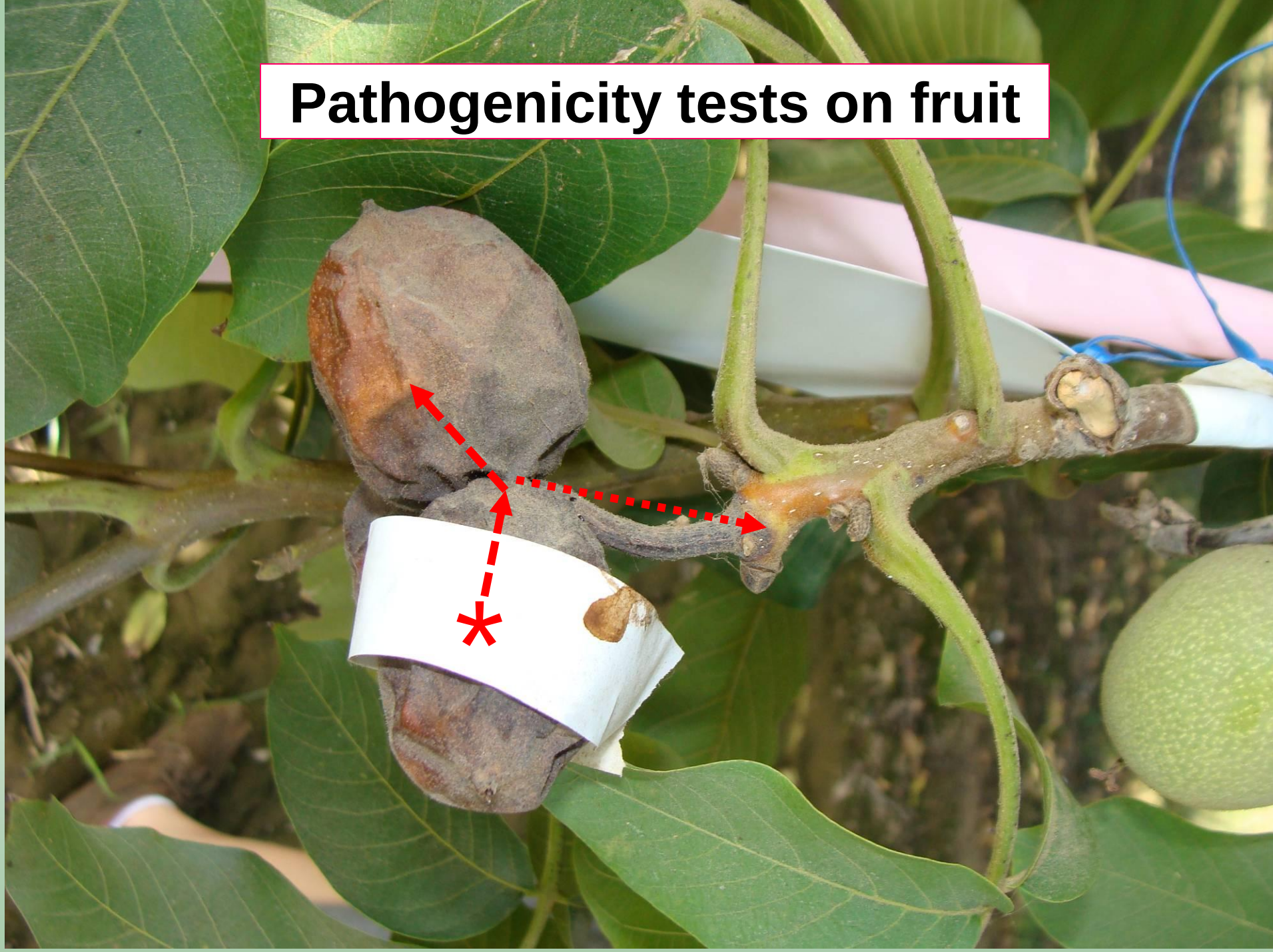
Pathogenicity tests on shoots



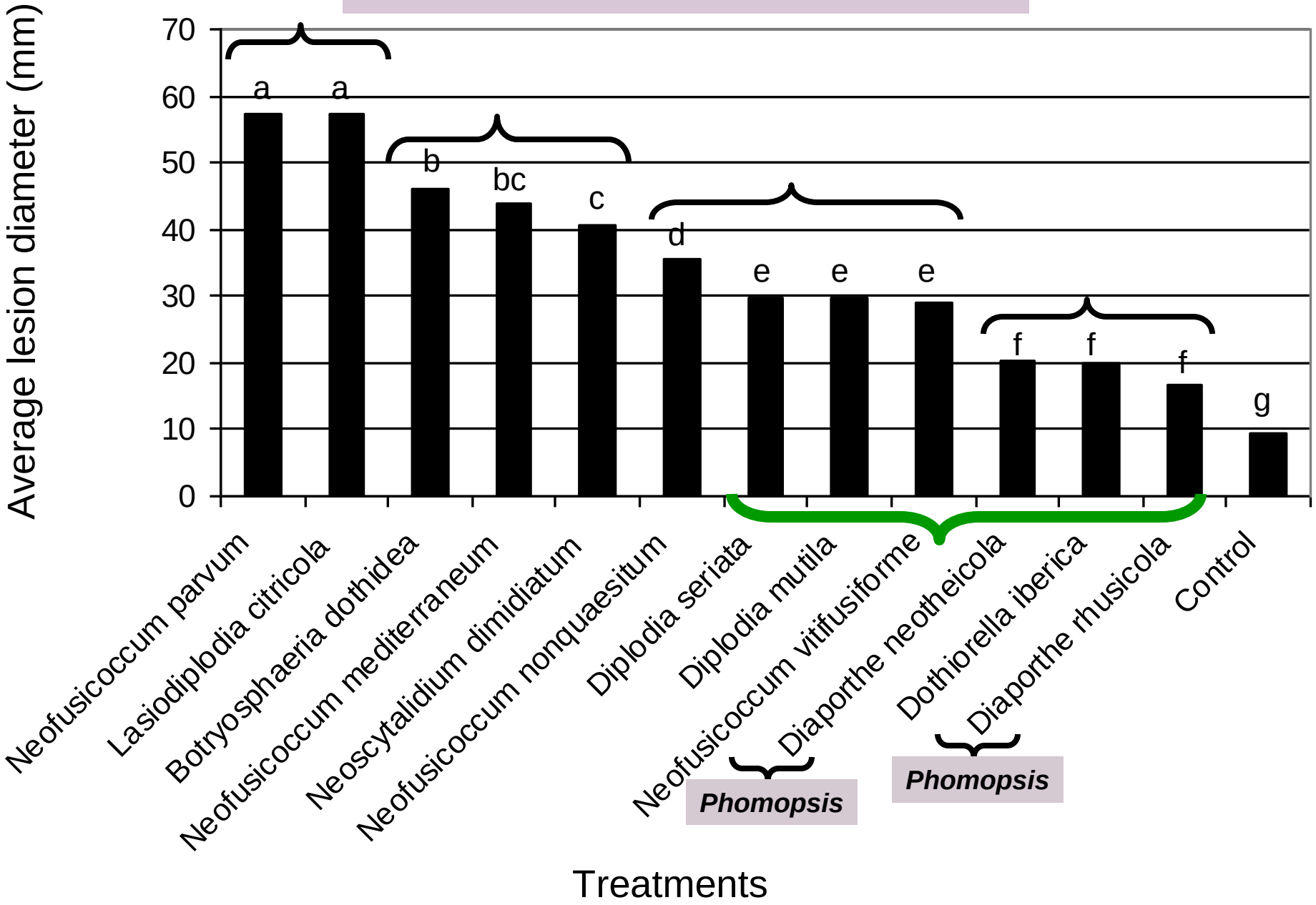
Lasiodiplodia citricola **inoculated on cultivar Vina after 3 weeks**

After artificial inoculation

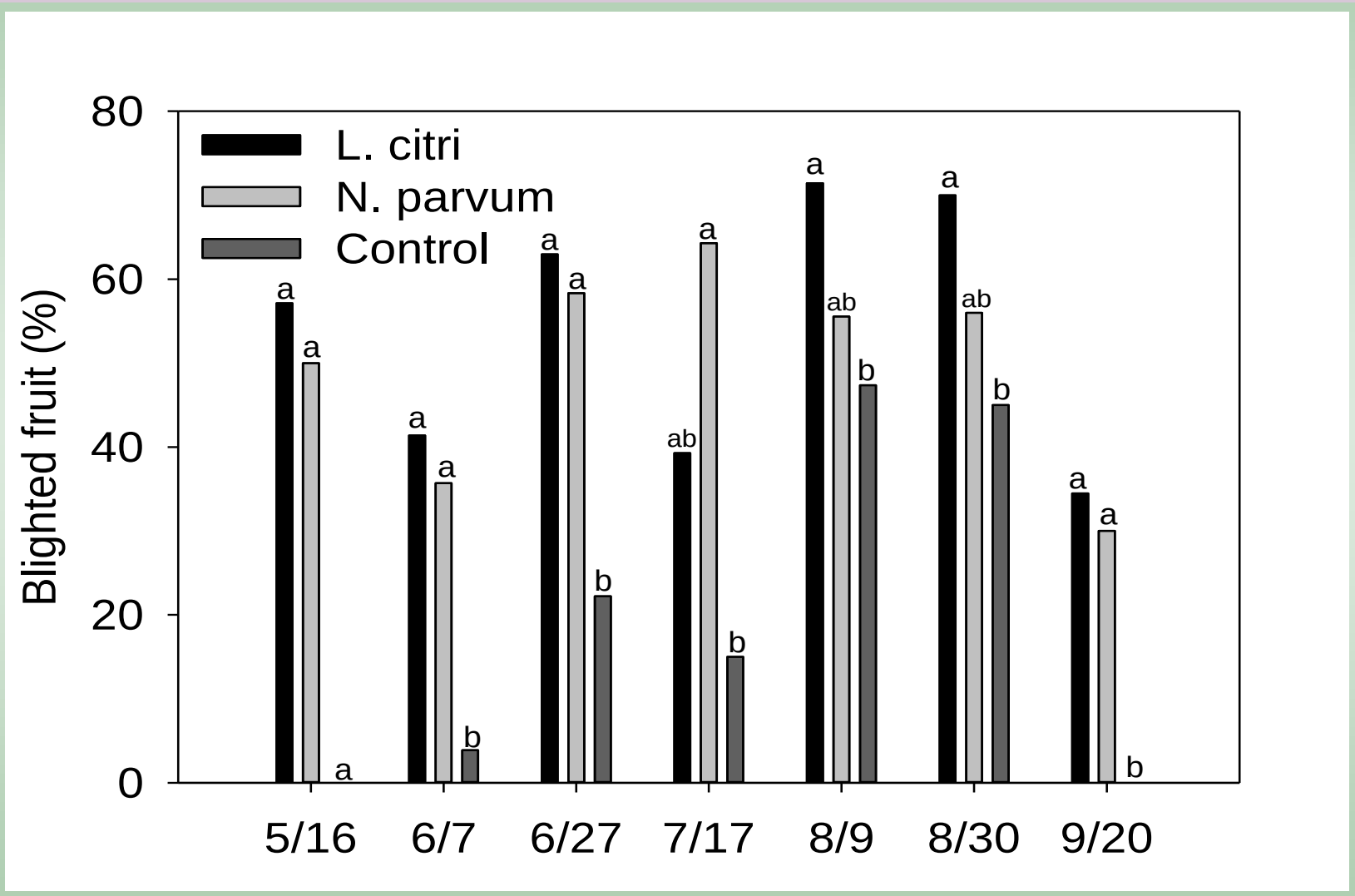
Pathogenicity tests on fruit



Pathogenicity tests on fruit



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



… after wounding…

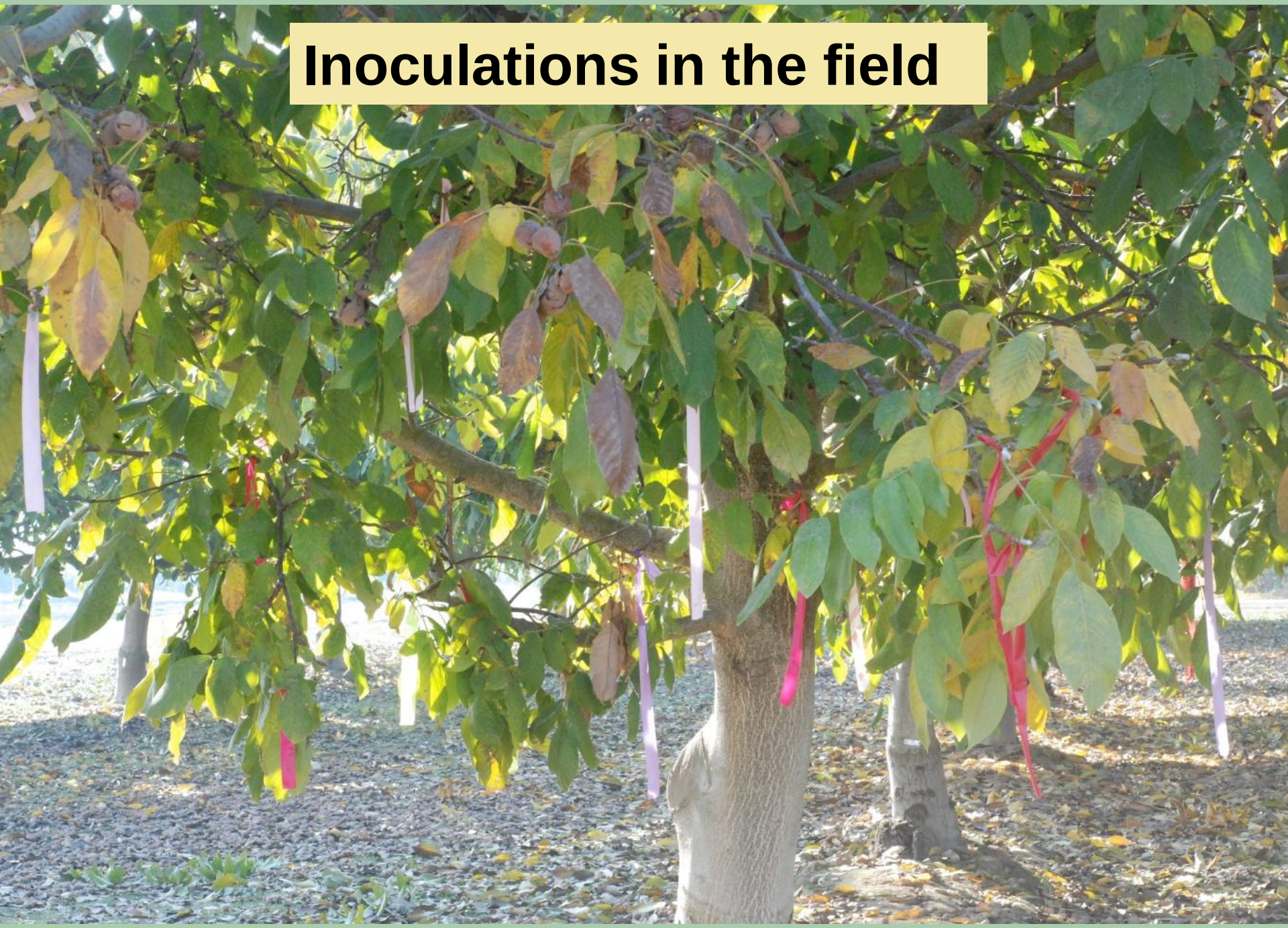
Incidence of fungal pathogens isolated from blighted fruit (collected from trees & ground)

Orchard	Collection	Walnut blight	Botryosph. /Phom (%)	Fusarium (%)	Alternaria (%)	Aspergillus (%)	Gloeosporium & Colletotrichum (%)
1	Tree	+	20	---	40	28	---
2	Tree	-	12	---	12	72	---
3	Tree	+	11	29	34	---	---
4	Tree	ND	80	10	10	---	---
1	Ground	+	67	67	50	67	33
4	Ground	ND	50	50	25	---	---

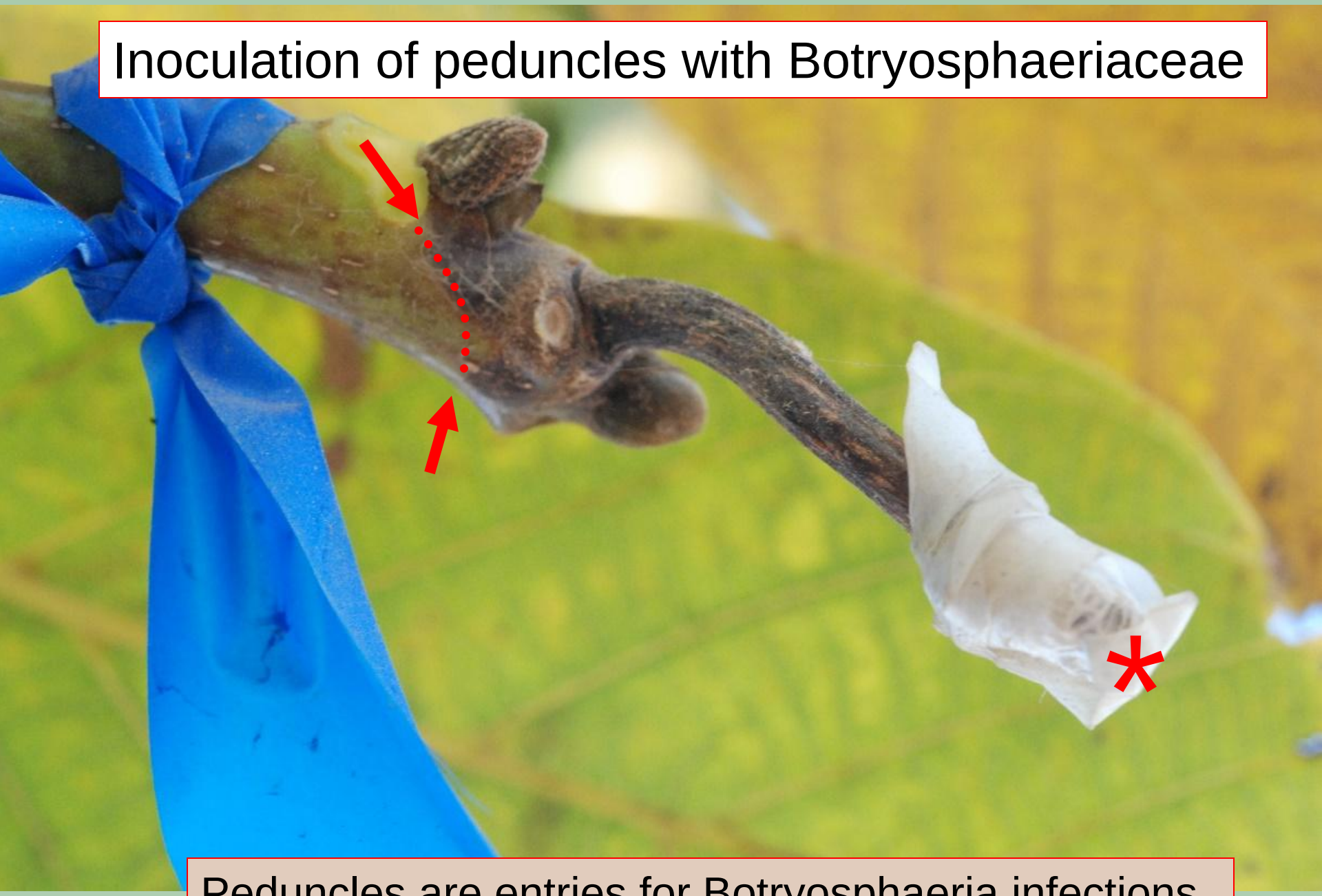
It seems that walnut blight can serve as an entry for *Botryosphaeria* infections ...

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

Inoculations in the field

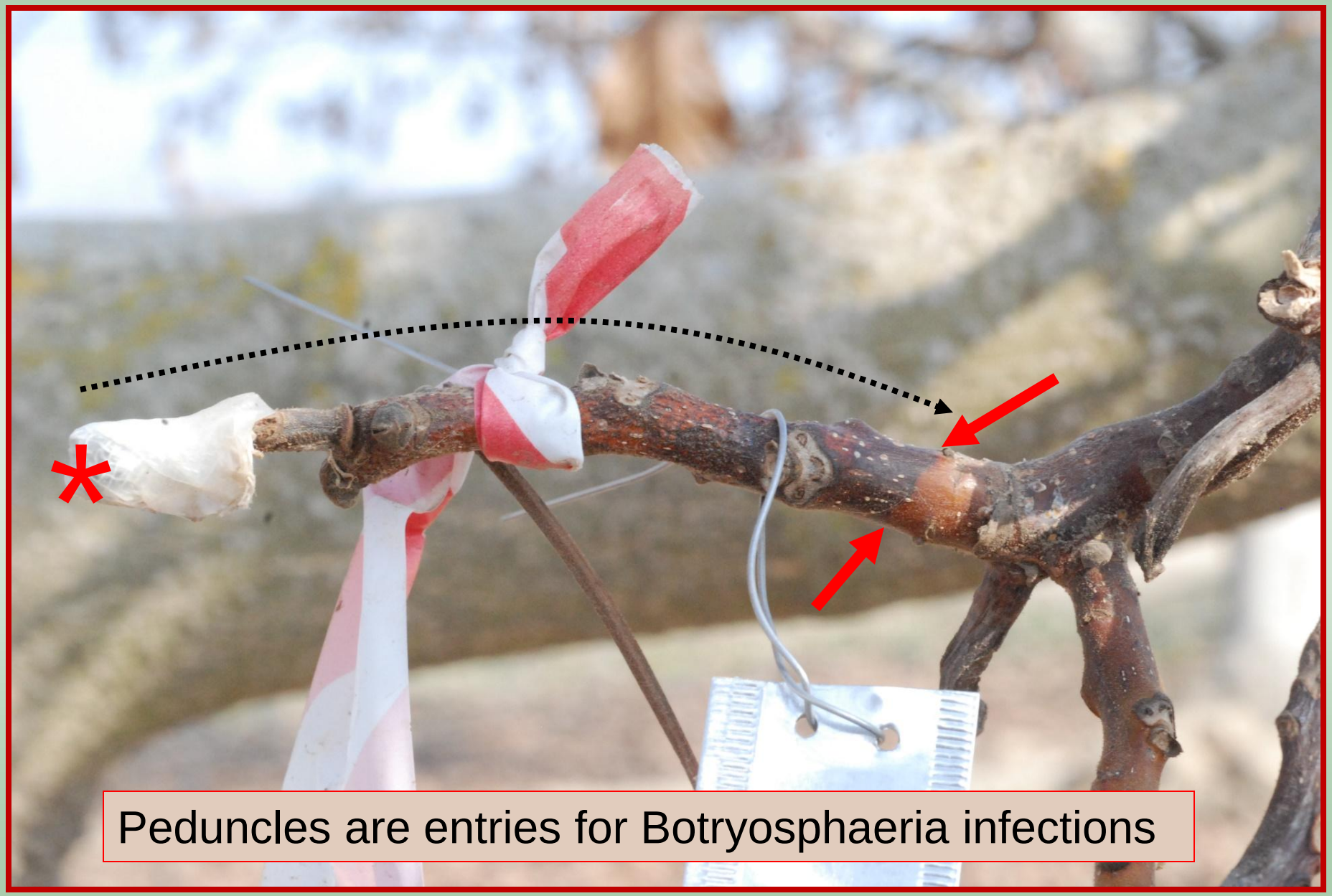


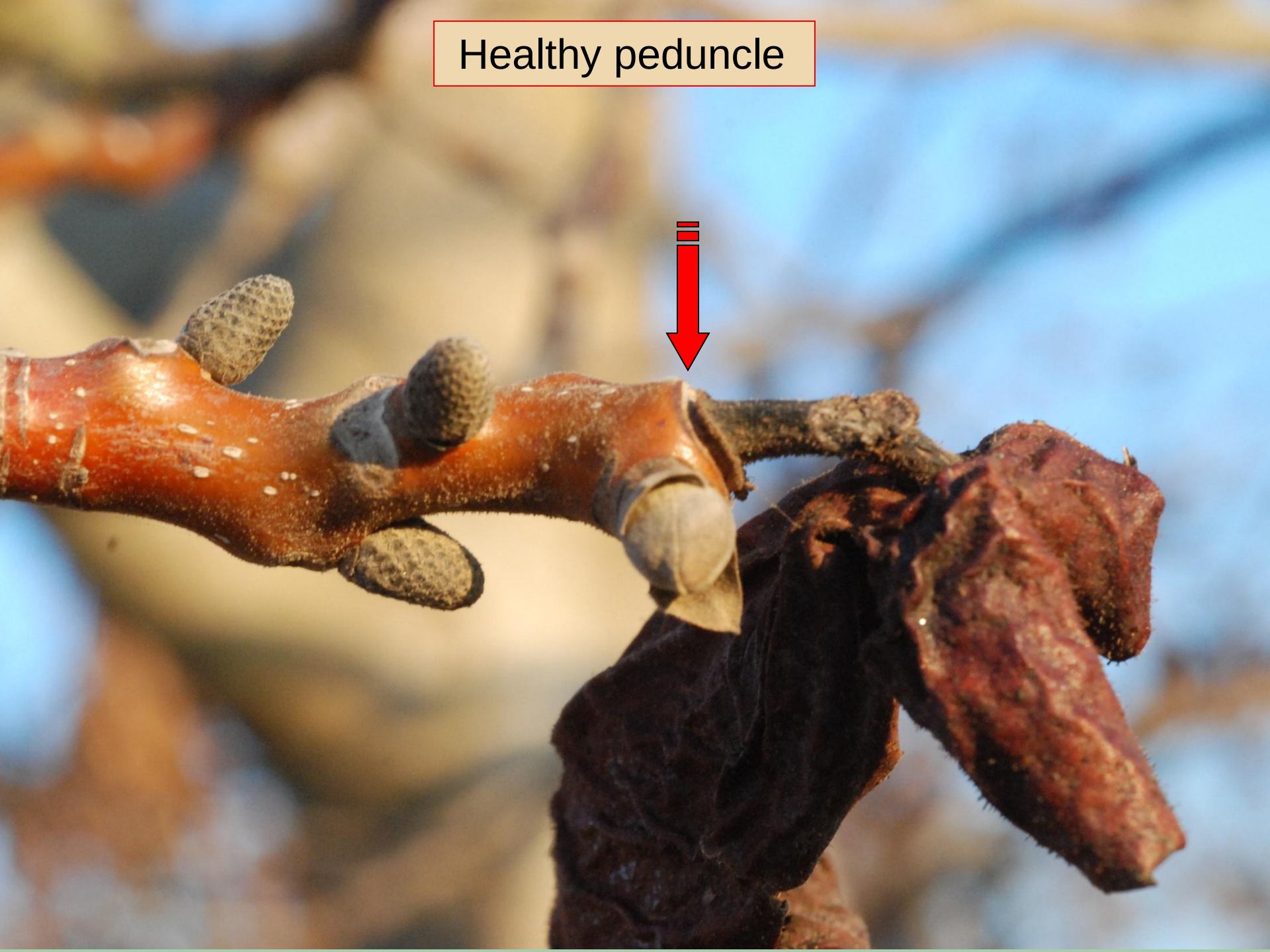
Inoculation of peduncles with Botryosphaeriaceae



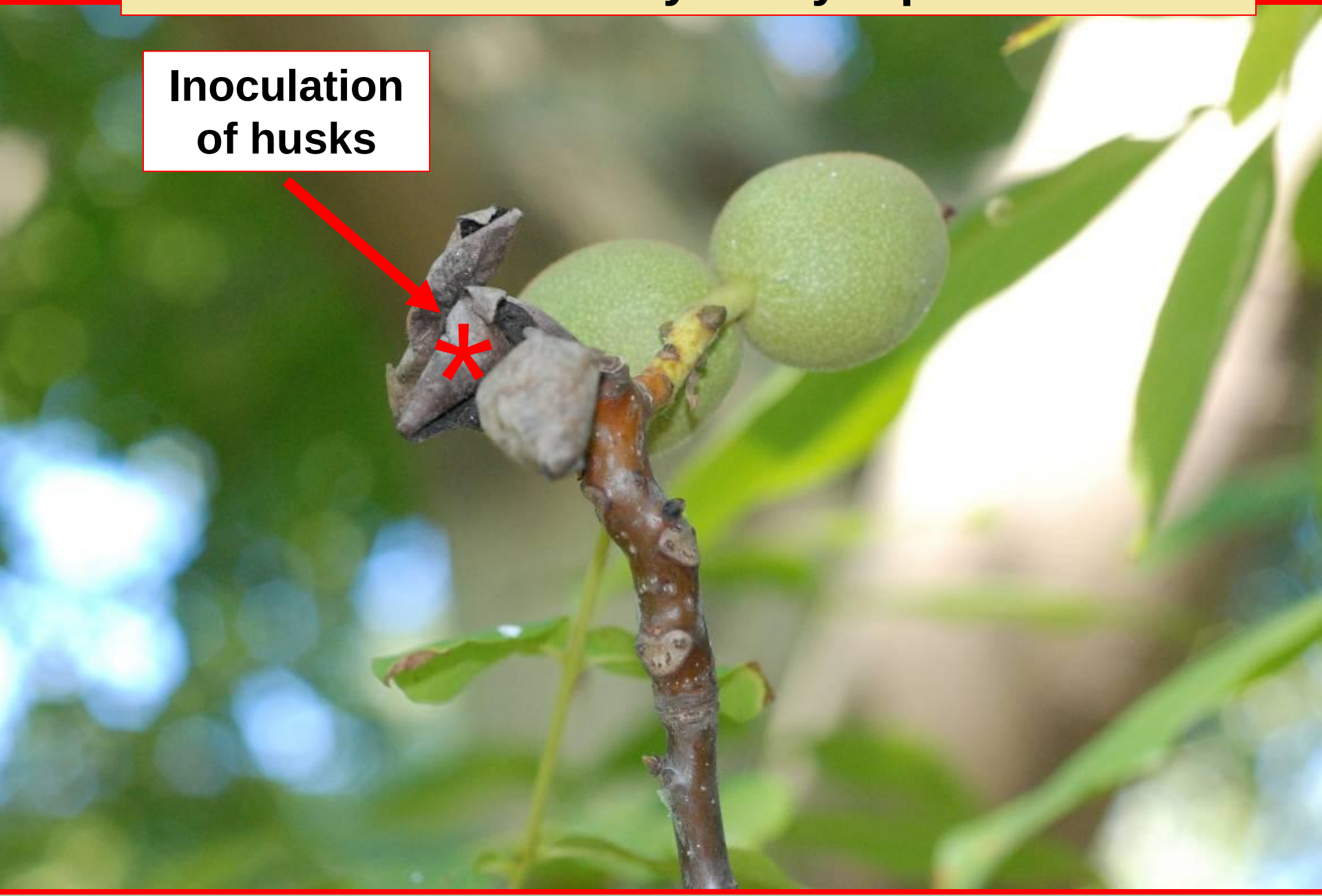
Peduncles are entries for Botryosphaeria infections

Inoculation of peduncles with Botryosphaeriaceae

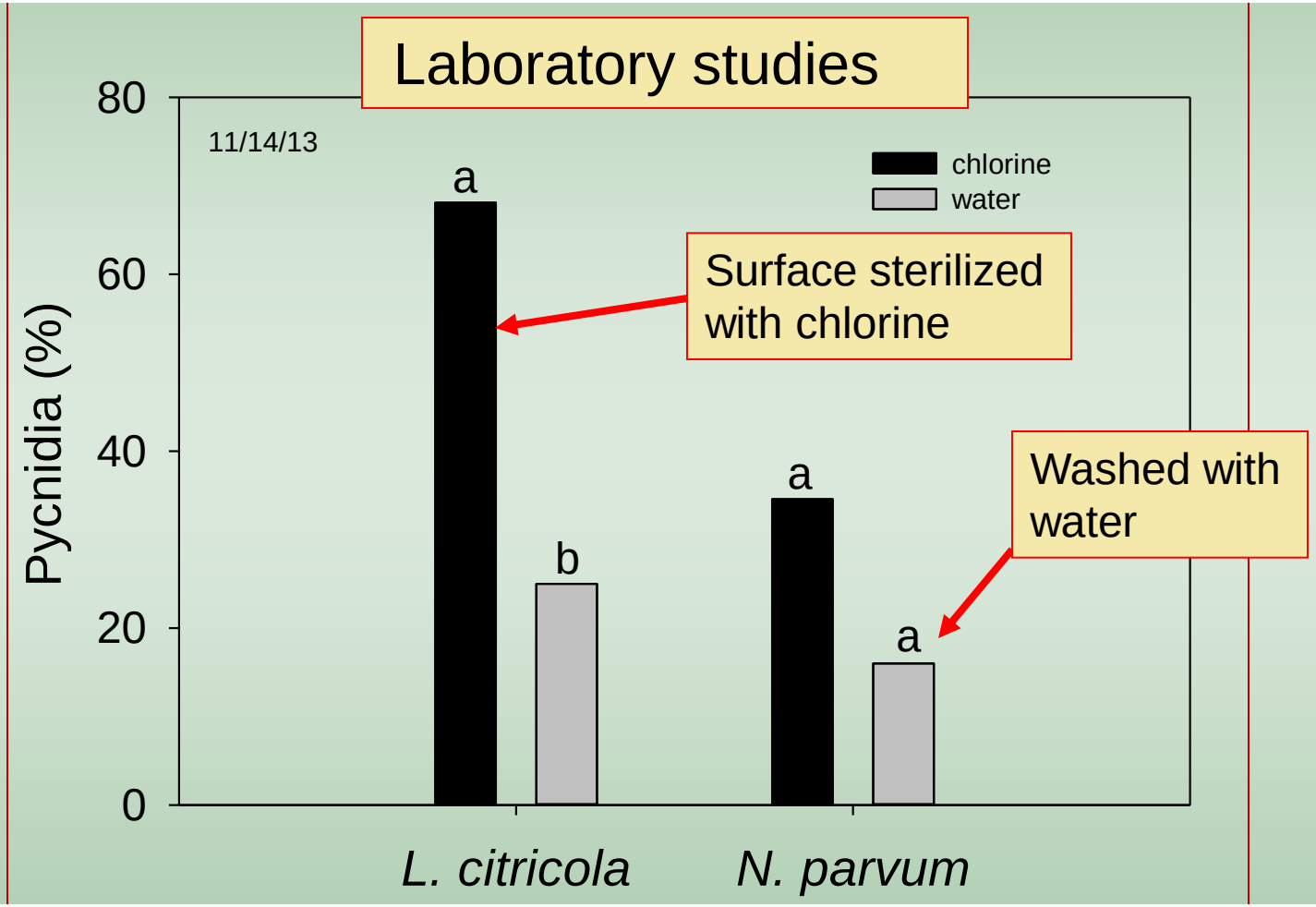



Healthy peduncle

Infection of husks by Botryosphaeriaceae

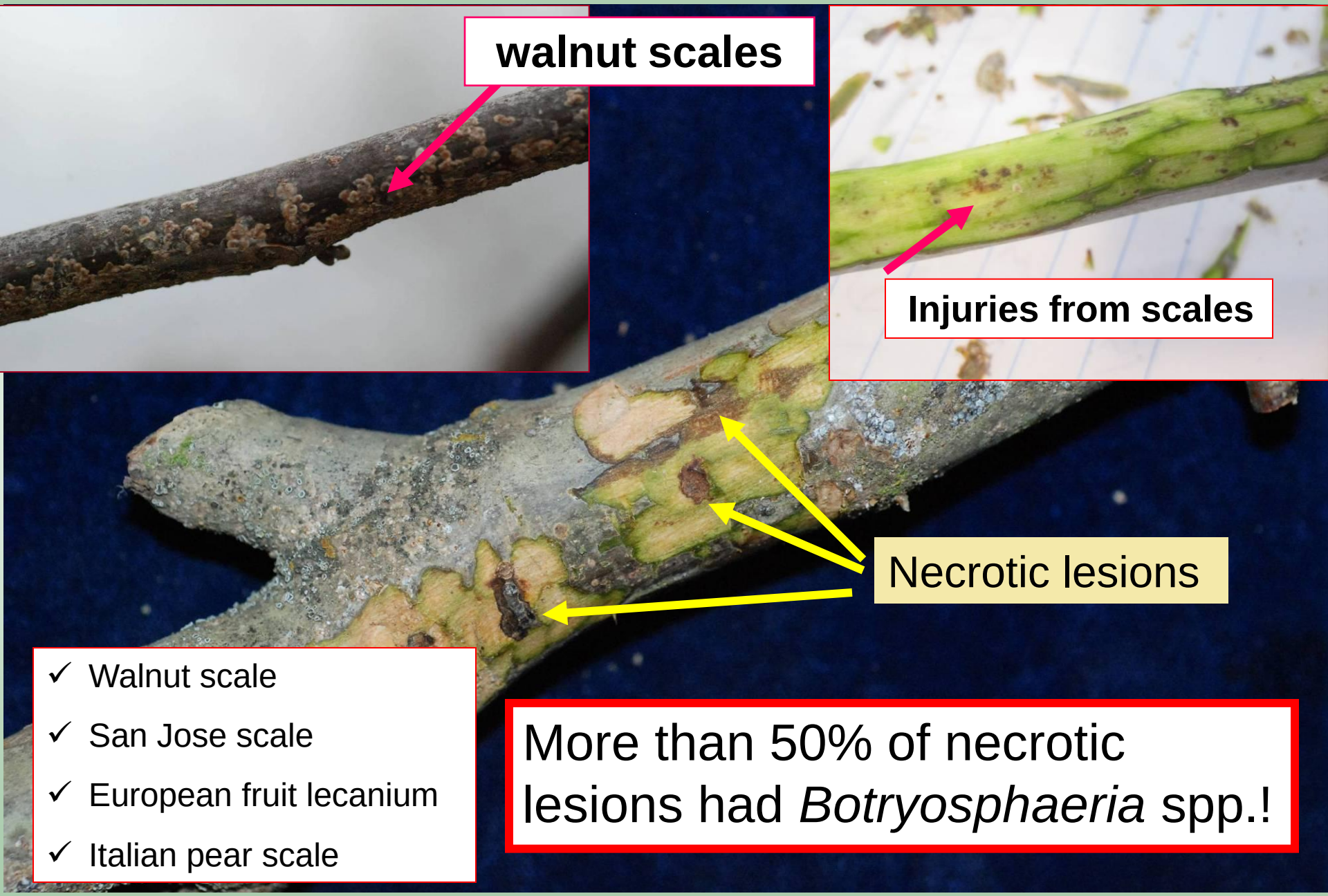


Inoculation of **walnut husks** with *Lasiodiplodia citricola* and *Neofusicoccum parvum* - 2013



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

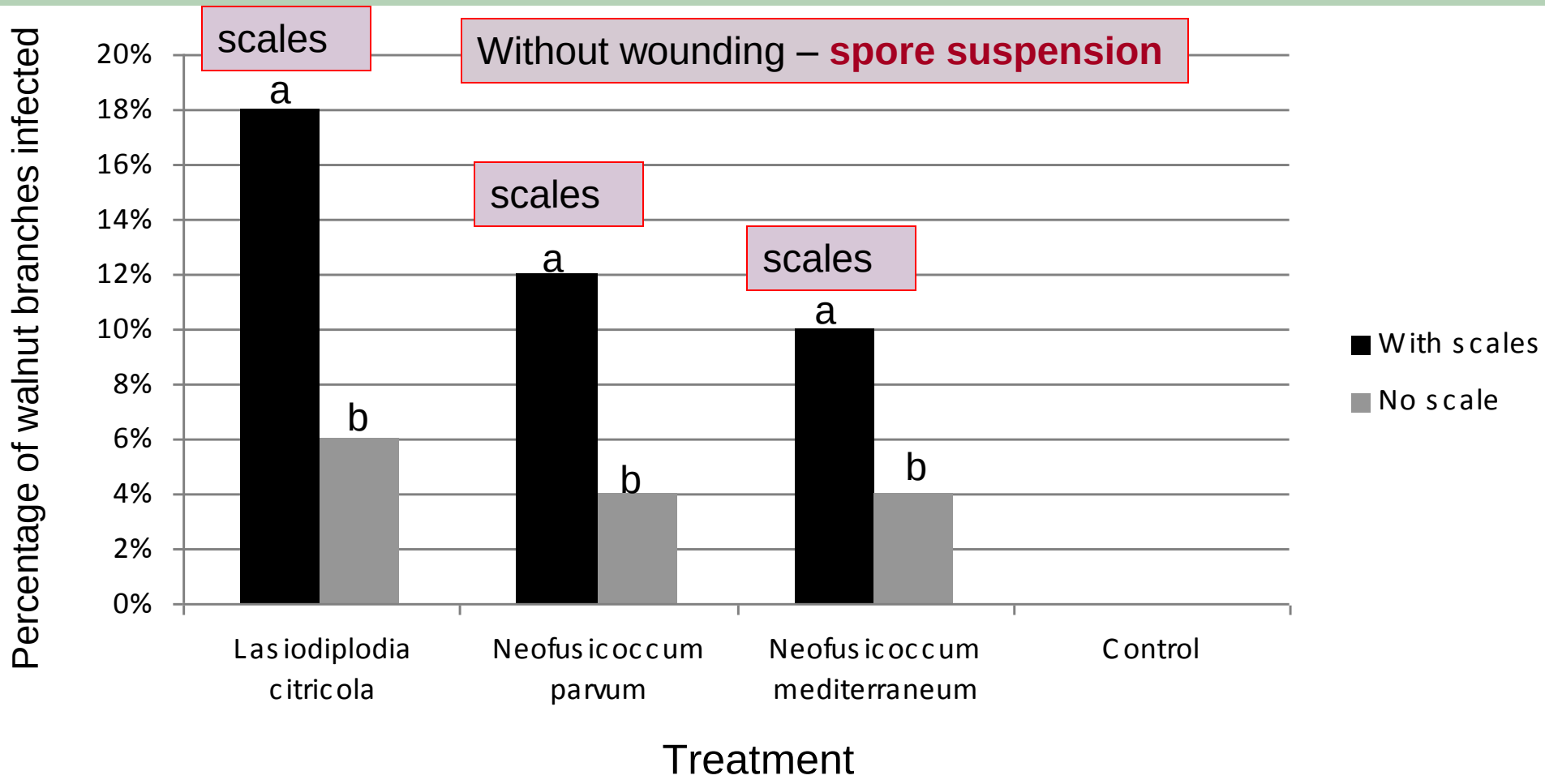
Effects of walnut scales on Botryosphaeria



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

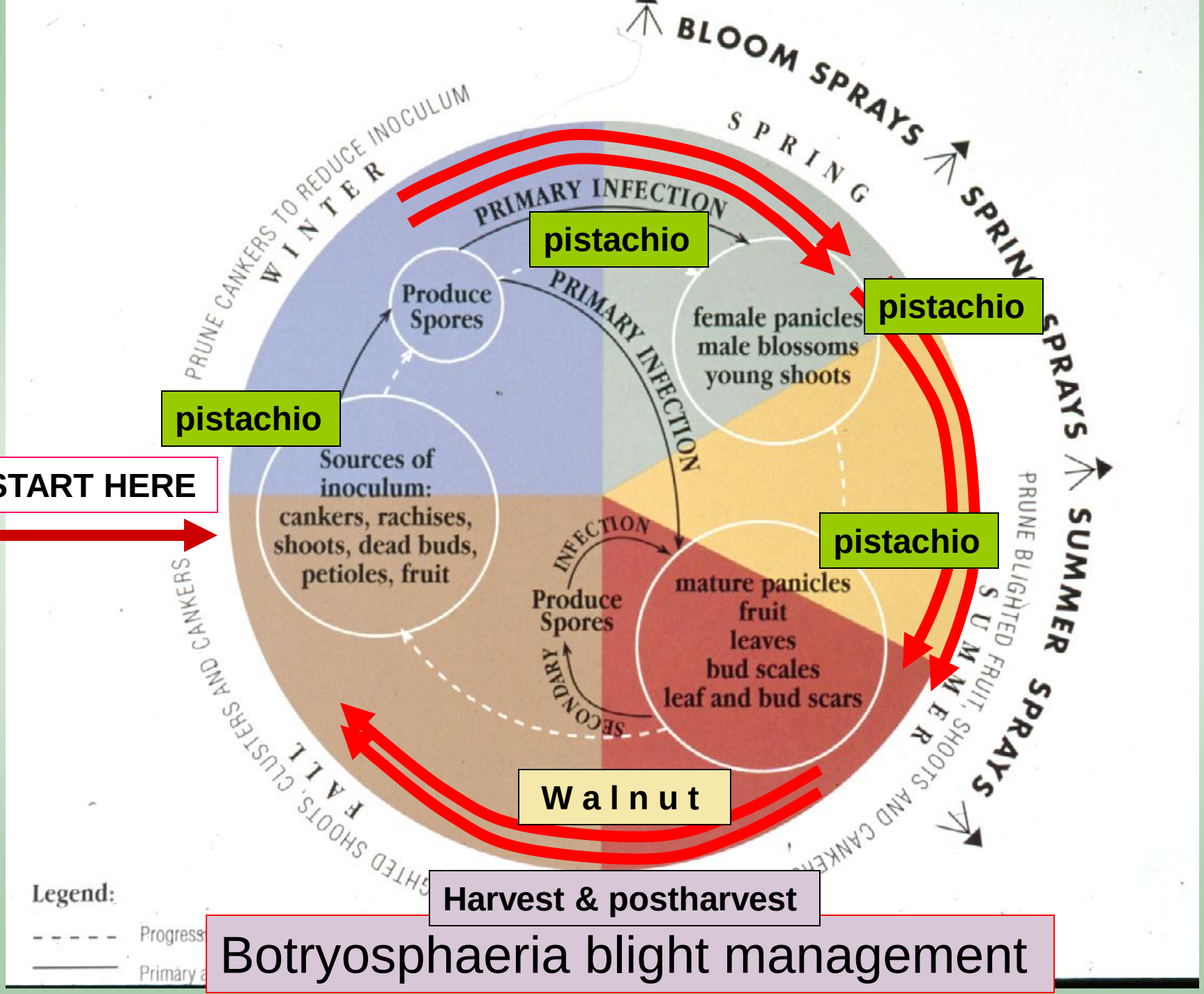
More than 50% of necrotic lesions had *Botryosphaeria* spp.!

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



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

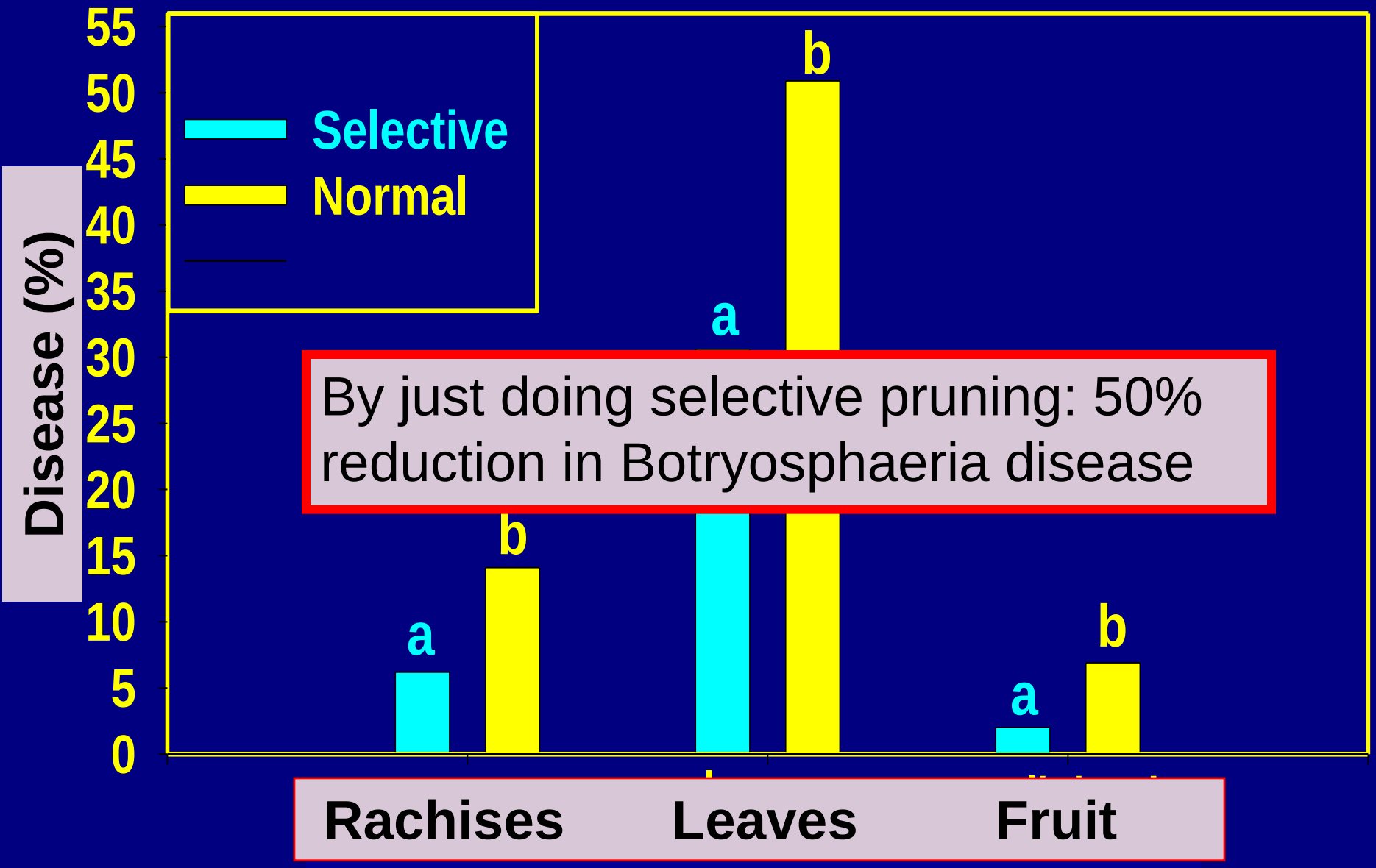
Management of Botryosphaeria and Phomopsis blight and canker



Botryosphaeria blight management

Sanitation by pruning

Removel of Bd Cankers by Pruning



Management of Botryosphaeria and Phomopsis blight and canker

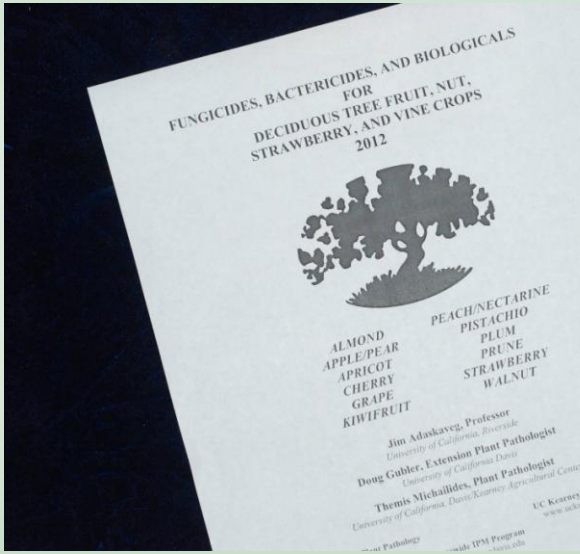
- **Cultural control:** Sanitation (prune dead branches or blighted shoots); avoid sprinkler irrigation that wets the canopy.

+

- **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	---	

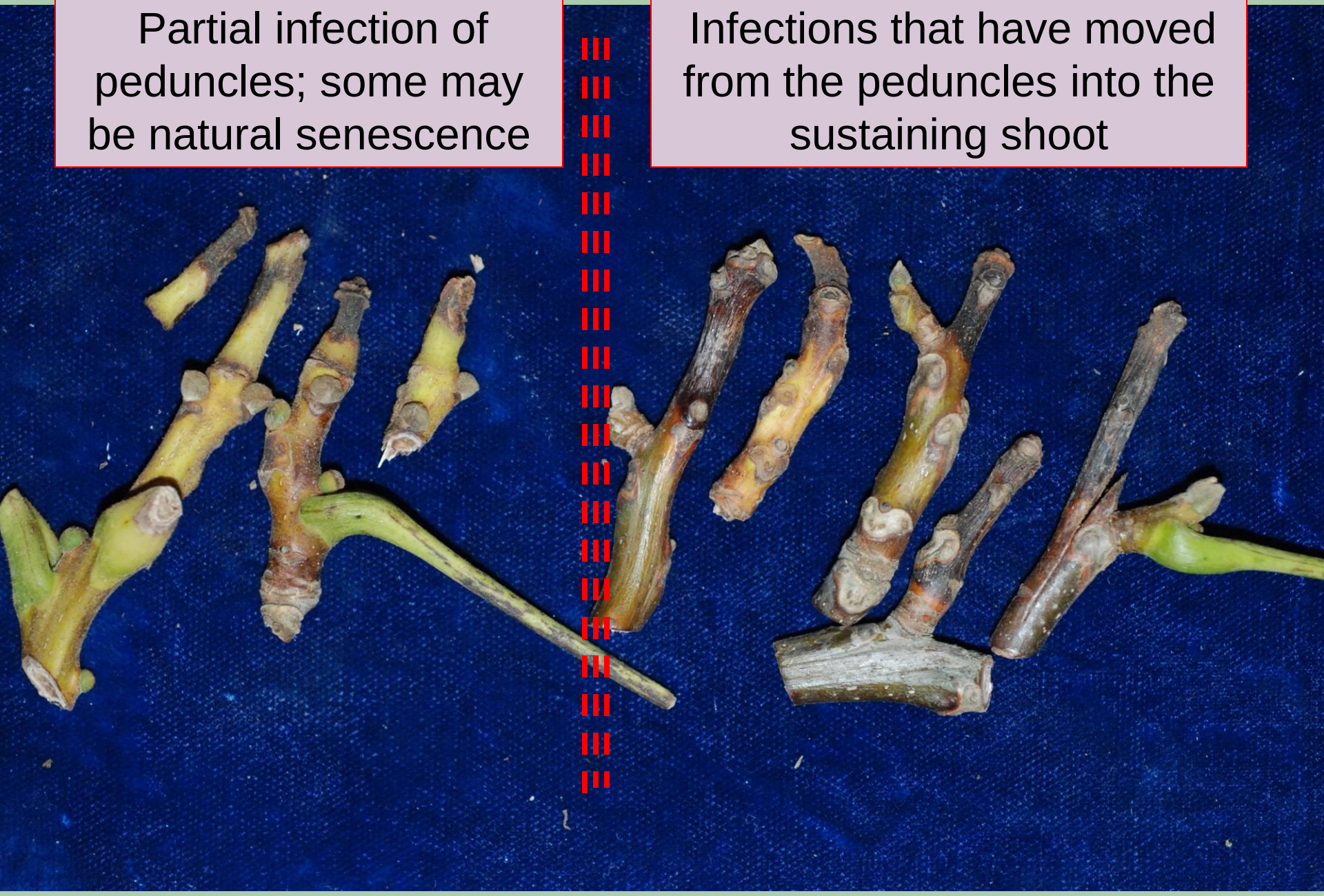
Spray dates: 17 May; mid June; & mid July

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

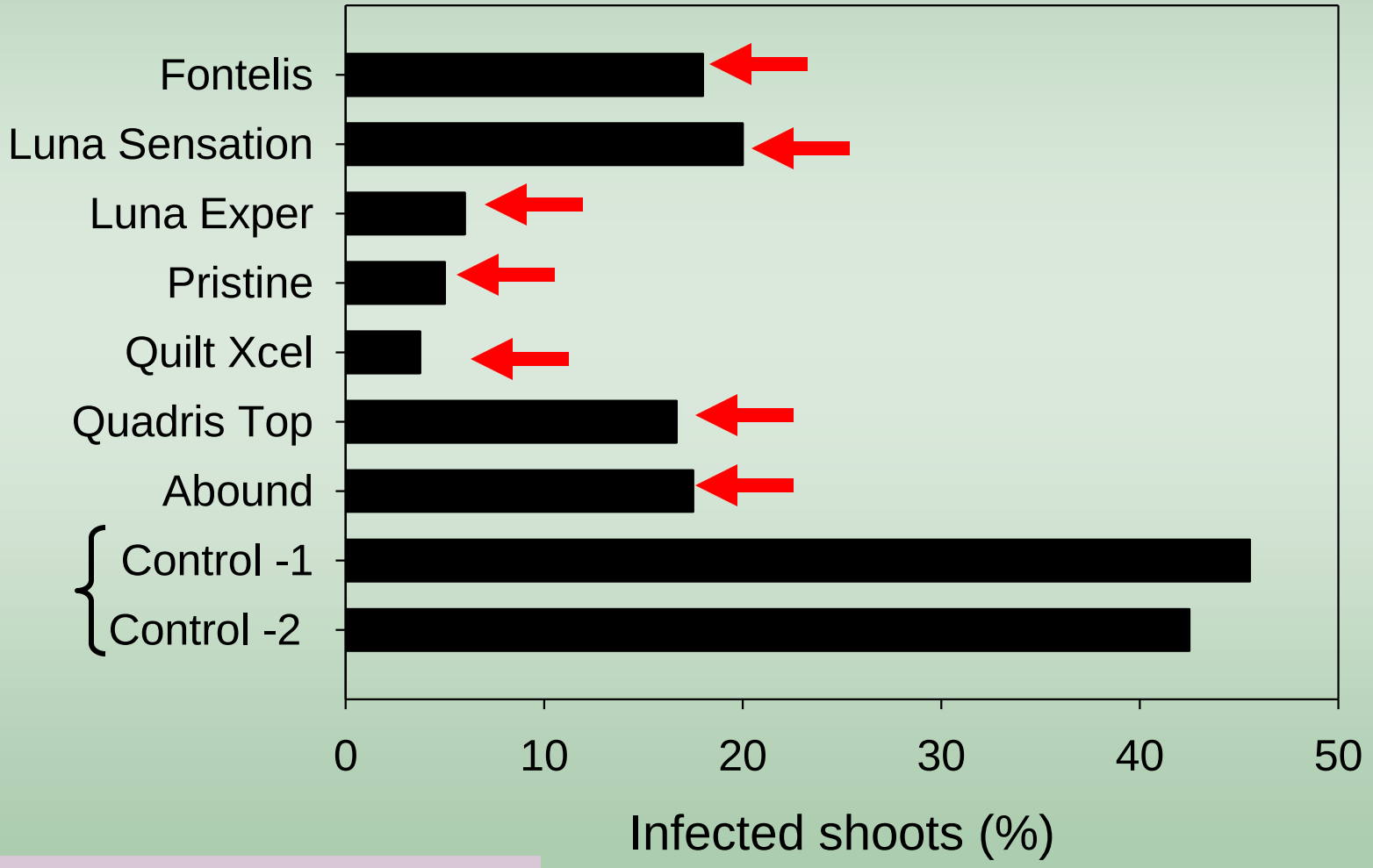
- peduncles
- current growth shoots

Partial infection of peduncles; some may be natural senescence

Infections that have moved from the peduncles into the sustaining shoot

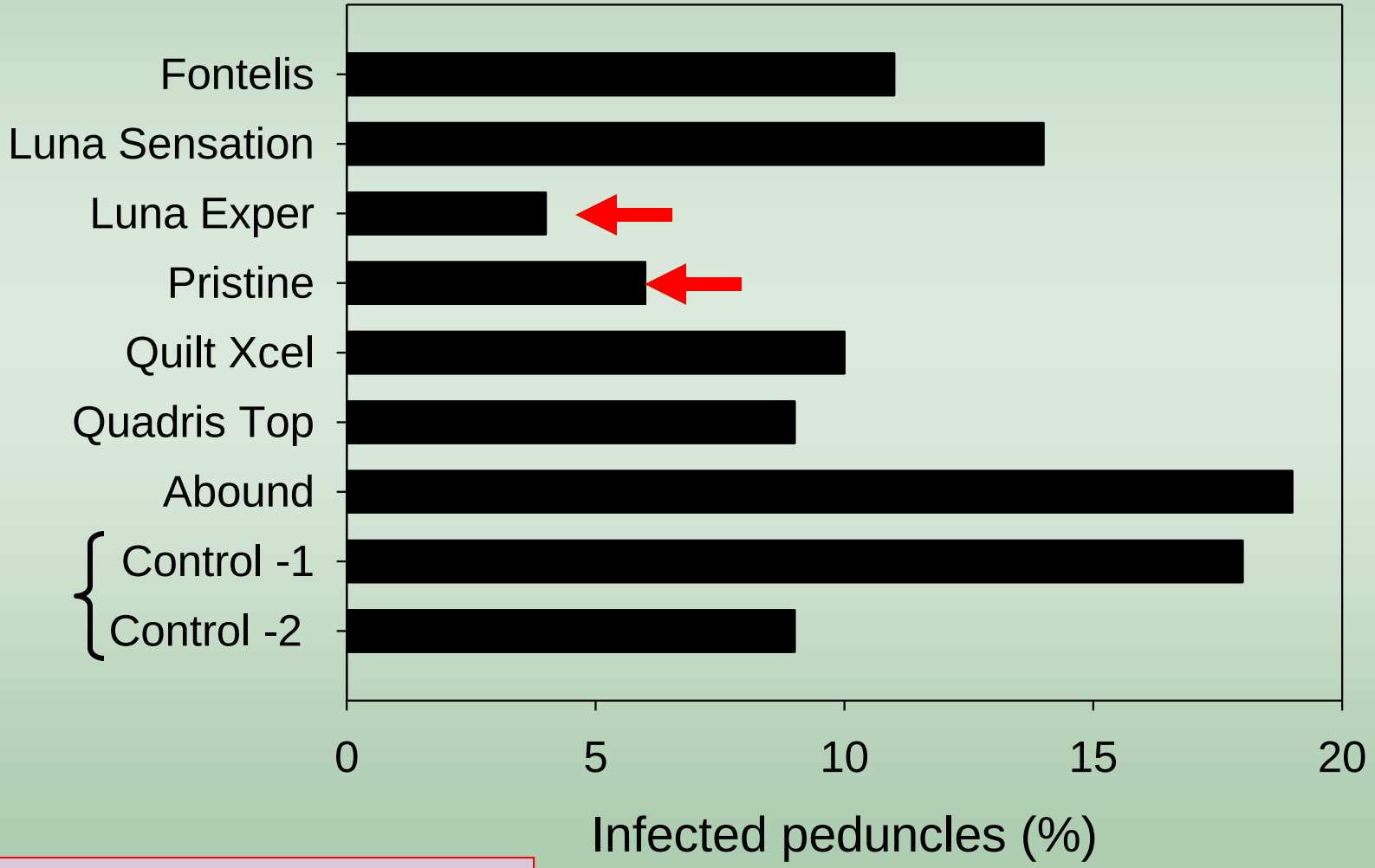


Effects of fungicides on Botryosphaeria in walnut shoots (Butte Co.; MM grower)



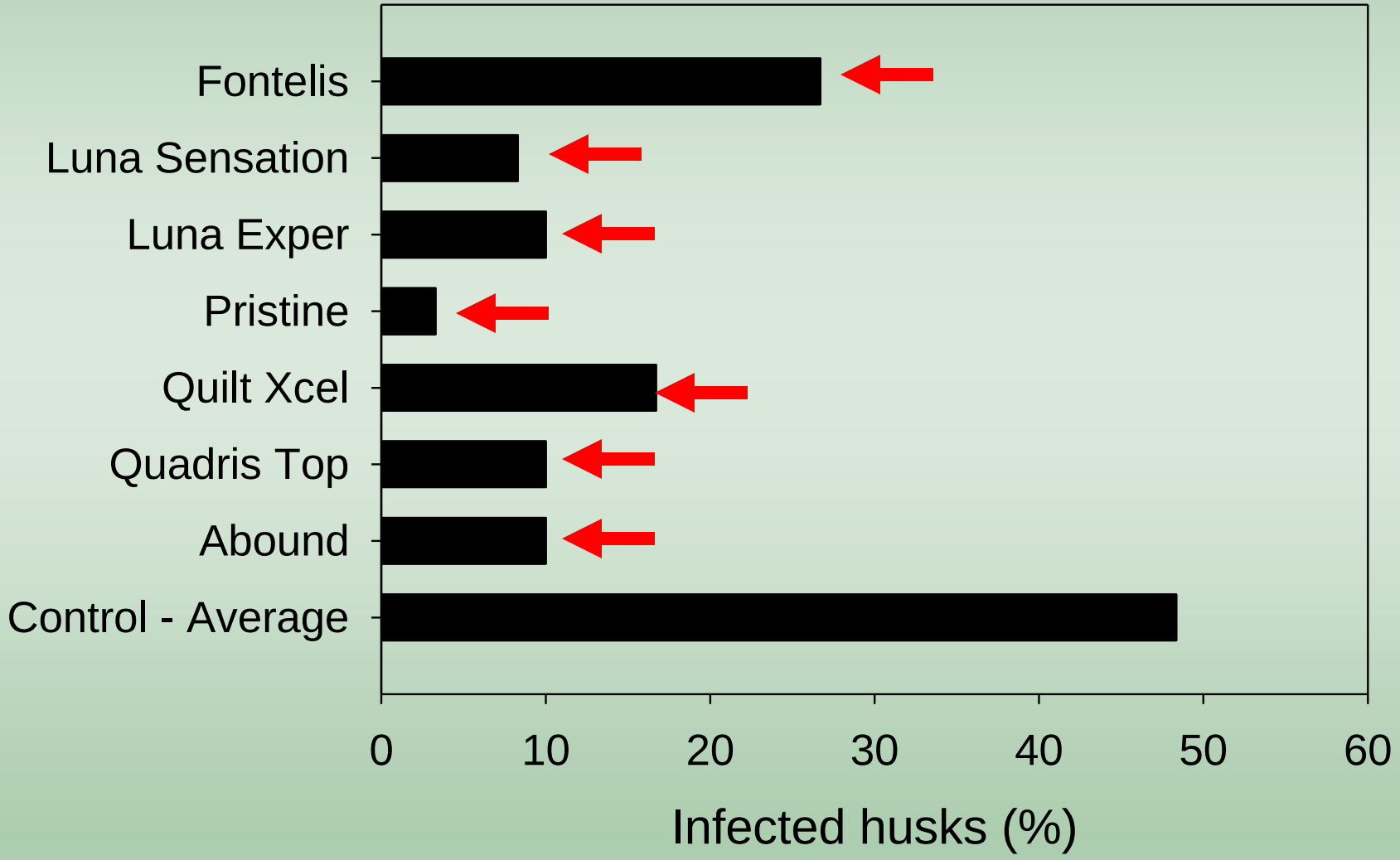
Spray dates: 17 May; mid June; & mid July

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

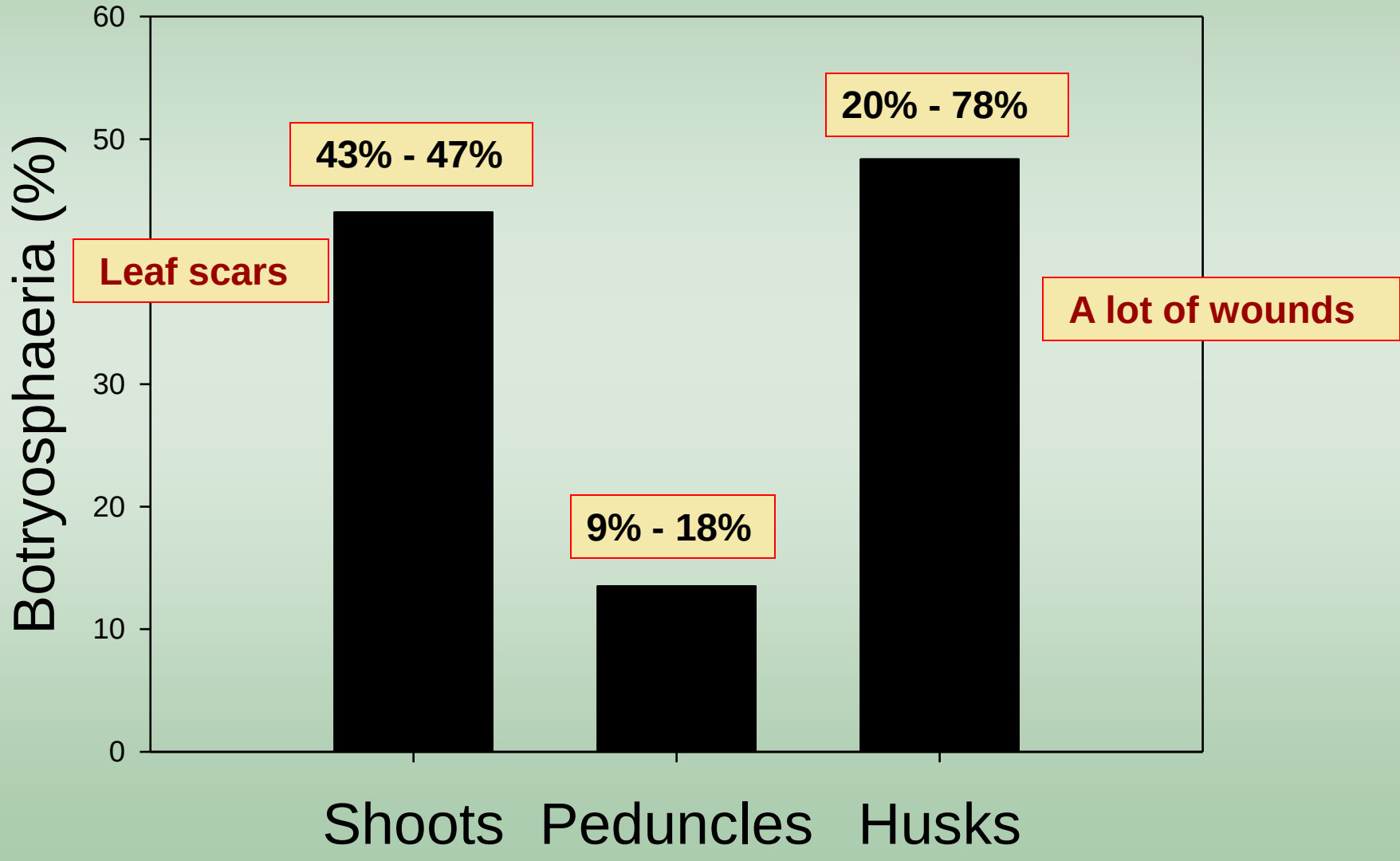


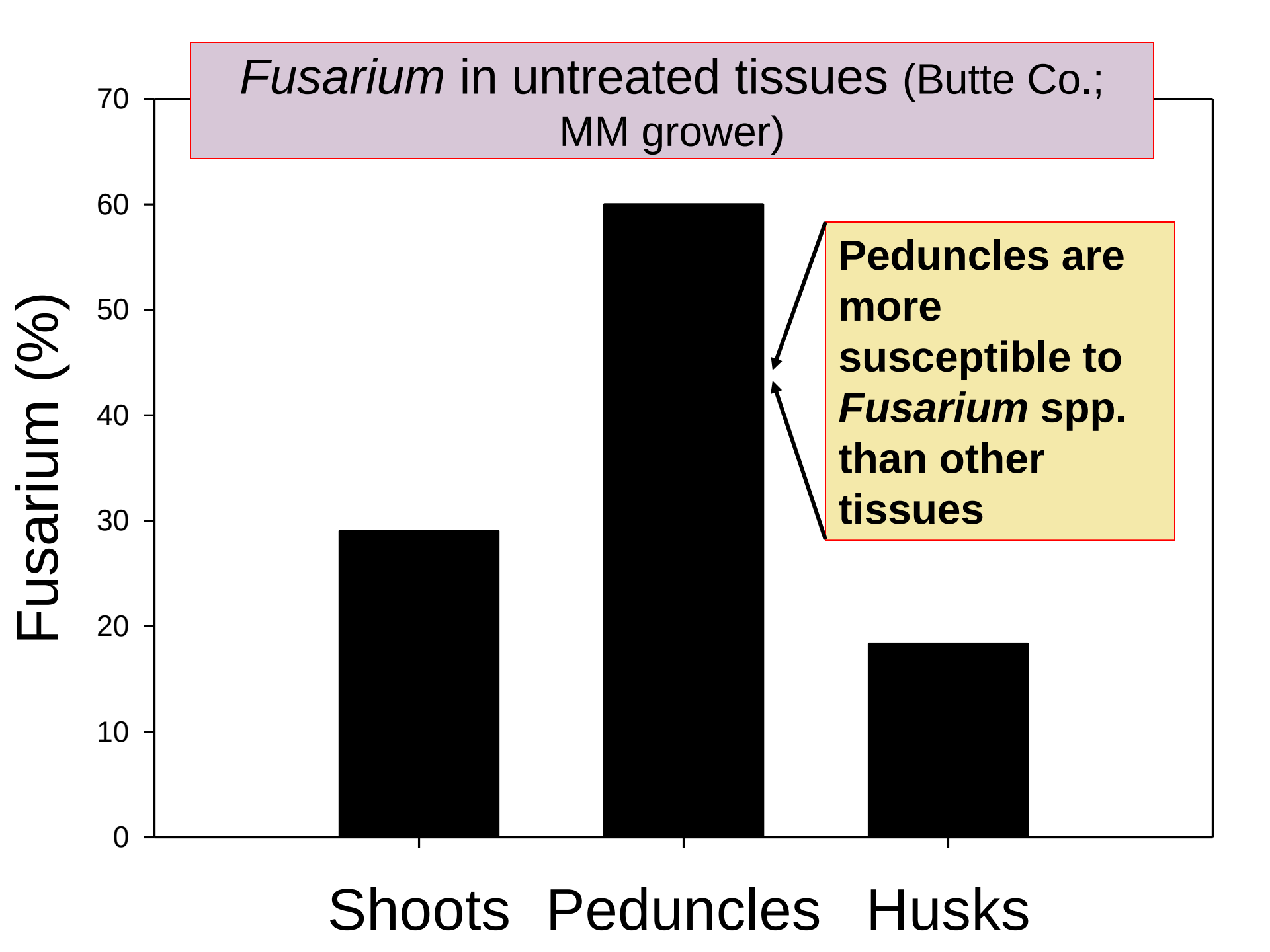
Spray dates: 17 May; mid June; & mid July

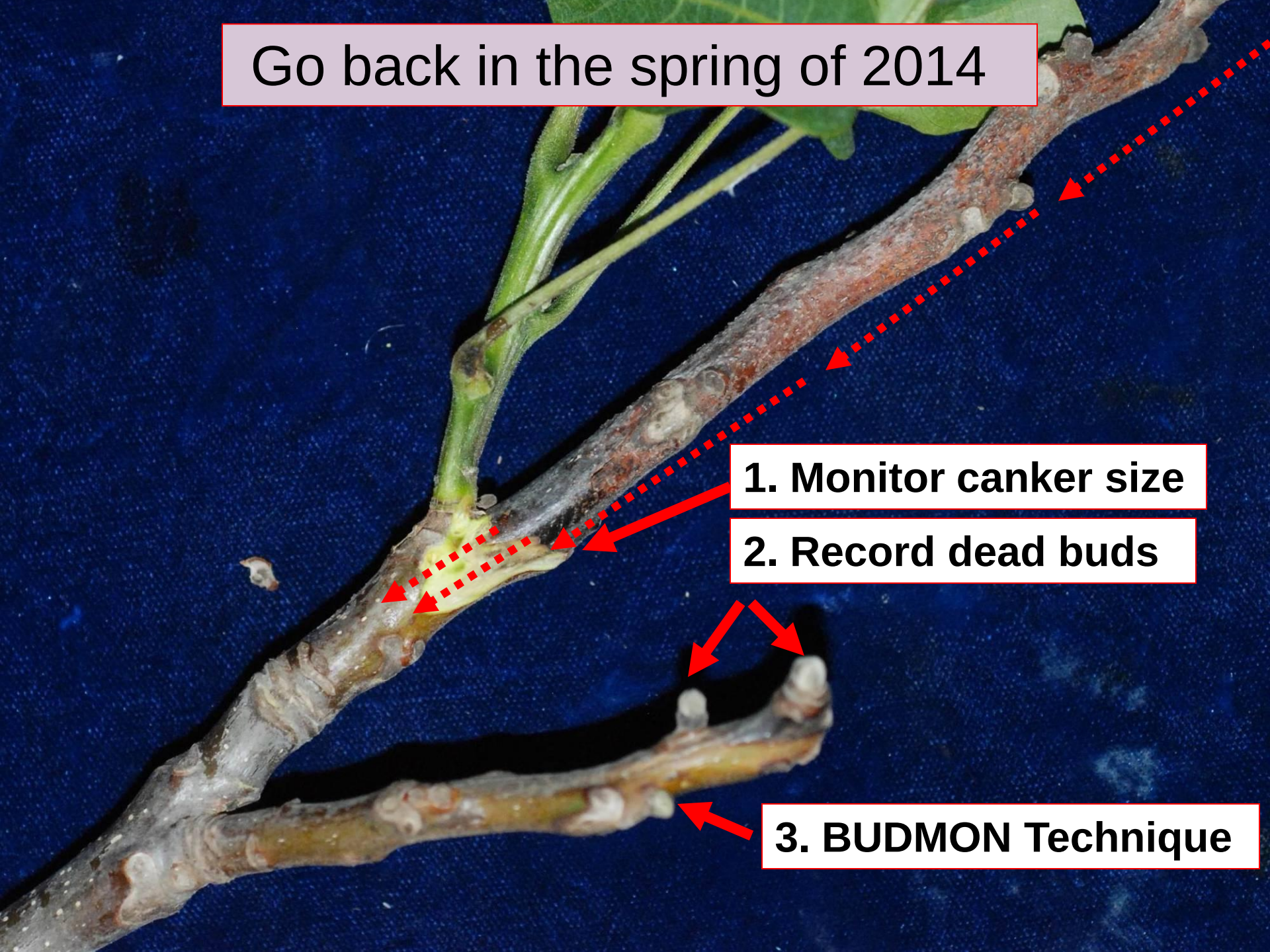
Effects of fungicides on Botryosphaeria in husks (Butte Co.; MM grower)



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




Fusarium in untreated tissues (Butte Co.; MM grower)
Fusarium (%)
70
60
50
40
30
20
10
0
Shoots
Peduncles
Husks
Peduncles are more susceptible to *Fusarium* spp. than other tissues


Go back in the spring of 2014
1. Monitor canker size
2. Record dead buds
3. BUDMON Technique

CONLCUSIONS

- ✓ 10 species of Botryosphaeriaceae (and at least 2 *Phomopsis*) can cause Bot/Phomopsis canker and blight in walnut.
- ✓ Four of them are very aggressive: *Lasiodiplodia citricola, Neofusicoccum mediterraneum*, *Neofusicoccum parvum, & Botryosphaeria dothidea*.
- ✓ Walnuts support the airborne ascospore stage of Botryosphaeria in addition to water-splashed pycnidiospores.
- ✓ Wounds (fruit & peduncle scars, leaf scars, pruning, and other wounds) can be infected.
- ✓ The effects of walnut blight on Botryosphaeria infection need to be studied further.

CONLCUSIONS

- ✓ Under dry weather conditions, low levels of disease symptoms during the growing season; symptoms develop mainly at harvest & postharvest.
- ✓ Walnut scales predispose shoots and favor infection by Botryosphaeriaceae.
- ✓ Some fungicides sprays during the season seem to reduce Botryosphaeria infections!
- ✓ Future research: Emphasis on latent infections on green fruit, the postharvest phase of the disease, and certainly the management of the disease.

Thank you

The Sleeping Giant