Understanding and Managing Walnut Botryosphaeria/Phomopsis Canker and Blights

(Influence of El Niño on the Sleeping Giant)

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

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Cooperators: **J. Hasey, R. Buchner, B. Coates, K. Pope, K. Anderson, J. Grant, and D. Lightle:** UCCE Sutter/Yuba/Colusa, Tehama, San Benito, Yolo/Solano, Stanislaus, San Joaquin, and Butte/Glenn counties, respectively

El Niño winters in California (1982 through 2015)

Winter 1982-1983 “El Niño storms”

Winter 1994-1995 “winter storms”

Winter 1997-1998 “El Niño storms”

The Bot disease started in 1983, probably in the oldest pistachio orchard in the State (Butte Co., CA)

El Niño winters in California (1982 through 2015)

Winter 1982-1983 “El Niño storms”

Winter 1994-1995 “winter storms”

Winter 1997-1998 “El Niño storms”


Botryosphaeria Blight
in Pistachio Orchards
1995
Sacramento
Fresno
Bakersfield

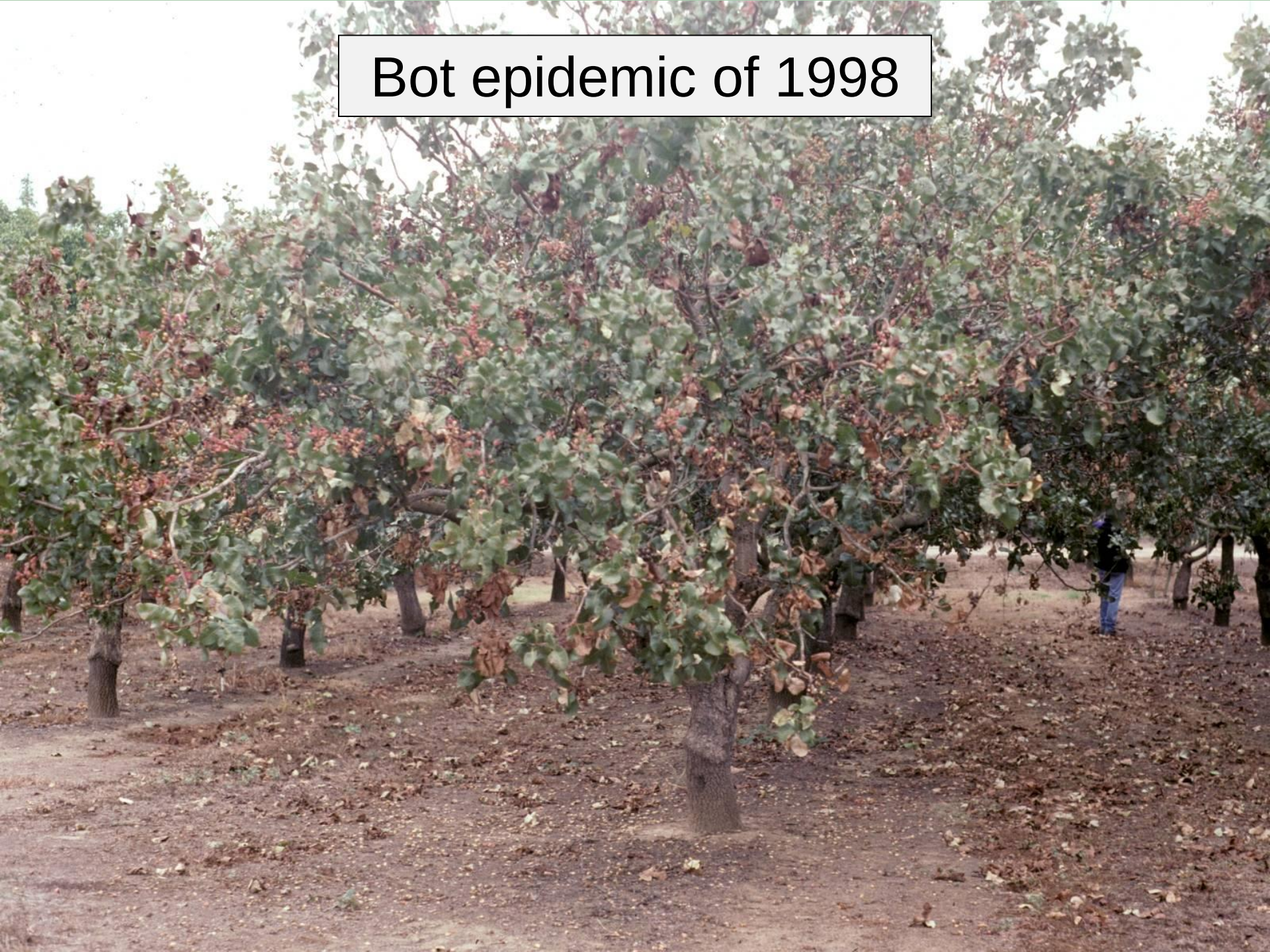
El Niño winters in California (1982 through 2015)

Winter 1982-1983 “El Niño storms”

Winter 1994-1995 “winter storms”

Winter 1997-1998 “El Niño storms”

Bot epidemic of 1998



… because of Botryosphaeria blight

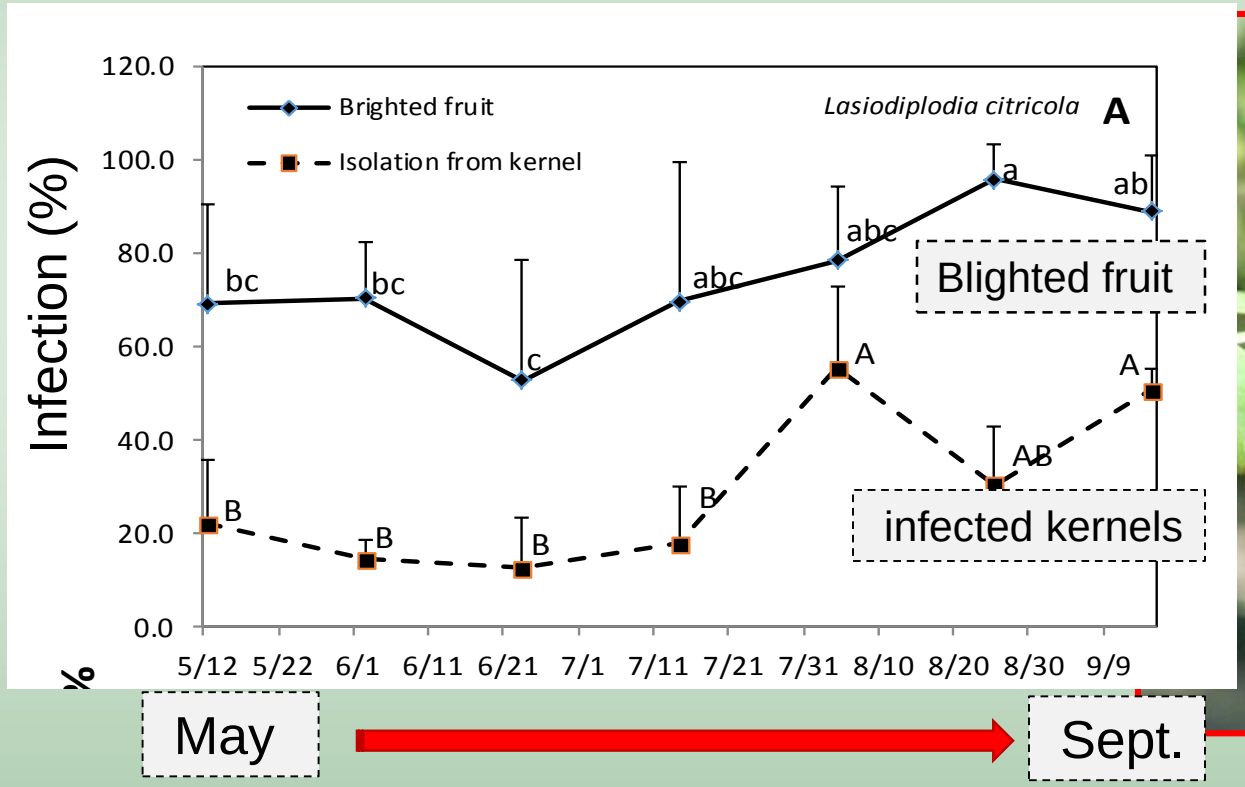
Winter 2015-2016 “El Niño?

Botryosphaeria /Phomopsis of walnuts in Spain

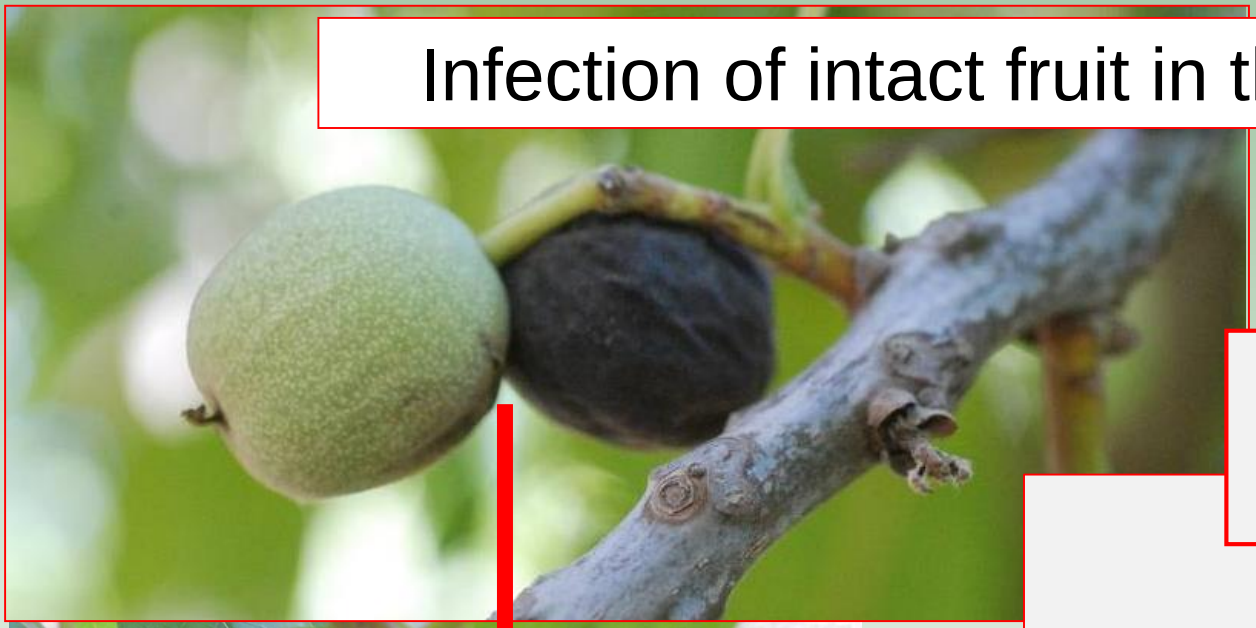
Symptoms we expect to see in walnut orchards in an El Niño year in California

Latent infection of fruit:

Blighted fruit and pathogen isolation from kernels of walnut fruit inoculated with *Lasiodiplodia citricola*



Infection of intact fruit in the orchard

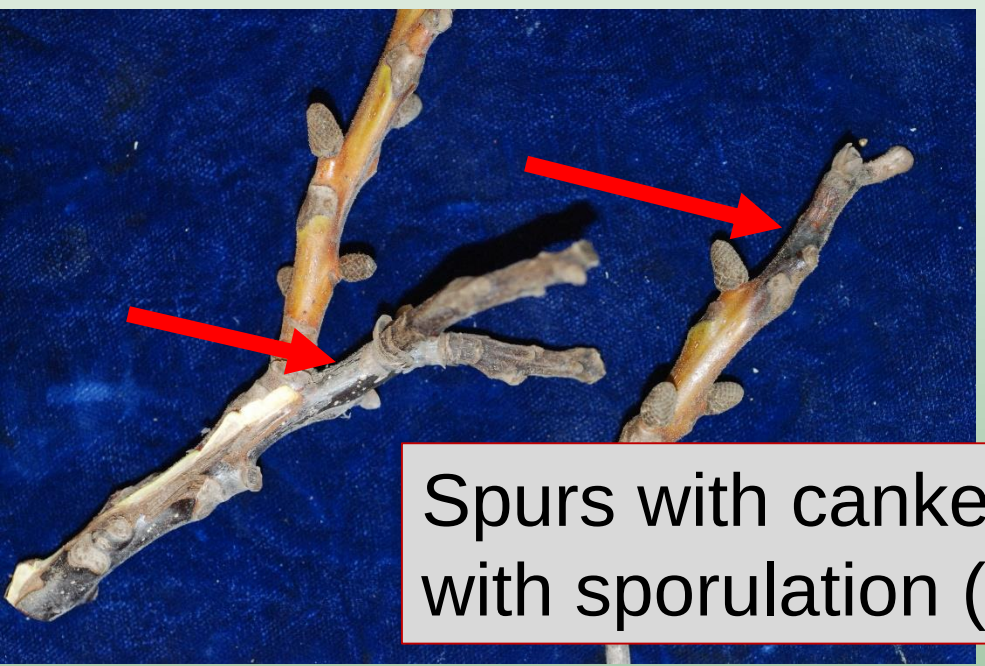


All *Botryosphaeria* & *Phomopsis* species

Fruit → Fruit

Peduncle

Infect spurs/shoots



Spurs with cankers covered with sporulation (pycnidia)

Susceptible walnut cultivars

Ashley

Chandler

Howard

Tulare

Vina

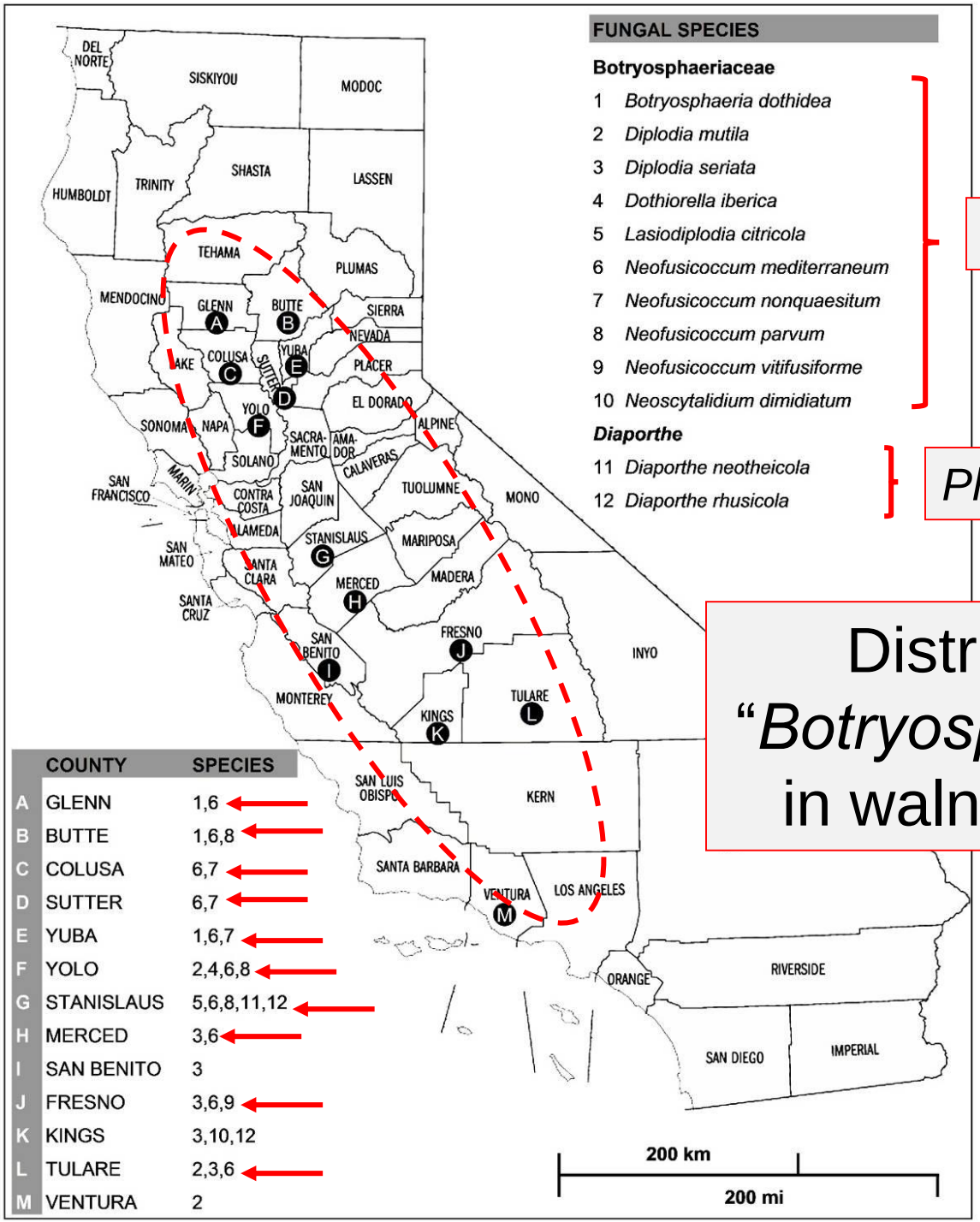
Serr

Hartley

Payne

Dixon

Livermore



Botryosphaeriaceae

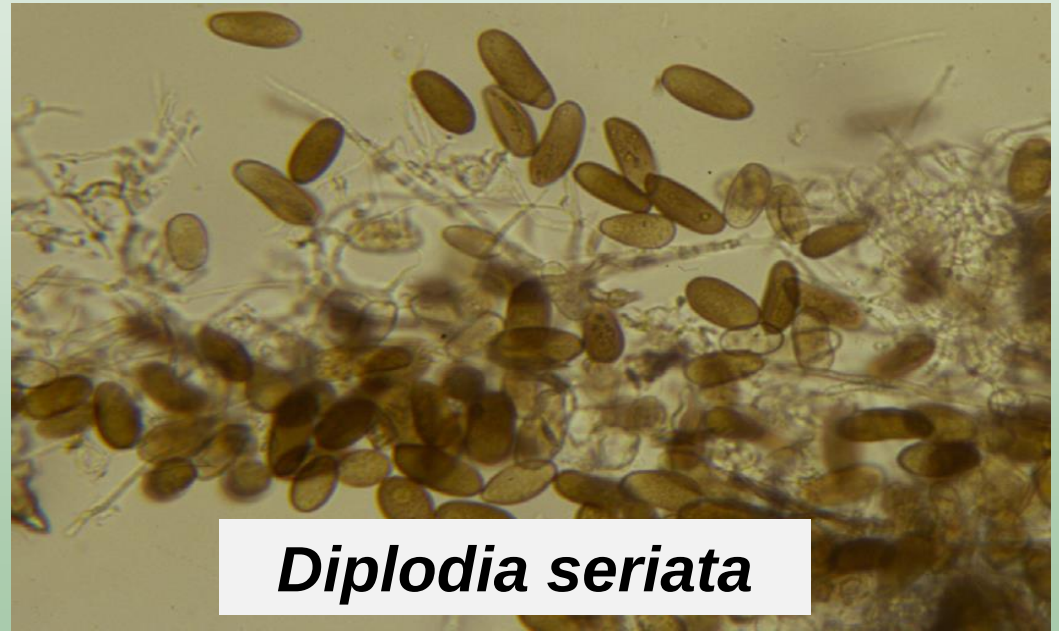
Phomopsis

Distribution of "*Botryosphaeria*" spp. in walnut orchards

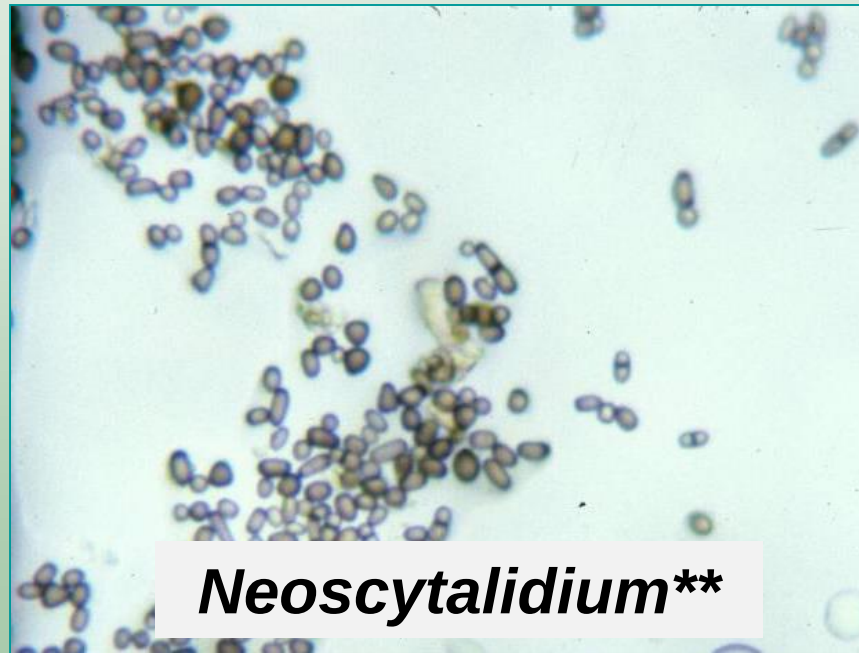
← *N. mediterraneum* = widespread

Botryosphaeria dothidea
***Neofusicoccum* spp.**

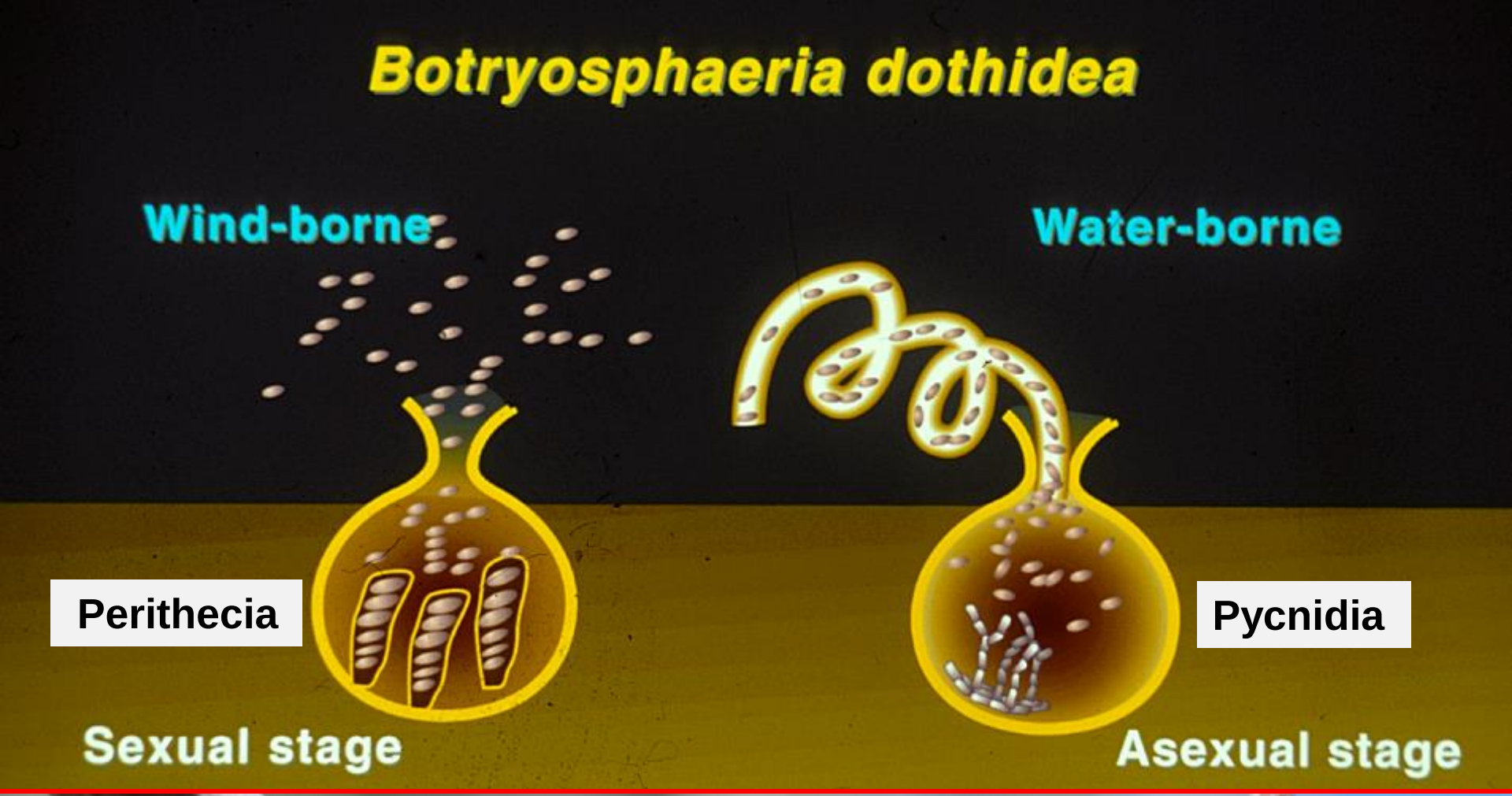
***Lasiodiplodia* spp.**



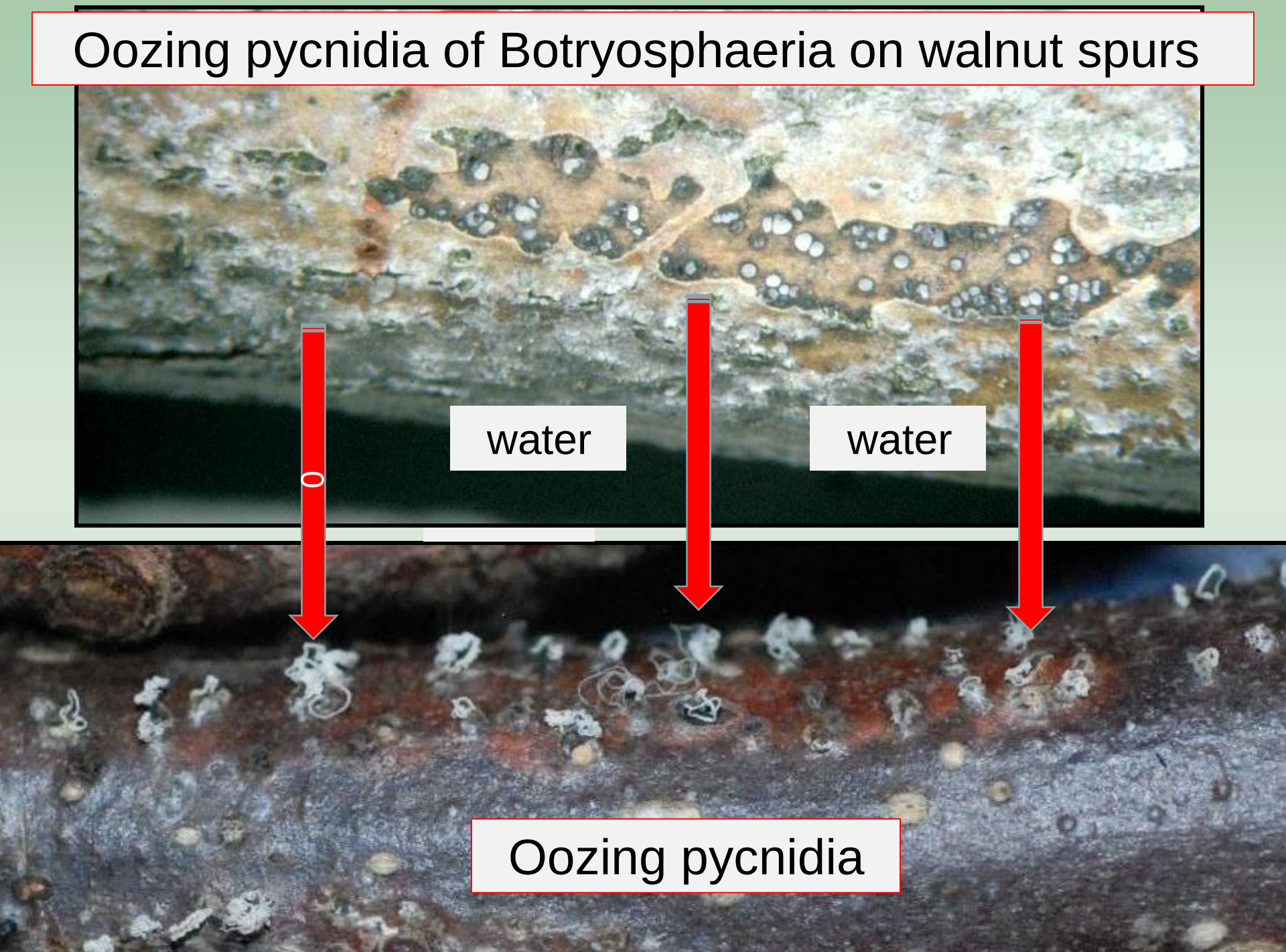
Diplodia seriata

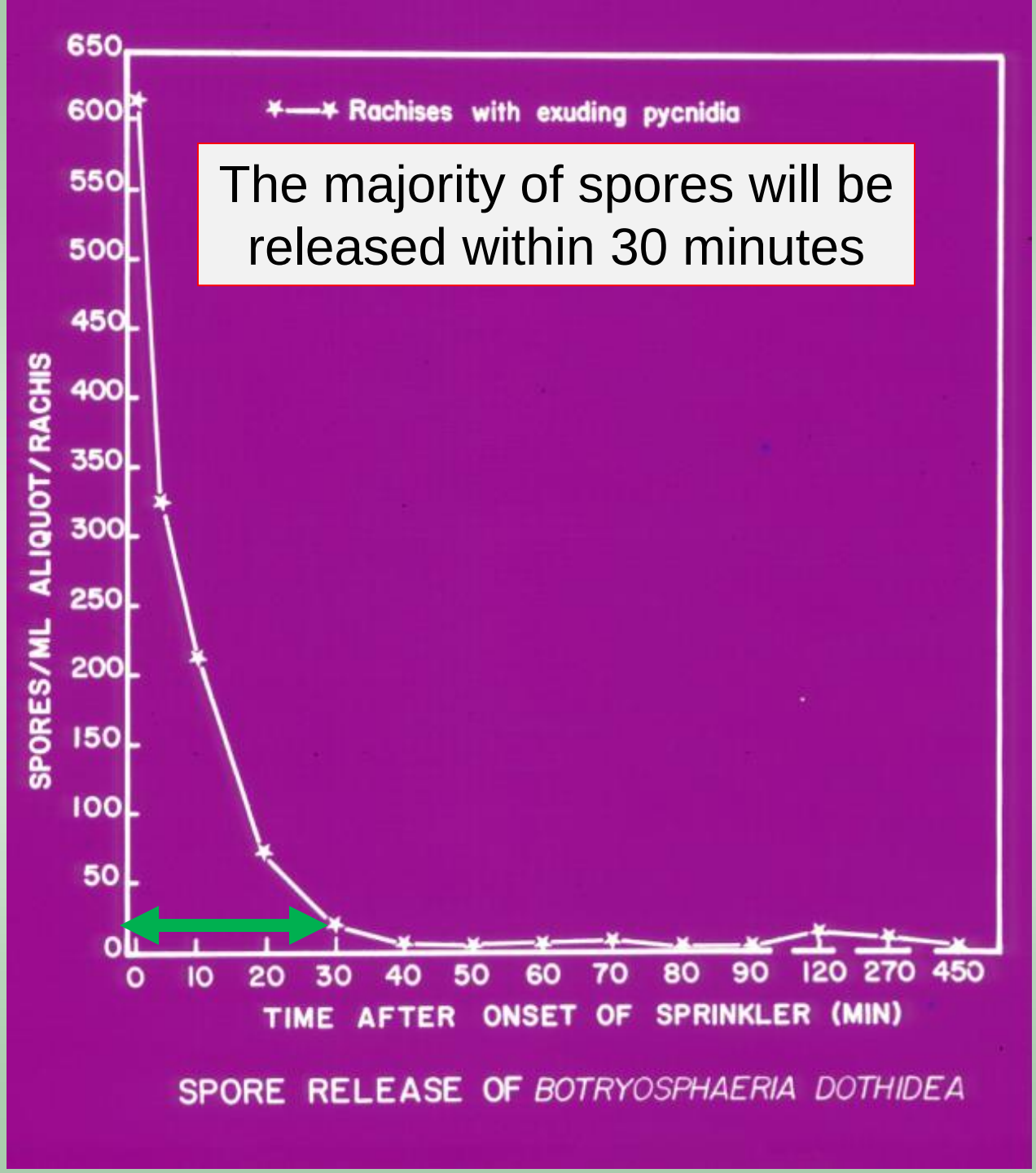


Neoscytalidium**


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

Oozing pycnidia of Botryosphaeria on walnut spurs

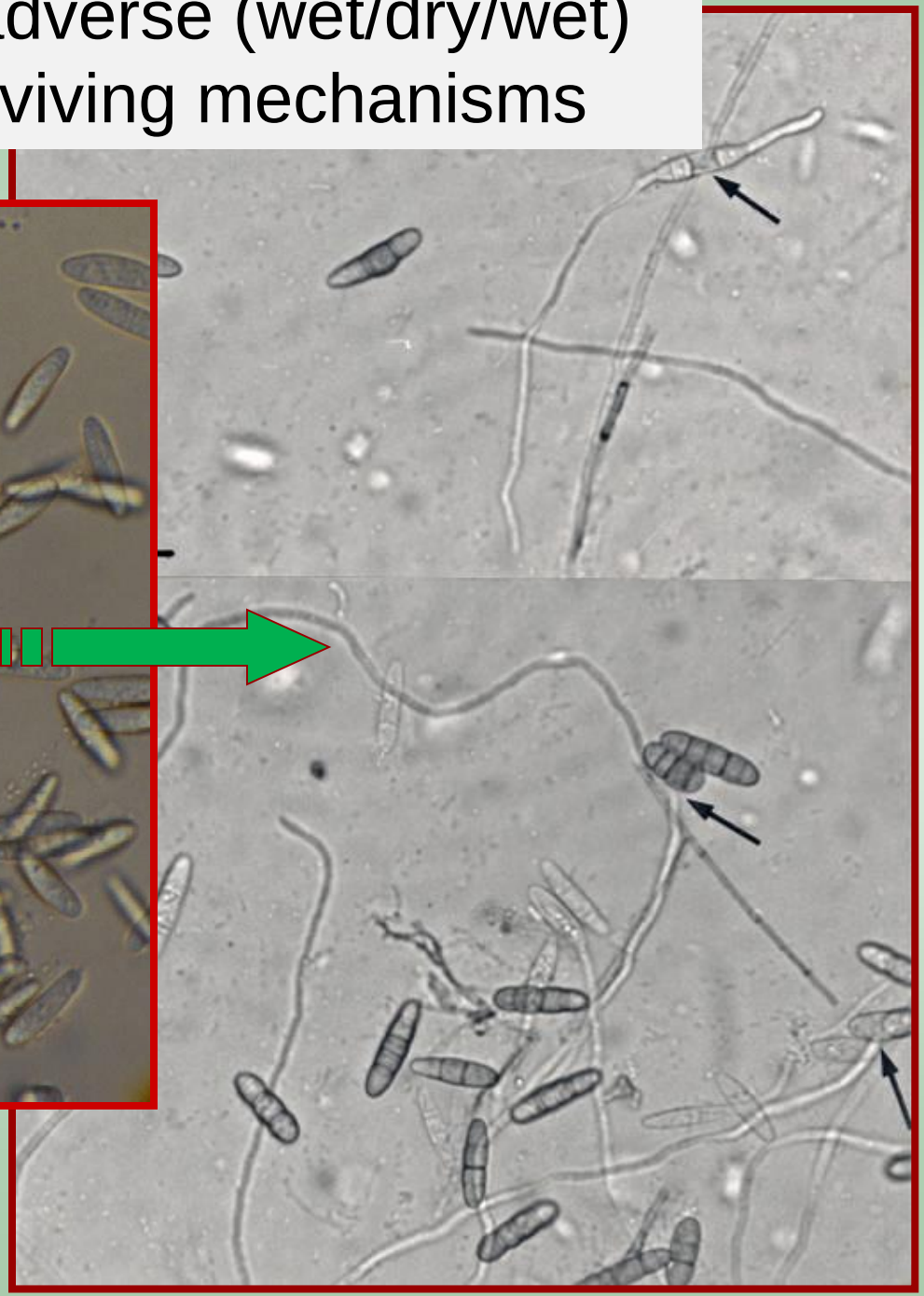



Rachises with exuding pycnidia
The majority of spores will be released within 30 minutes
SPORES/ML ALIQUOT/RACHIS
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0 10 20 30 40 50 60 70 80 90 120 270 450
TIME AFTER ONSET OF SPRINKLER (MIN)
SPORE RELEASE OF BOTRYOSPHAERIA DOTHIDEA

Spores of *Botryosphaeria*

they germinate within 1.5 hours wetness!

Germination under adverse (wet/dry/wet) conditions and surviving mechanisms



Botryosphaeria spread

✓	rain & moving water in the orchard	+++++++*
✓	air (airborne ascospores)	++
✓	pruning equipment	+
✓	insects	?

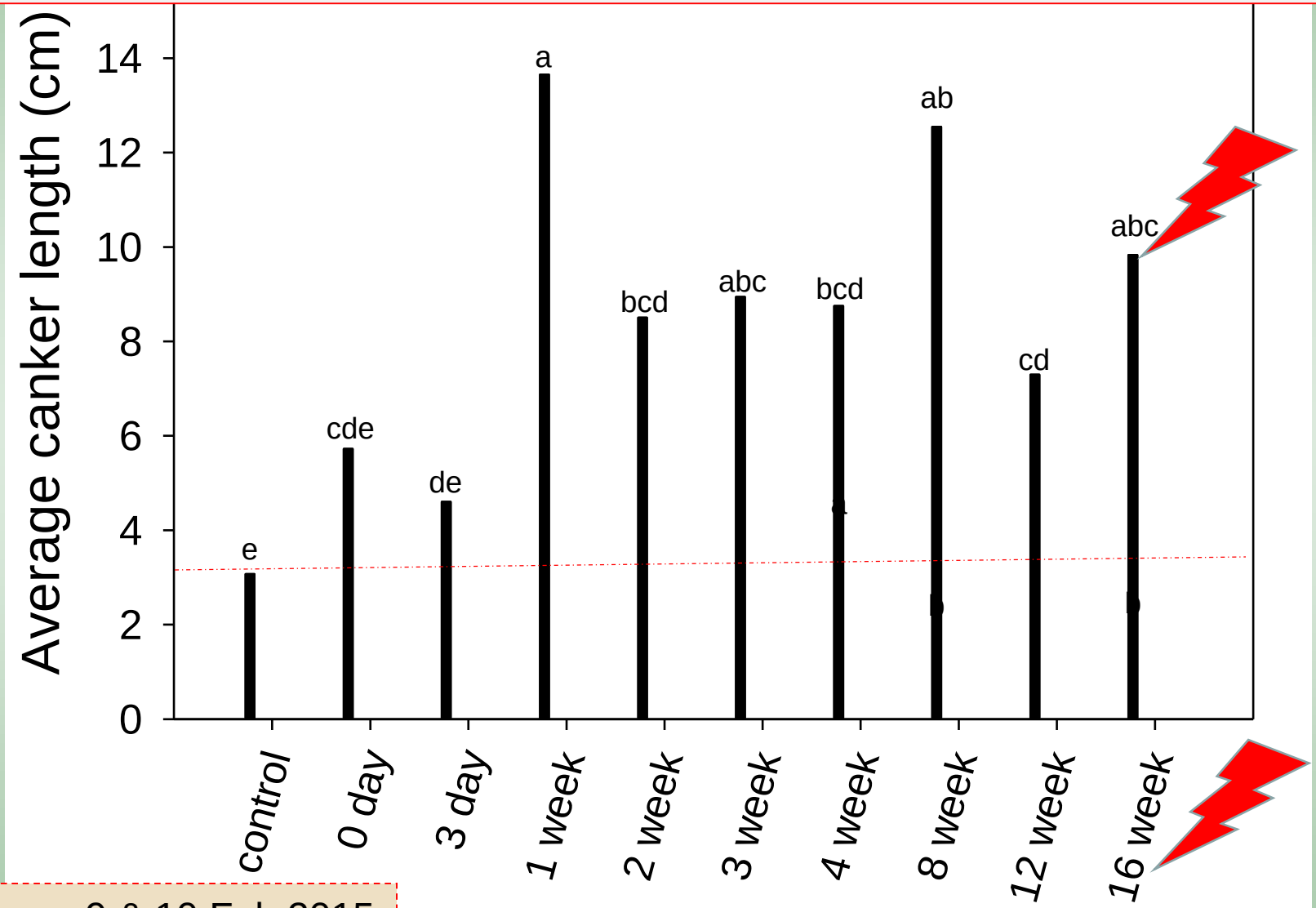
*rain, dew, sprinkler irrigation

Conditions for infection events

- ✓ Presence of inoculum
- ✓ Rain: at least 1/4”
- ✓ Temperature: ≥ 50°F
- ✓ Presence of susceptible tissues

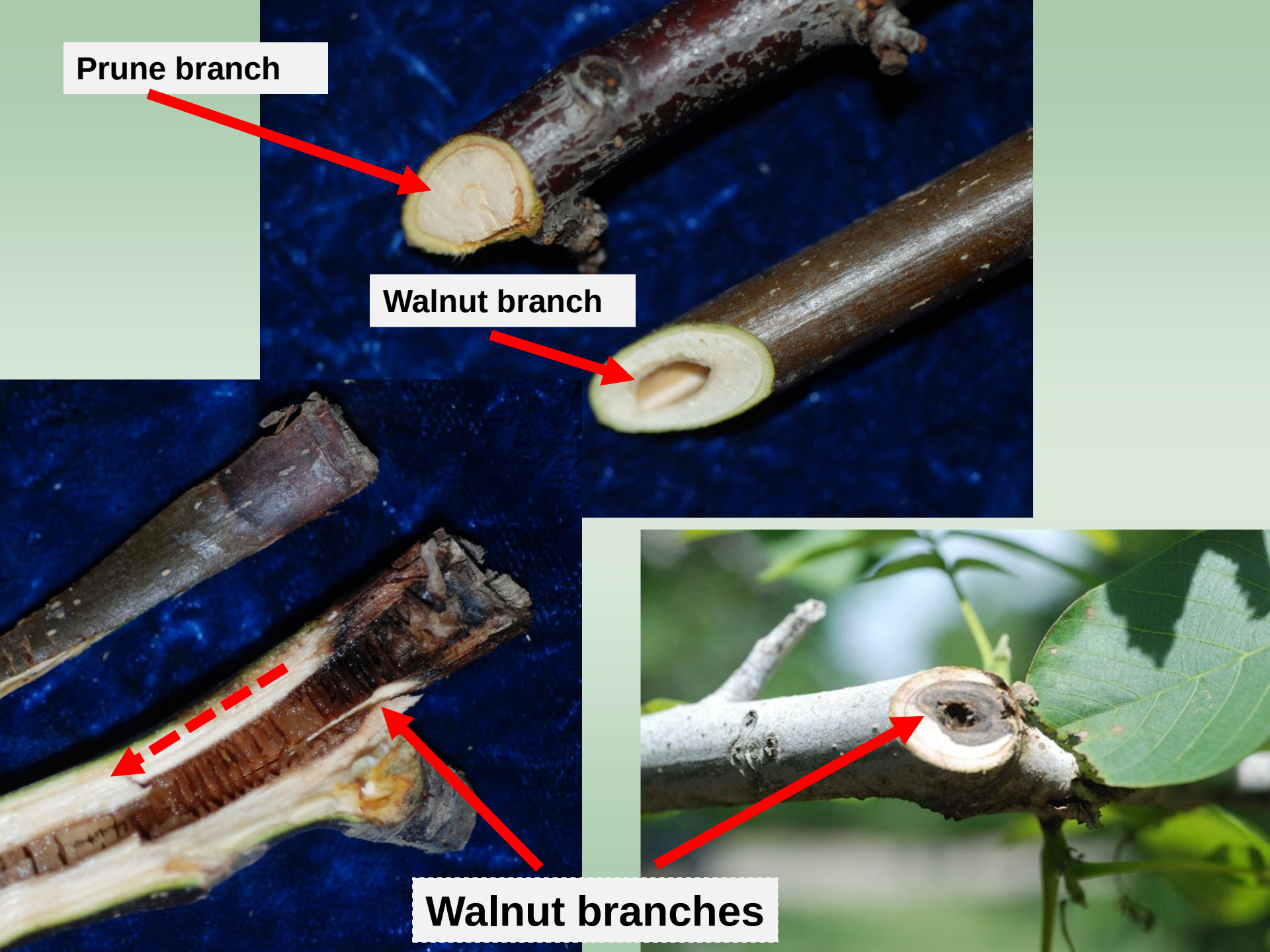
Cankers associated with pruning wounds

Susceptibility of pruning wounds of 1-, 2-, 3-, & 4-year-old wood to infection by Bot

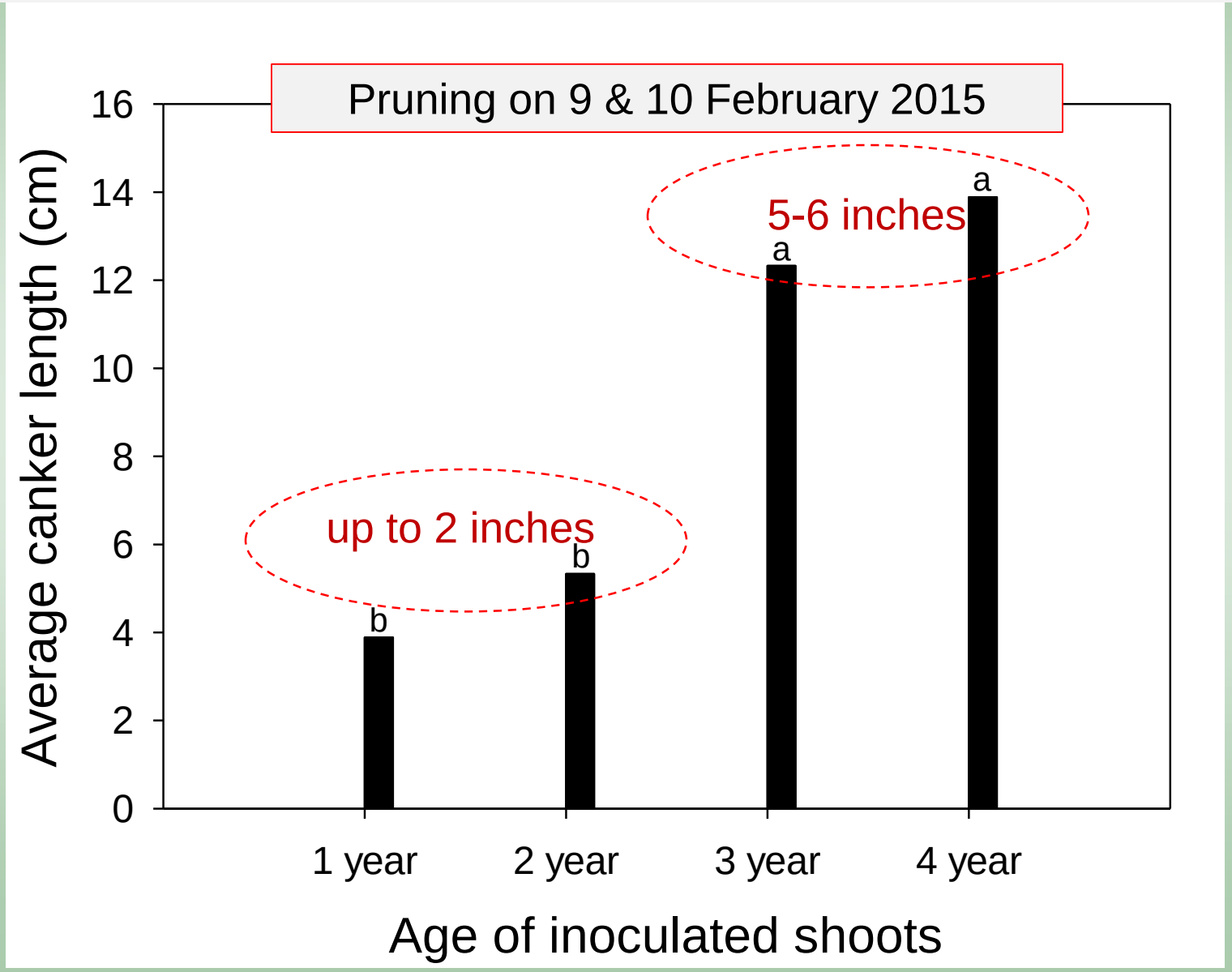


Pruning on 9 & 10 Feb 2015

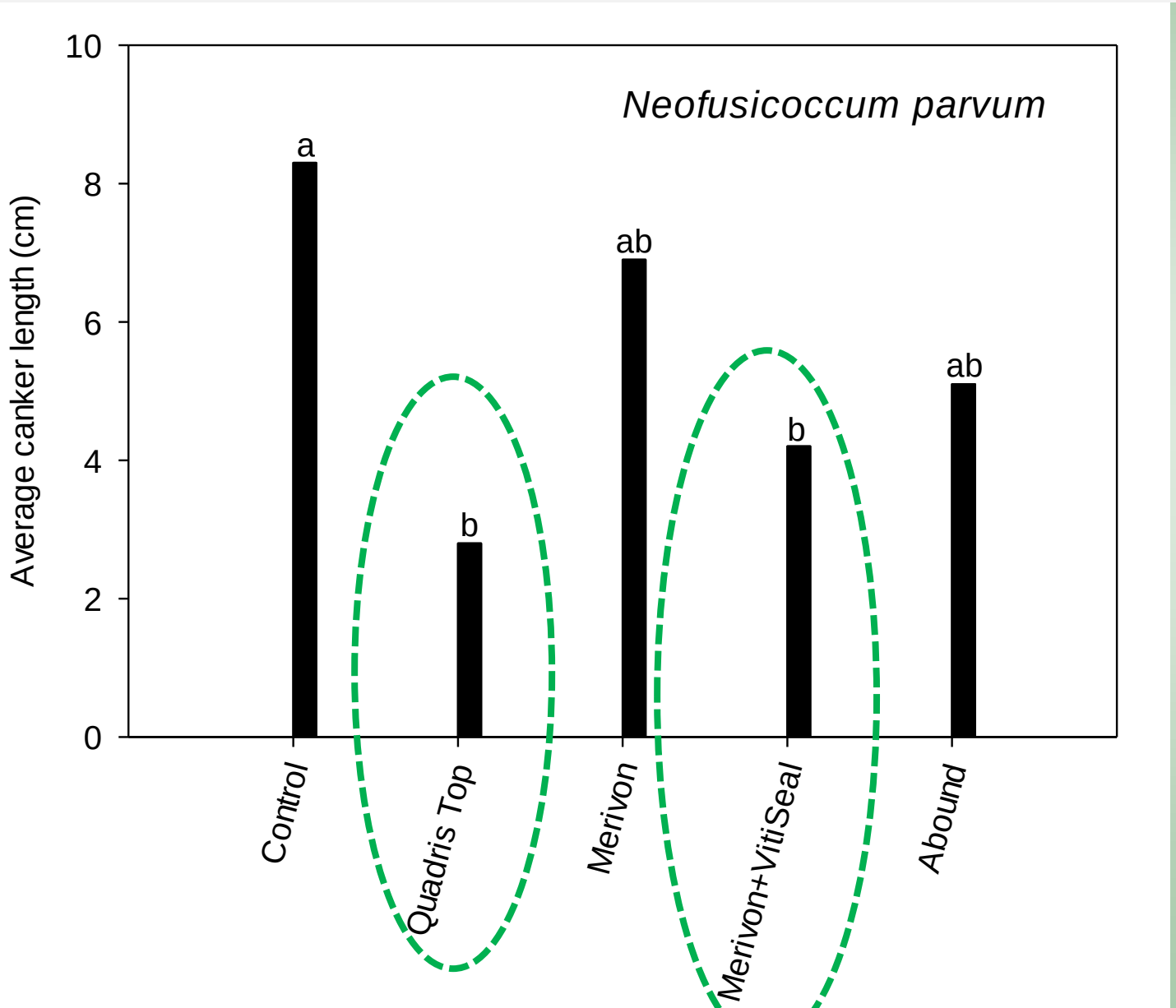
Post-pruning inoculation date


Prune branch
Walnut branch
Walnut branches

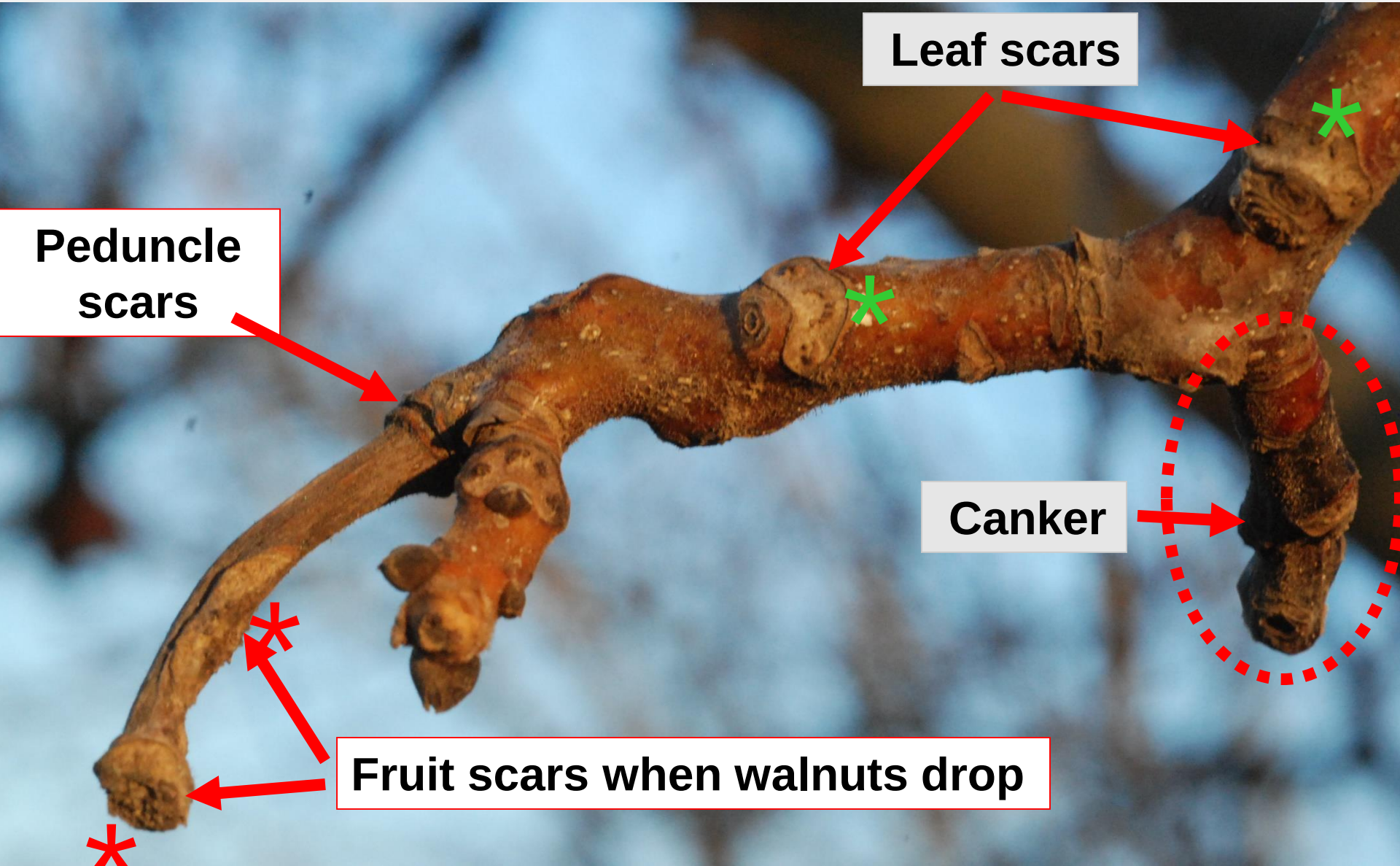
Susceptibility of pruning wounds to infection by Bot as affected by age



Treatment of pruning wounds with fungicides and then inoculation with *Neofusicoccum parvum*



Wounds in the field during 1) the season, 2) at harvest and 3) postharvest



Infection Courts of *Botryosphaeria* and *Phomopsis*

During the season:

- ✓ Wounds from hail, freeze, sunburn, wood peckers
- ✓ Prun
- ✓ Scal
- ✓ Waln

At harvest:

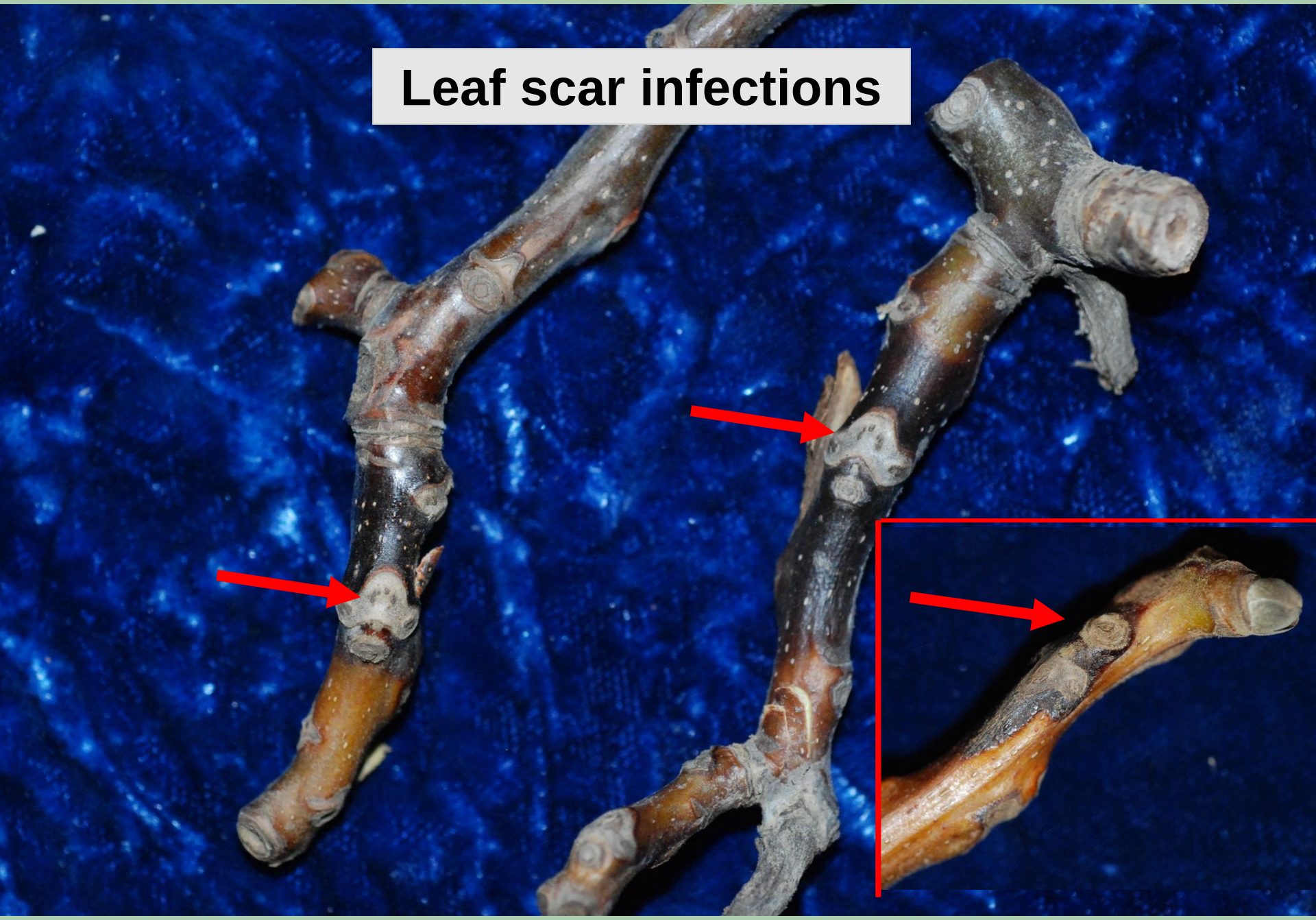
- ✓ Scars from peduncles
- ✓ Fruit wcars

ounds

Postharvest:

- ✓ Peduncle scars
- ✓ Leaf scars
- ✓ Husks (remaining on the tree)
- ✓ Pruning wounds
- ✓ Wounds from freeze damage
- ✓ Injuries from wood peckers
- ✓ Other type of injuries

Leaf scar infections



Injuries (wounds) by walnut scale & Botryosphaeria

walnut scale

Injuries from scales

Necrotic lesions

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

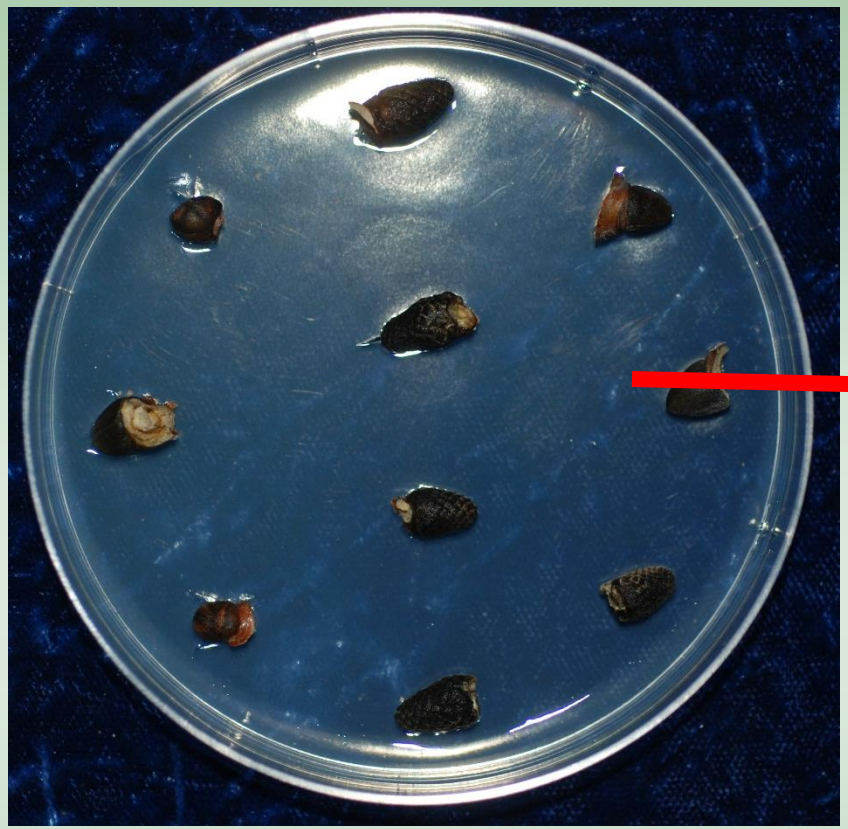
Management of Botryosphaeria canker and shoot blight:

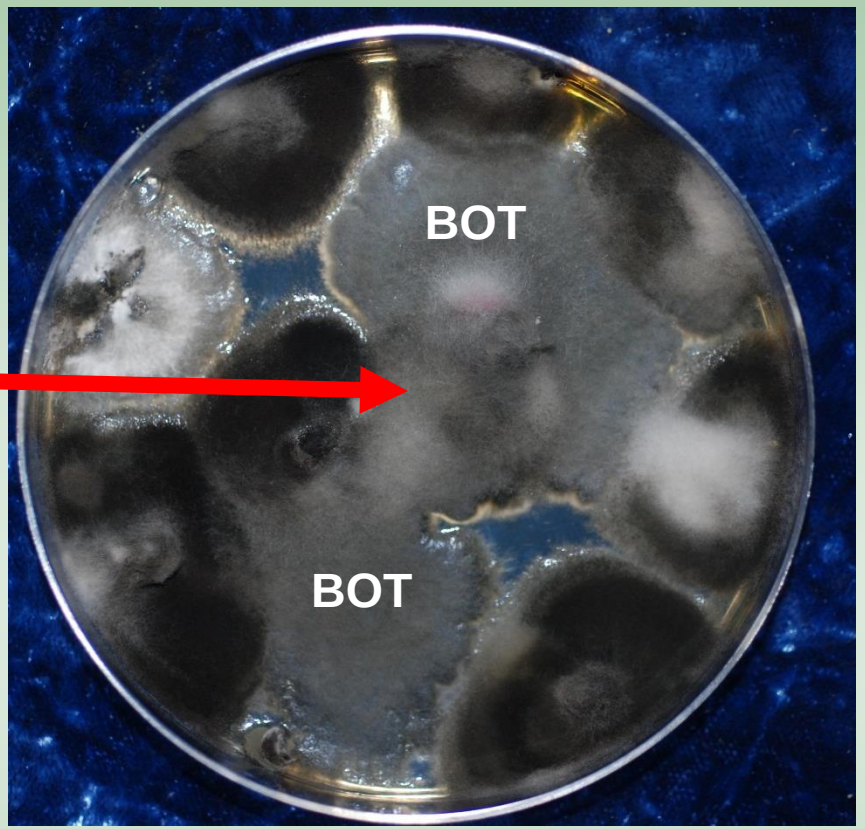
- **1. Assessment of Bot inoculum risk:** BUDMON, or CANCERED SPURS (… in progress).
- **2. Cultural control:** Sanitation: prune infected shoots to remove cankers and reduce spore inoculum; avoid wetting the tree canopy.
- **3. Chemical control:** Apply fungicide sprays**.**

Best control…

- **Integrated disease control:** Use all of the above (1 + 2 + 3).

BUD MONitoring (= BUDMON) Technique





Bud collection:
February/March

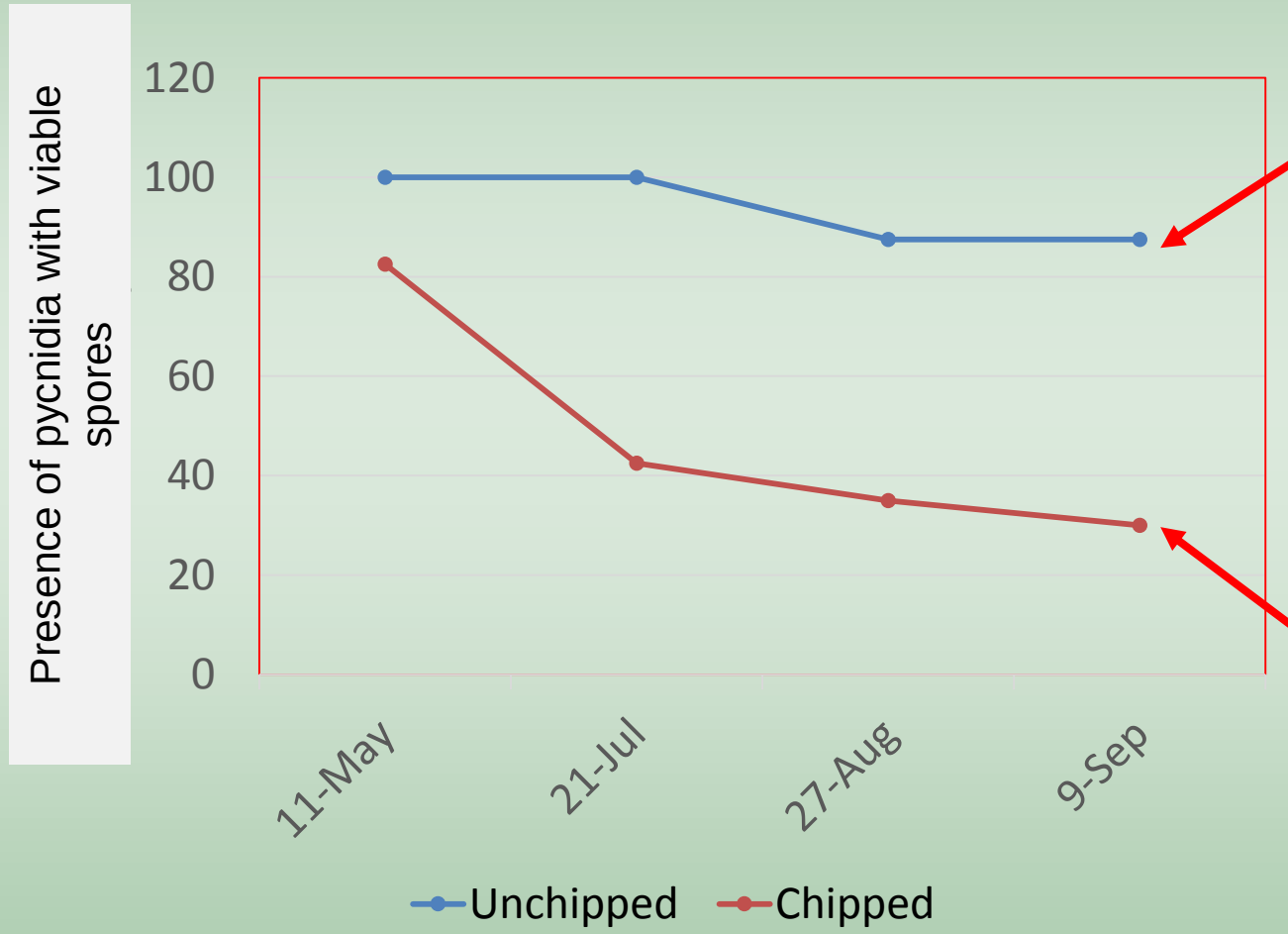
Results in 6-7 days

% of buds with Bot

Sanitation by pruning

Walnut prunings

Bot survival in chipped wood

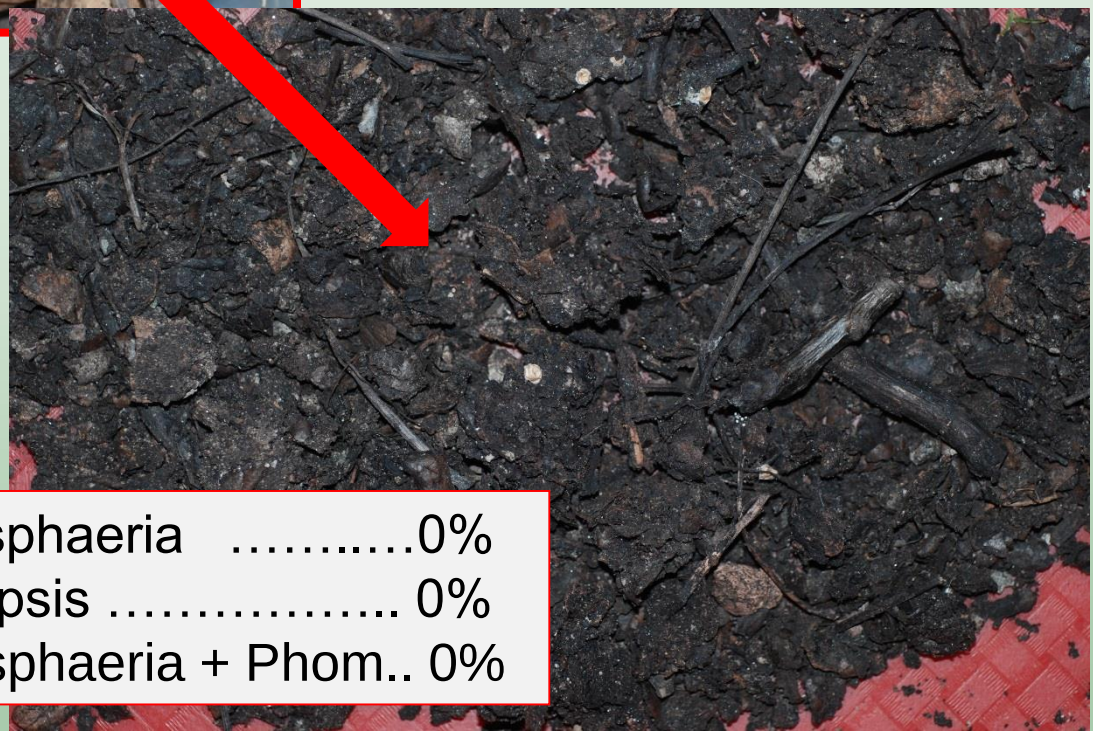


c/o Katherine Pope, UCCE Yolo /Solano

Botryosphaeria ……. 40%
Phomopsis …….. 30%
Botryosphaeria + Phom..… 20%
No pycnidia……..…..10%

90%

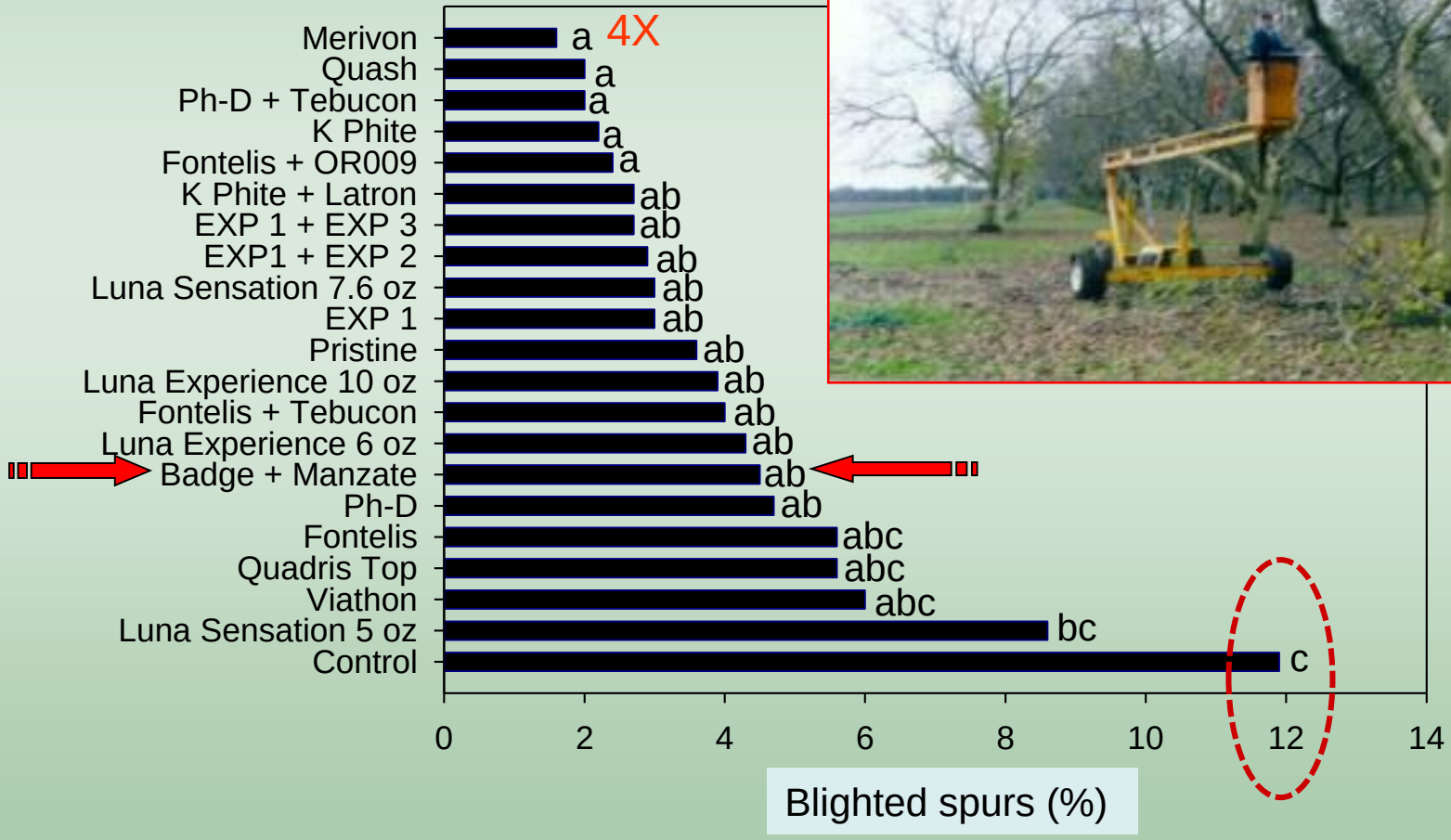
Compost



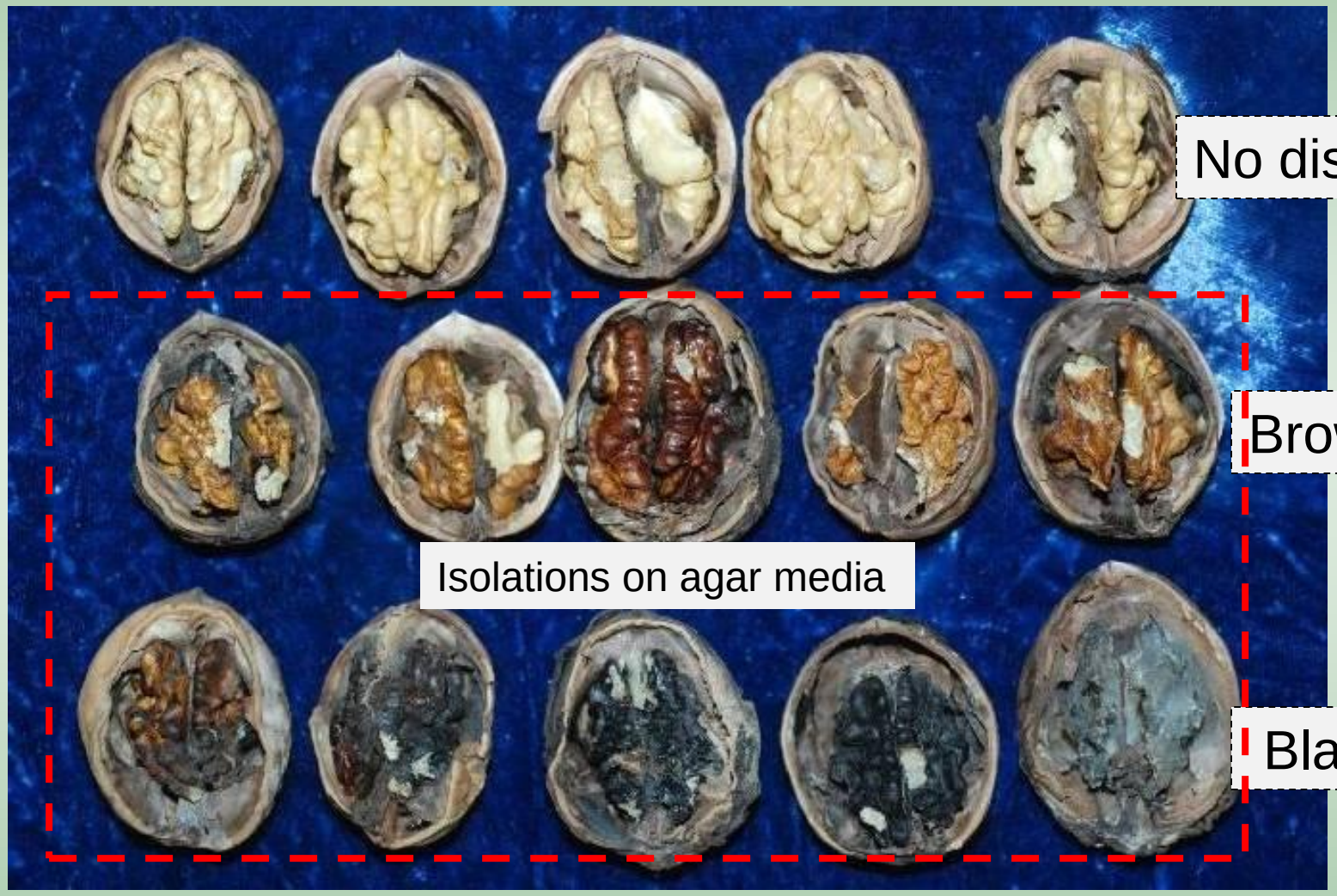
Botryosphaeria ……..…0%
Phomopsis …….. 0%
Botryosphaeria + Phom.. 0%

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

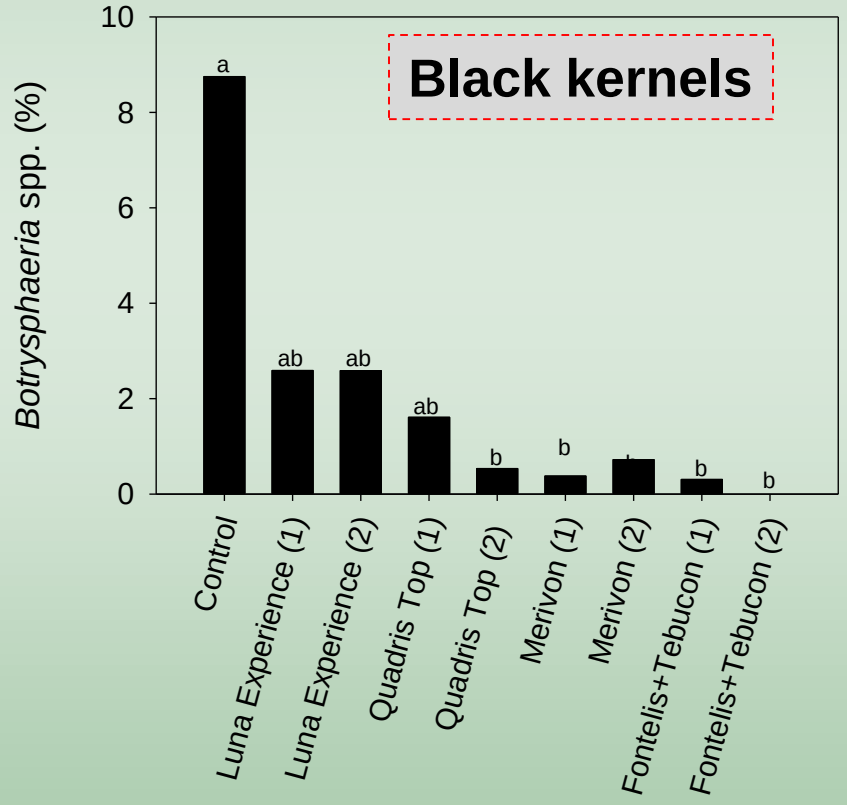
SPRAYS: May 8, June 12, and July 10

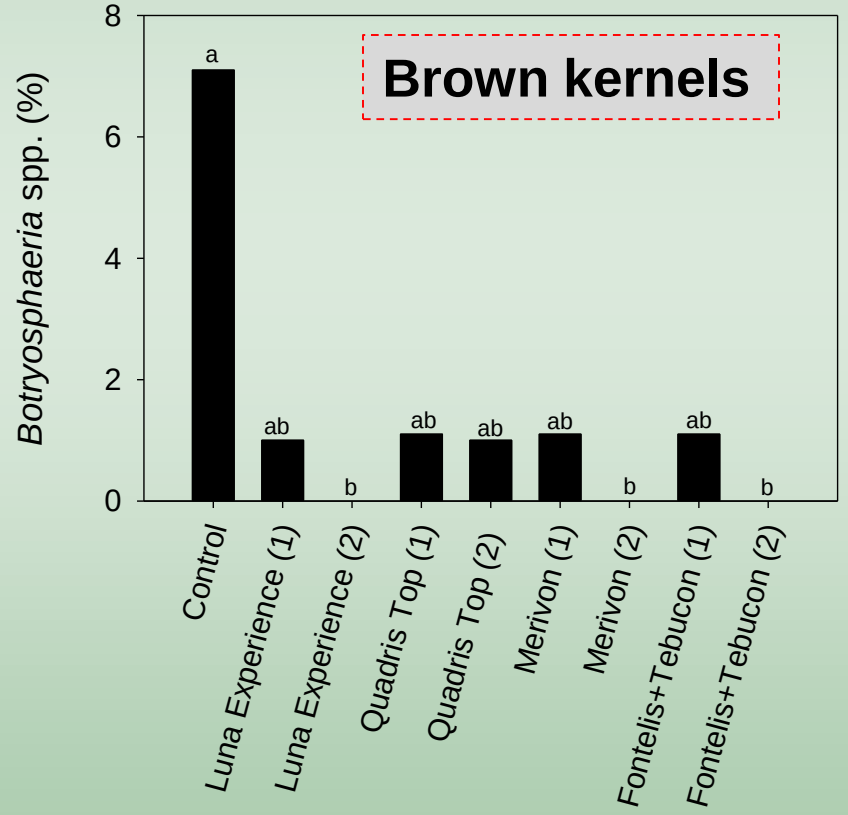


Nuts at harvest



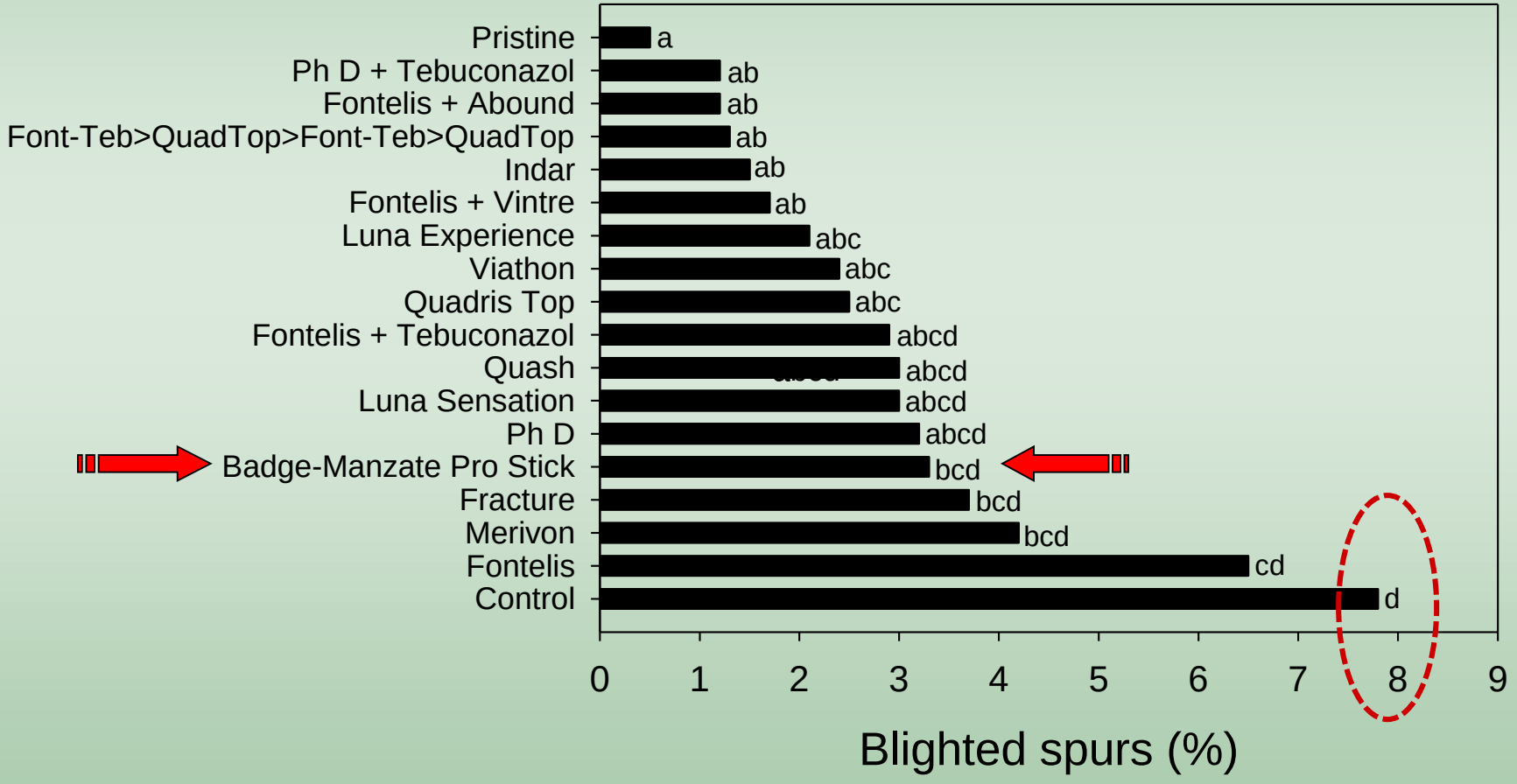
Effects of fungicides on Botryosphaeria in Chandler walnut (black and brown kernels) (Colusa Co.) - 2014



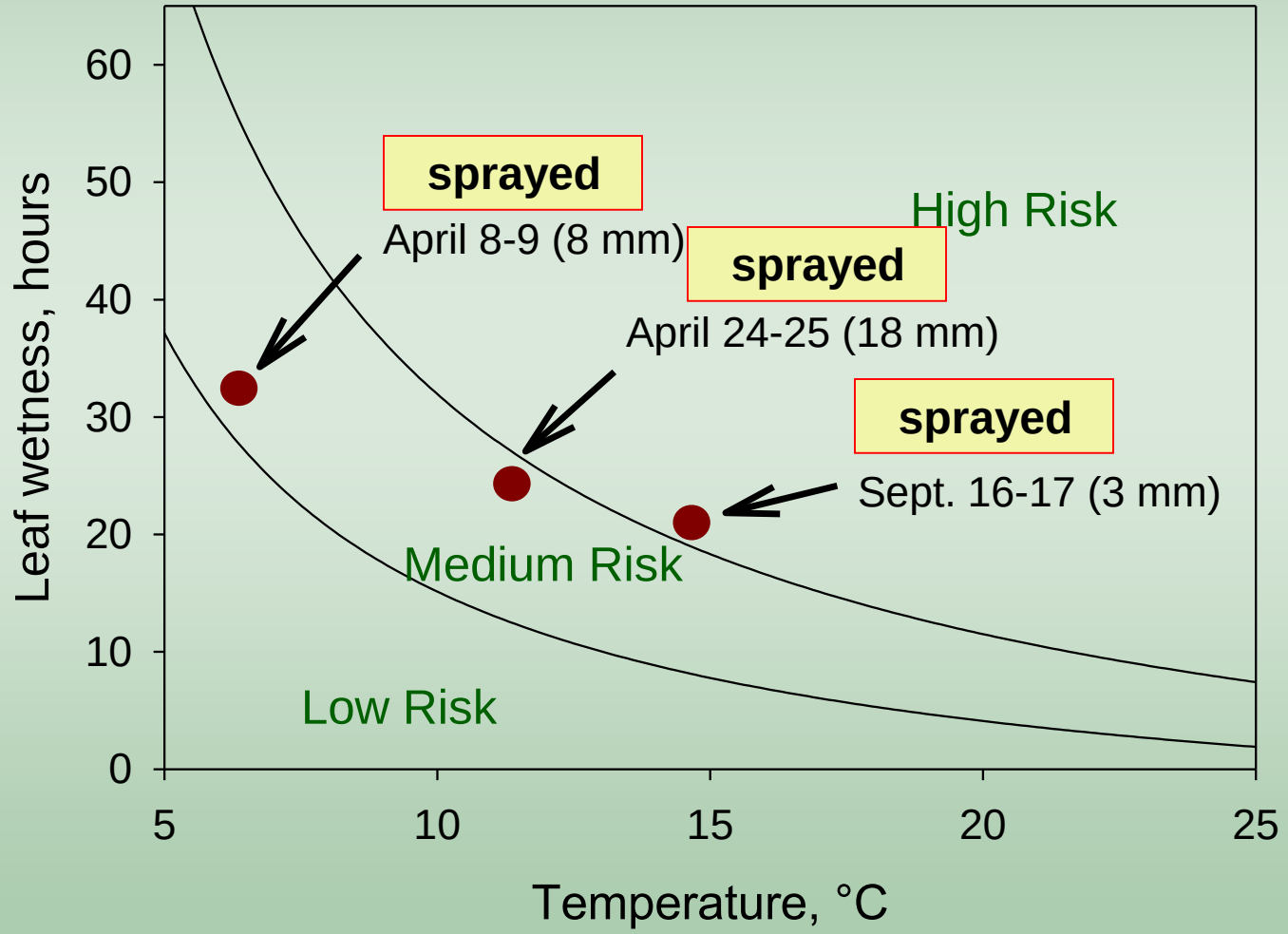


Efficacy of four calendar sprays of fungicides in a Chandler walnut orchard in Butte Co. (Sacramento River) - 2015

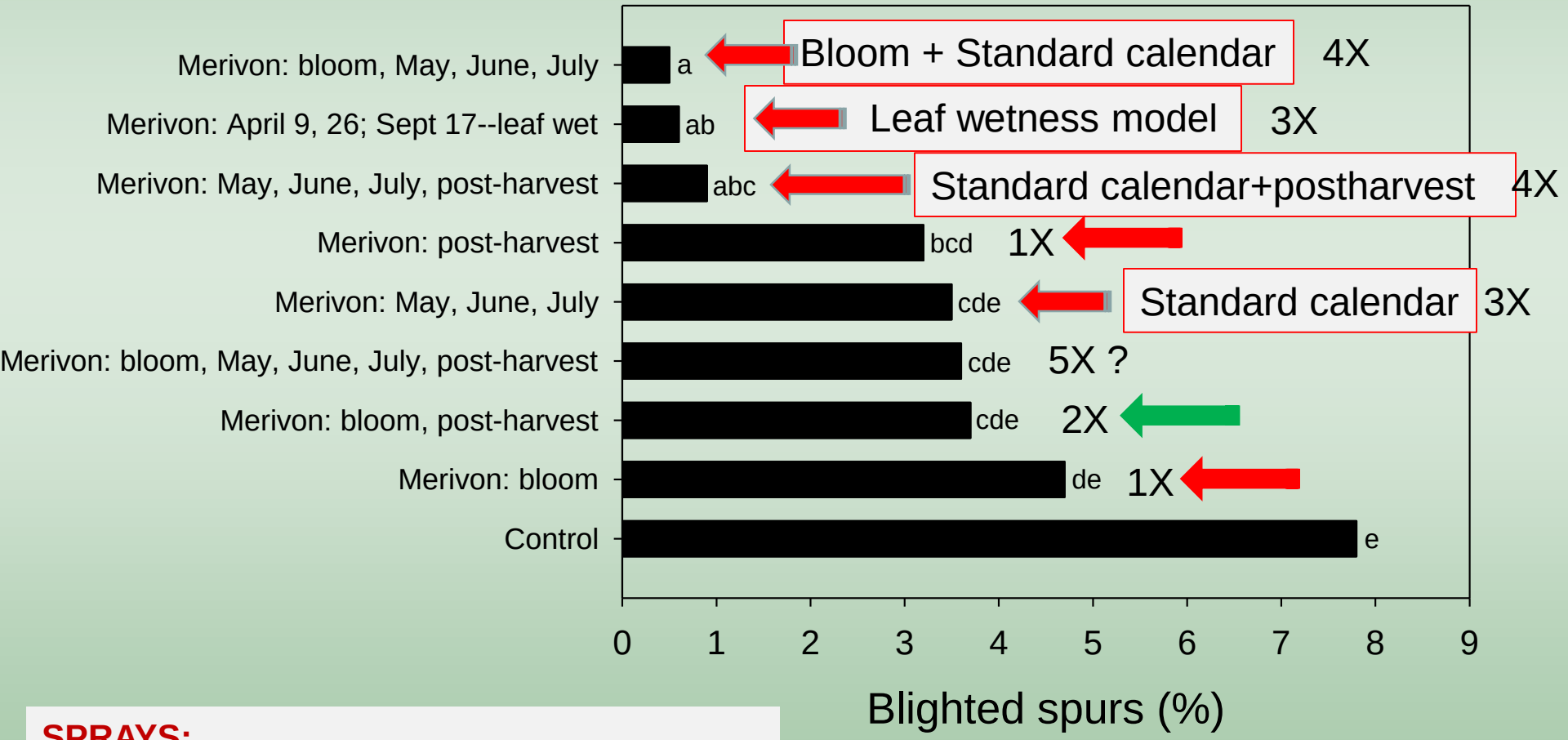
SPRAYS: May 12, Jun 11, Jul 10, Aug (4X SPRAYS)



Leaf wetness model (LWM) where rain exceeded threshold in a Chandler walnut orchard in Butte County



Various timings of Merivon® fungicide in a Chandler walnut orchard in Butte Co. - 2015

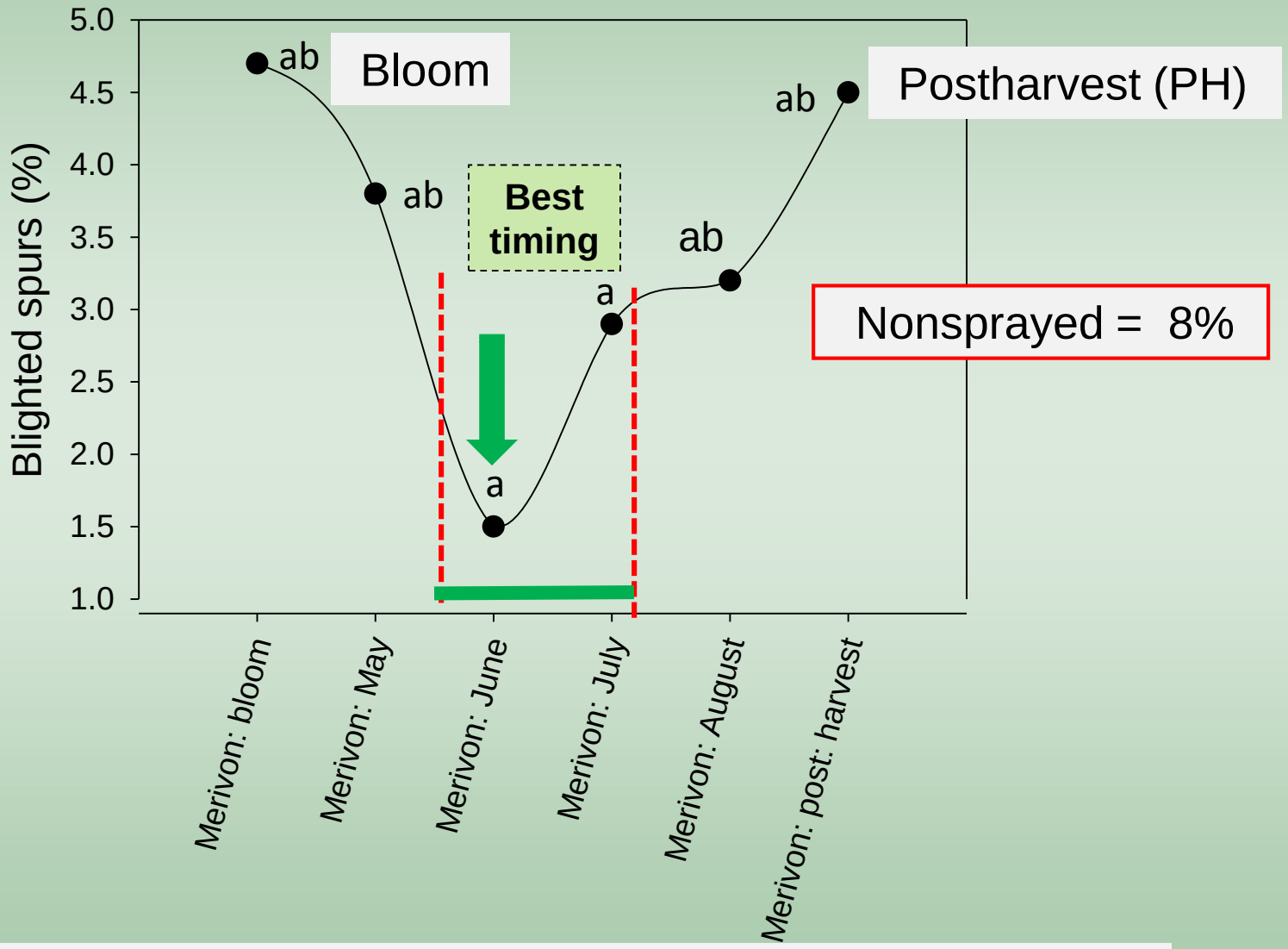


SPRAYS:

Calendar: May 12; Jun 12; Jul 10 = 3X

Bloom: Apr 9 = 1X; Postharvest: Nov 3 = 1X

Best-timing of a single spray of Merivon® in a Chandler orchard in Butte Co. - 2015



SPRAYS: Apr 9 (bloom); May 12; **Jun 12: Jul 10**; Aug 10; Nov 3 (PH)

FUNGICIDES, BACTERICIDES, AND BIOLOGICALS FOR DECIDUOUS TREE FRUIT, NUT, STRAWBERRY, AND VINE CROPS 2015

ALMOND
APPLE
APRICOT
CHERRY
GRAPE
KIWIFRUIT
PEACH/NECTARINE
PEAR
PISTACHIO
PLUM
POMEGRANATE
PRUNE
STRAWBERRY
WALNUT

James E. Adaskaveg, Professor
University of California, Riverside

Doug Gubler, Extension Plant Pathologist
University of California Davis

Themis Michailides, Plant Pathologist
University of California, Davis/Kearney Agricultural Center

UC Kearney Agricultural Research and Extension Center
www.uckac.edu/plantpath

www.ipm.ucdavis.edu

Efficacy of registered fungicides against Botryosphaeria canker and blight of walnut

Fungicide	Active ingredient	Efficacy
Quash……	metconazole	++++
Merivon……	fluxopyroxad+pyraclostrobin	++++
Pristine …….	boscalid + pyraclostrobin	+++
Quadris Top…..	difenoconazole + azoxystrobin	+++
Switch……	cyprodinil + fludioxonil	++++
PhD…..…….	Polyoxin-D	+++
Viathon……..	tebuconazole + phosphite	+++
K-Phite …….	Polyphosphite	++++
Luna Experience	fluopyram + tebuconazole	+++
Luna Sensation	fluopyram + trifloxystrobin	++
Fontelis	penthiopyrad	+++
Manzate	copper-mancozeb	++

Efficacy: + = poor: ++++ = excellent

http://www.ipm.ucdavis.edu

Scenarios for sanitation & sprays

✓ ***Orchards*** **- Heavy infection (>50%):** Prunings need to be chipped and they may be left in the orchard; apply 3-5 fungicide sprays ((bloom, May, Jun, July, and postharvest).

✓ ***Orchards*** **- Moderate infection (21% - 50%):** Prune or hedge these orchards first and then move into heavily infected orchards; prunings need to be moved out of the orchard; at least 3 sprays (bloom and June spray, & July – depending on weather conditions).

✓ ***Orchards*** **– Light infection (6% - 20%):**
Prune or hedge these orchards first and then move into more infected orchards; prunings need to be moved out of the orchard; two sprays (bloom and mid June to early July).

✓ ***Orchards*** **– Very light infection (1% - 5%):** Prune infections and destroy them out of the orchard; no spray(s) needed, unless it rains.

✓ ***Orchards*** **– No infection: no Botryosphaeria yet (0%):** Prunings can be chipped and left in the orchard; no spray(s) are needed.

CONLCUSIONS

- ✓ For best management we need all: a) assessment of inoculum risk; b) sanitation; and c) fungicide sprays.
- ✓ Sprays during May through July/August reduce Botryosphaeria (confirmed in 2014 & 2015).
- ✓ Bloom sprays and postharvest sprays seem to reduce disease (we need to repeat in 2016).
- ✓ Sprays after a rain/infection event seem to be very effective (we need to repeat in 2016).
- ✓ The best-timing spray seems to be around mid-June to early/mid July (we need to repeat in 2016).

Acknowledgments

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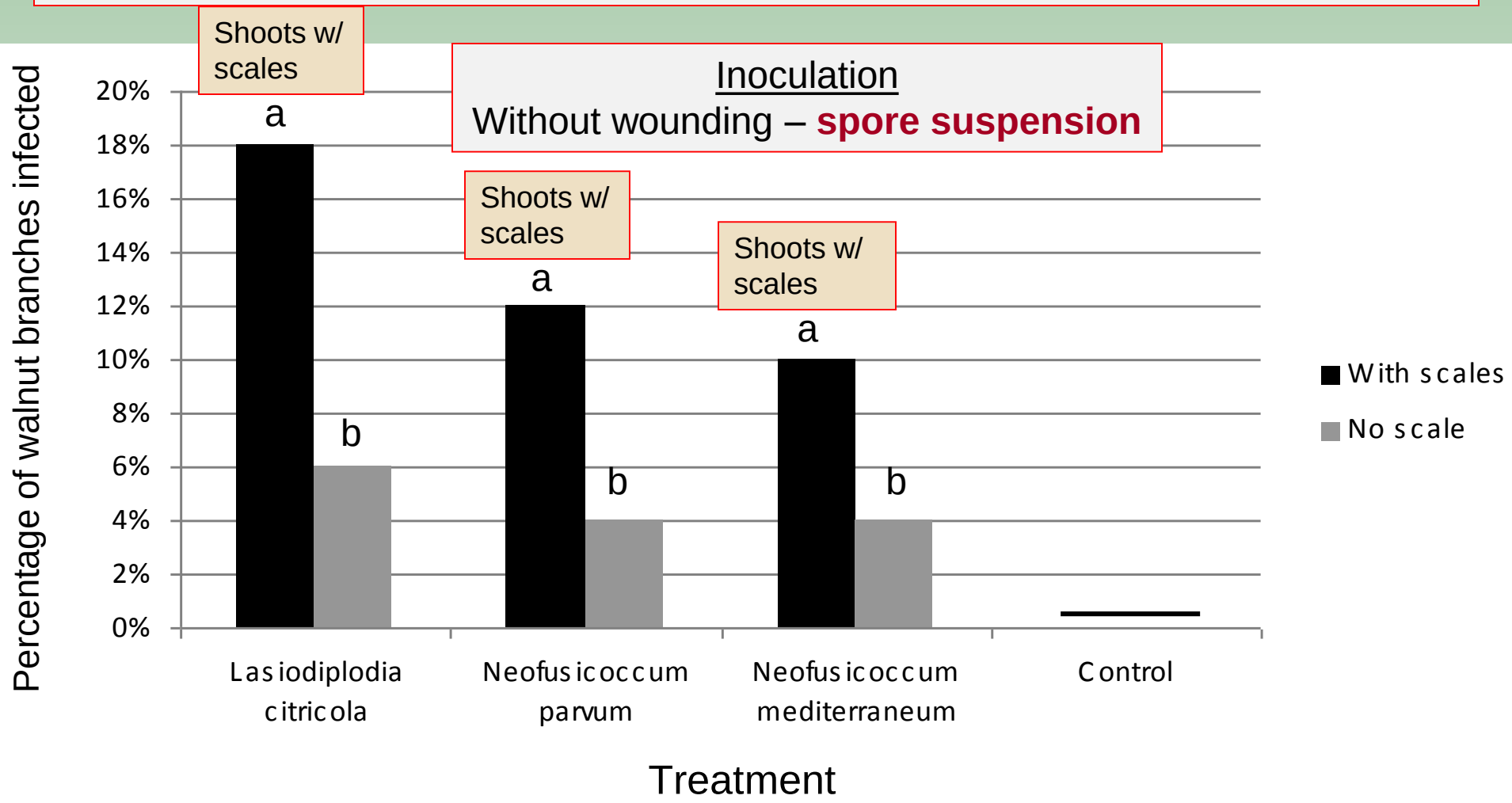
Dan Felts
Yong Luo
Ryan Puckett
Juan Moral
& farm advisors

Thank you

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**

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