Biology and Control of Neofabraea leaf spot and twig dieback, a new disease of SHD oil olives in California

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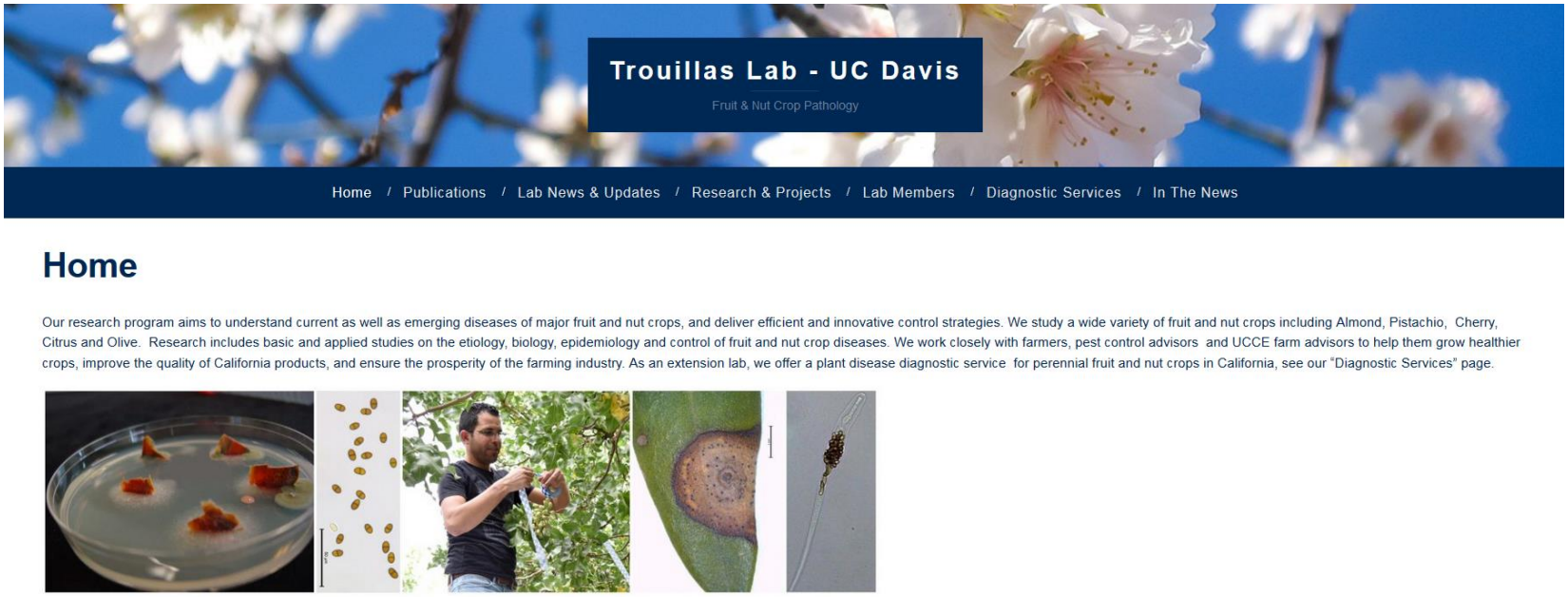
University of California
Agriculture and Natural Resources

Extension specialist in Plant Pathology:
Fruit & Nut crop industries for California



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Agriculture and Natural Resources

Disease diagnostic service: The disease clinic

- My lab provides support to CE advisors, PCA's and growers to diagnose diseases and disorders

- This service may extend into field visits, and potentially exposes my lab to new and emerging diseases

UC Cooperative extension network:

April 2016,
farm call with CE
advisors from SJ County

Super High Density olive orchard

University of California
Agriculture and Natural Resources

Olive oil olives, San Joaquin County, Spring 2016:

Symptoms: defoliation

Koroneiki

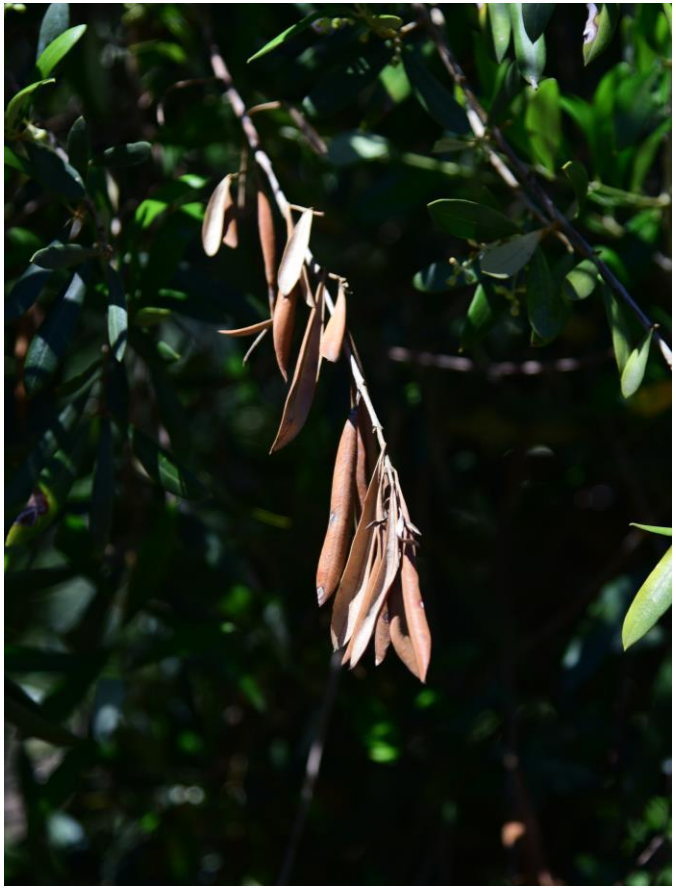
Arbosana

Leaf spots: Arbosana

Symptoms: twig lesions (Arbosana)

Symptoms: twig lesions (Arbosana)

Symptoms: twig dieback (Arbosana)



Symptoms: Branch cankers (Arbosana)

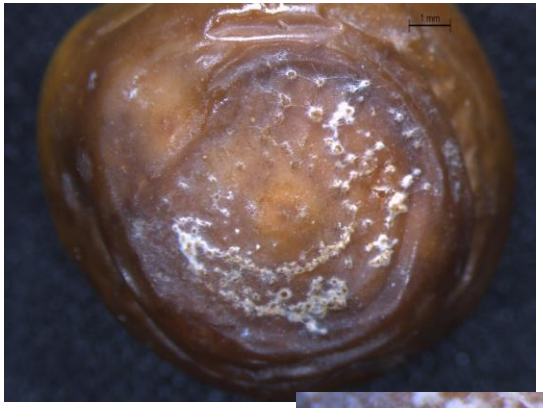
Symptoms: host susceptibility

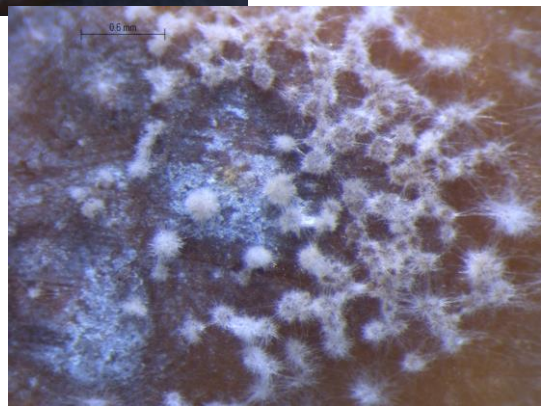
Arbosana

Koroneiki

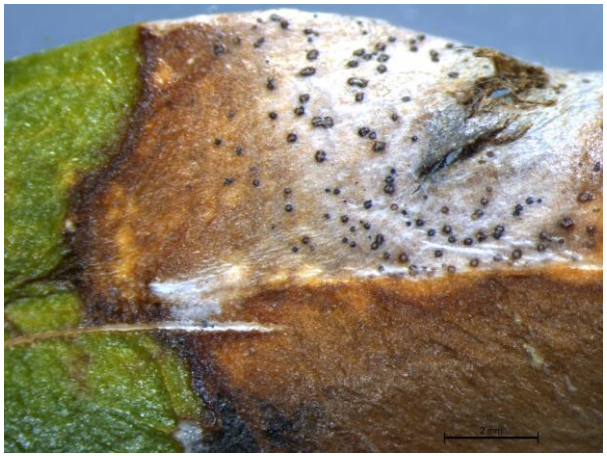
Neofabraea diseases in olive:

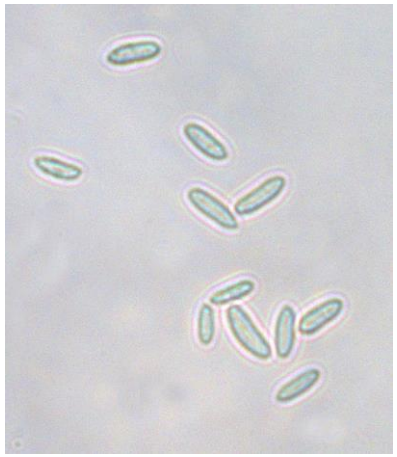
- Fruits can also get infected in CA (Arbequina), inoculum sources for the disease?



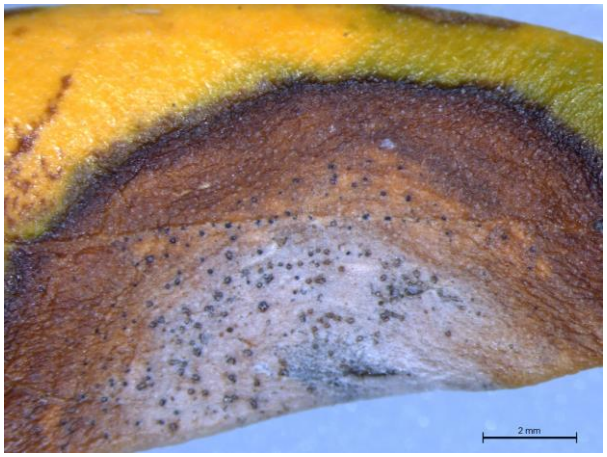


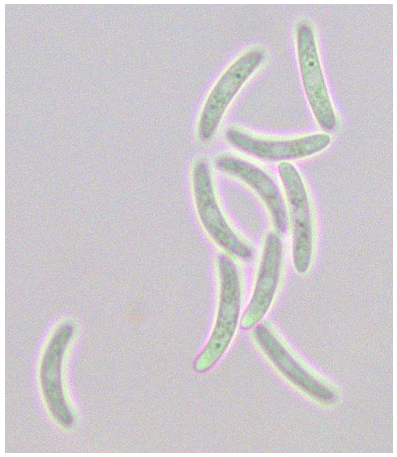
Disease diagnosis: morphological studies

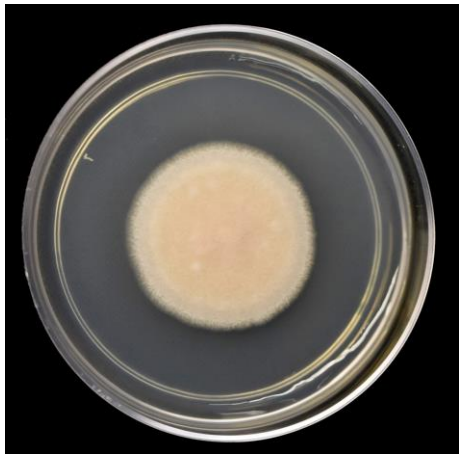




Neofabraea kienholzii



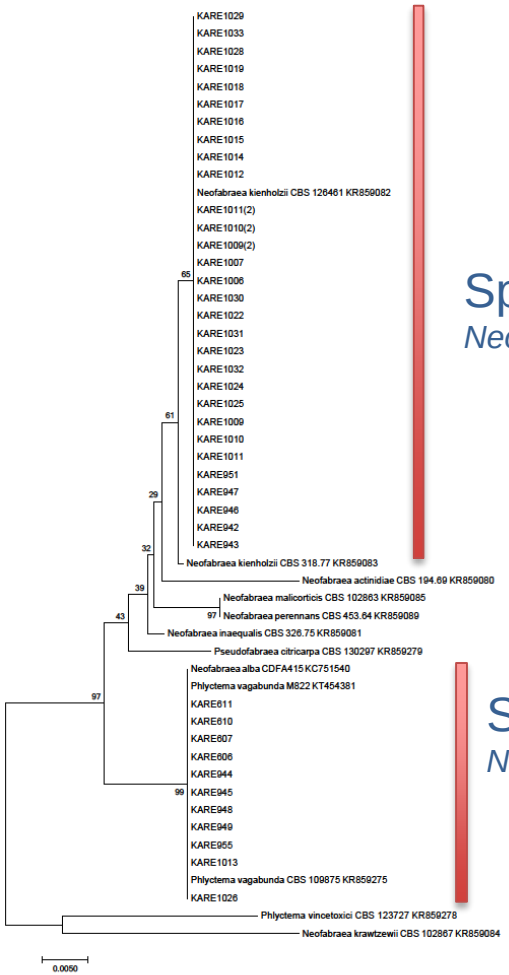




Neofabraea vagabunda

Disease diagnosis: molecular studies, species diversity

Polymerase chain reaction, amplification and sequencing of selected DNA region (internal transcribed spacer region (ITS) of the rDNA) for the identification of fungi



Species 1:
Neofabraea kienholzii

Species 2:
Neofabraea vagabunda

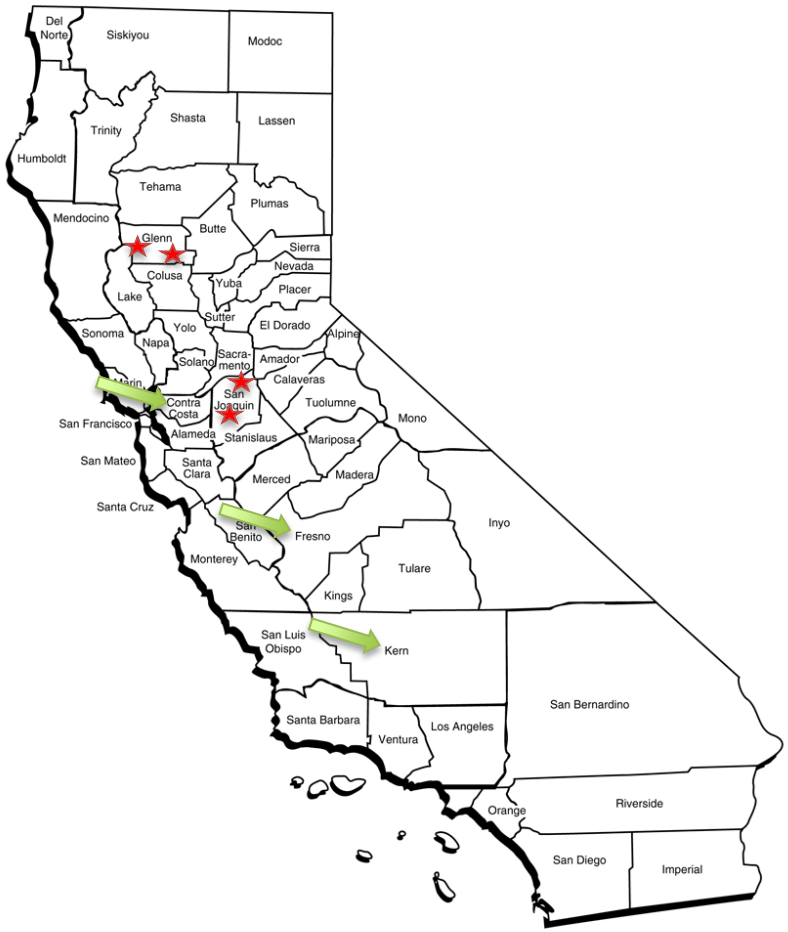
University of California
Agriculture and Natural Resources

Surveys for Neofabraea disease of olive:

Only found in Super High Density orchards and Arbosana olive so far

More surveys needed:

559-646-6566
flotrouillas@ucanr.edu



Not to be confused with:

Neofabraea leaf spots

Peacock leaf spots

Not to be confused with:

Olive knot

Harvester damage: breakage not associated with fungal infection

Not to be confused with:

Leaf senescence and leaf drop:

- General neglect of the normal inputs
- Water stress
- Frost damage
- Nitrogen on other nutrient deficiency

Photo credits: E . Fichtner

Neofabraea diseases in apple and pear:
Bull's eye rot and canker

Photo credits: Iain MacSwann

- "Bull's-eye rot" occurs on fruit at open lenticels or at breaks in the skin
- The rot spots may be only specks, but most of them are 0.5 to 1 inch
- Spots may occur singly or be numerous.

Neofabraea diseases in apple and pear:
Bull's eye rot and canker

Photo credits: OSU Extension Plant Pathology Collection

- The fungus overwinters in cankers and infected fruits
- Conidia are exuded from acervuli and dispersed by rain
- Perennial canker is associated with the low temperature or southwest injury, and pruning wounds
- The fungus can infect through the wounded portions of the tree
- Oregon, Washington, and California

Neofabraea coin disease of ash:

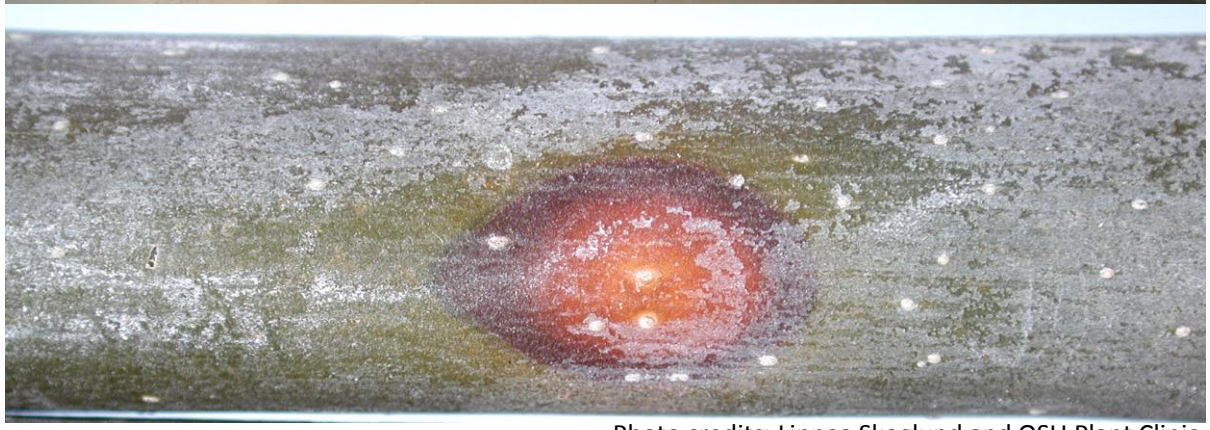


Photo credits: Linnea Skoglund and OSU Plant Clinic

- Found on nursery stock Michigan, Oregon, and Ontario, Canada
- Cankers are annual

Neofabraea diseases in olive:

- Lepra Fruit Rot/Leprosis
  - Tuscany Italy in 1907 (Petri, 1915)
  - Spain (Roca et. al., 2007)

- First report of *Neofabraea alba* causing fruit spot on olive in North America. (Rooney-Latham et al., 2013). Found in coratina and picholine cultivars in two commercial orchards in Sonoma County. Pathogenic in frantoio.

Photo credits: S. Rooney-Latham and Doug Gubler

Neofabraea diseases in olive:

- First report of *Neofabraea vagabunda* causing branch cankers on olives in Spain.

J. Romero et al. (Feb 2016). Found in Arbequina and Picual.

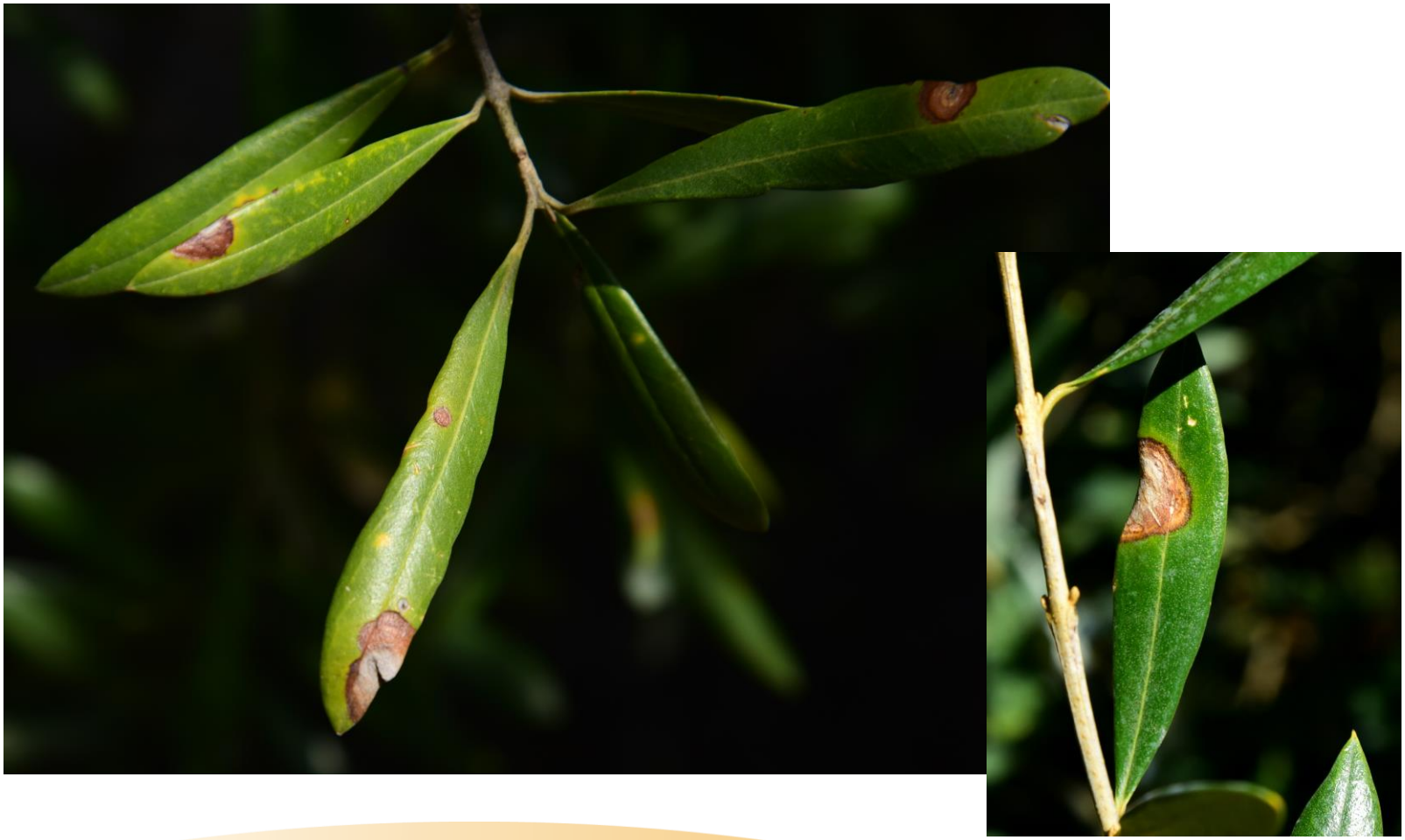
Photo credits: J. Romero

Disease emergence: super-high-density oil olive

- Intensification of agricultural practices
- Mechanical harvest
- Changing weather conditions

Disease emergence: Infection occurs at wounds caused by mechanical harvesters

Disease emergence: Infection occurs at wounds caused by mechanical harvesters



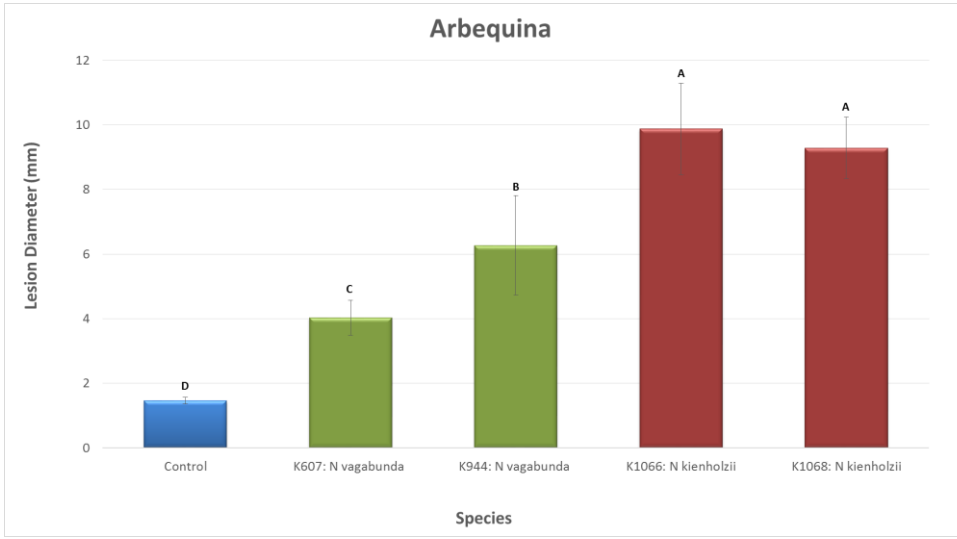
Disease emergence: Infection occurs at wounds caused by mechanical harvesters

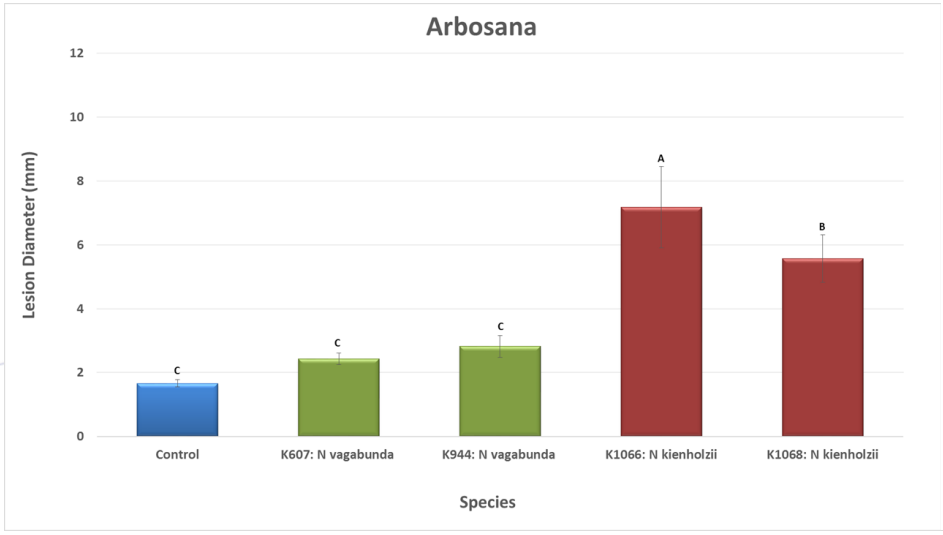
Pathogenicity on leaves: Wounds required for infection!

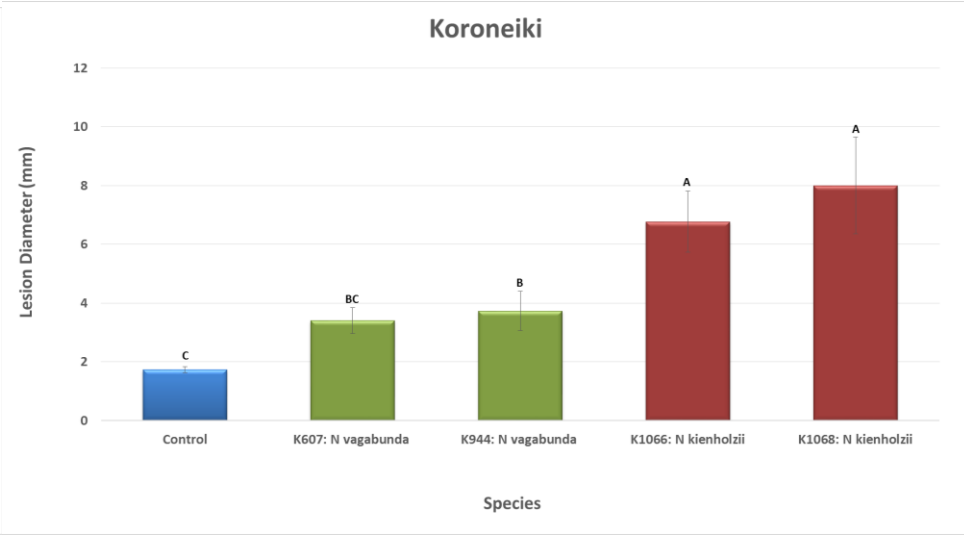
New growth in the spring does not get infected

Inoculation 12-22-2016

Rating 2-27-2017

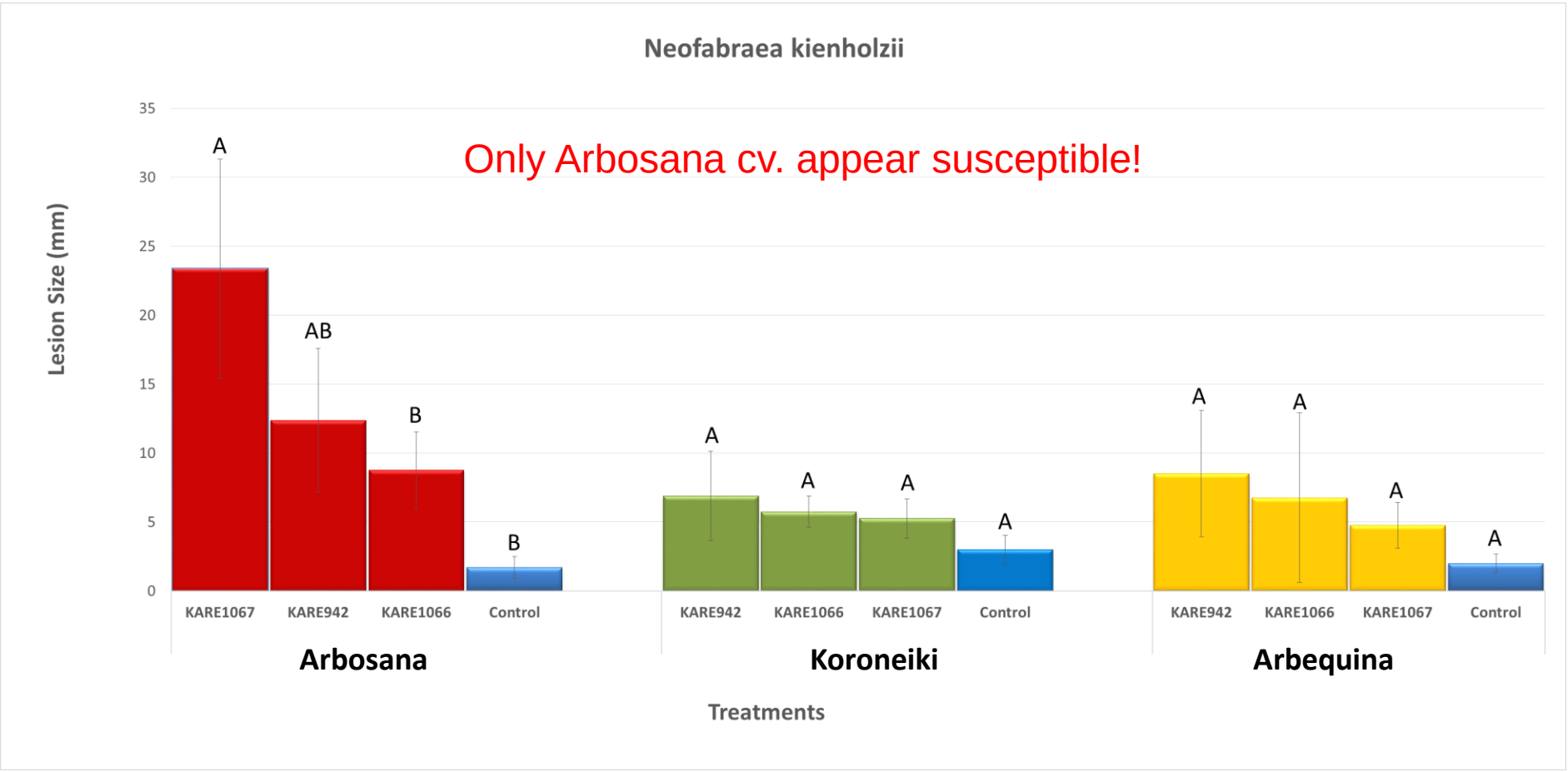




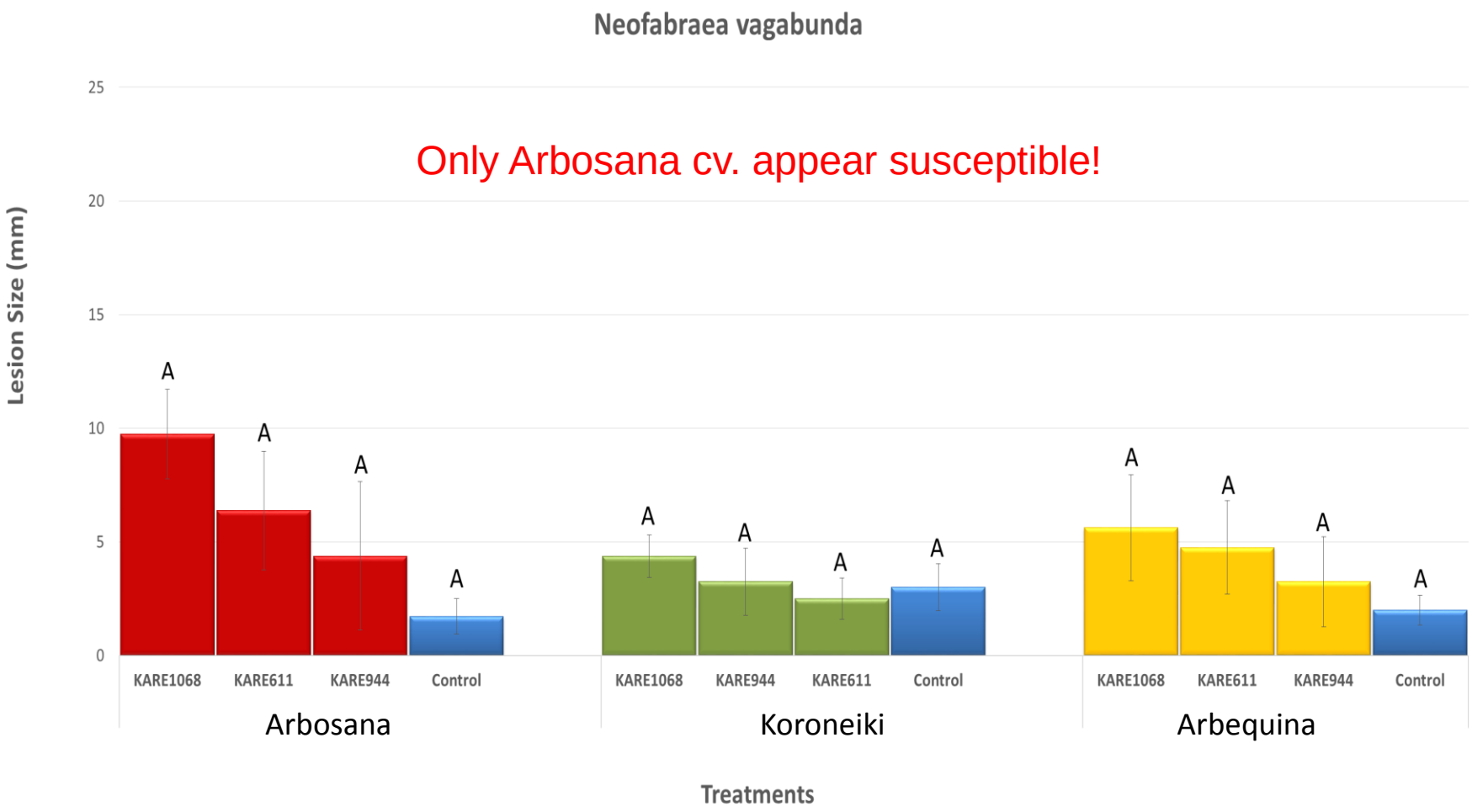


Pathogenicity on twigs: field trials

Pathogenicity on twigs: *N. kienholzii*



Pathogenicity on twigs: *N. vagabunda*



Pathogenicity in apple:

N. Kienholzii Control *N. vagabunda*

Pathogenicity in apple: Inoculum source

plant disease

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DISEASE NOTES

First Report of *Neofabraea alba* Causing Branch Canker Dieback of Apple in California

S. Rooney-Latham and **M. C. Soriano**, California Department of Food and Agriculture, Sacramento 95832.

Pathogenicity in olive fruits:

Disease cycle:

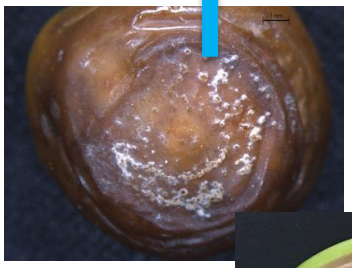
Rain

Fall: Infection of fresh wounds

Symptoms best visible in March

Fall: Mechanical harvest

April: Defoliation



Inoculum reservoir: Old olive leaves and fruits, apples (November)

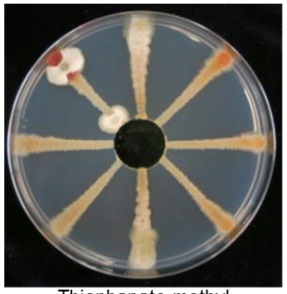
Disease control: fungicide trials

Copper fungicides?

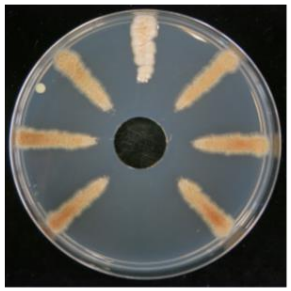
Fungicide trials: *In vitro* (Adaskaveg's Lab, UCR)

In vitro sensitivity of *Neofabraea* sp. isolates to selected fungicides

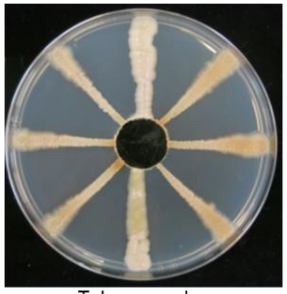
	EC_{50} for mycelial growth (ppm)					
isolate	Thiophanate-methyl	Thiaben-dazole	Tebucon-azole	Cyprodinil	Fluopyram	Chloro-thalonil
K606 (N. alba)	1.341	0.151	0.036	>6	0.117	0.094
K942	0.248	0.261	0.003	0.024	0.036	0.032
K1006	0.230	0.261	0.004	0.025	0.059	0.045
K1012	0.210	0.234	0.005	0.040	0.047	0.057



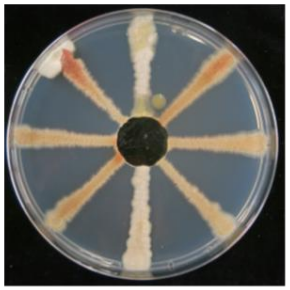
Thiophanate-methyl
Stock conc. 1000 ppm



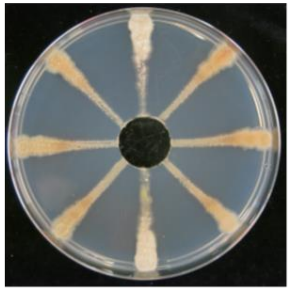
Thiabendazole
Stock conc. 100 ppm



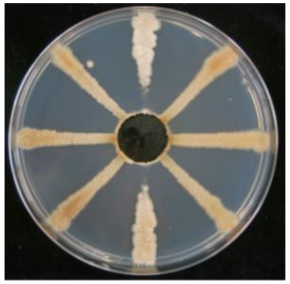
Tebuconazole
Stock conc. 10 ppm



Cyprodinil
Stock conc. 30 ppm



Fluopyram
Stock conc. 200 ppm



Chlorothalonil
Stock conc. 100 ppm

Fungicide trials: field trials

- Topsin M (thiophanate-methyl – group 1)
- Inspire Super (difenoconazole/cyprodinil – group 3+9)
- Luna Experience (fluopyram/tebuconazole – group 3+7)
- Luna Sensation (fluopyram/trifloxystrobin – group 7+11)
- Mertect (thiabendazole – group 1)
- Kocide 3000 (Copper Hydroxide)
- Rhyme (flutriafol – group M3)
- Vangard WG (Cyprodinil 75% – group 9)
- Ziram (ziram – group M3)
- Bravo (Chlorothalonil – group M5).

Fungicide trials 2016-2017: Trial 1a & 1b

- Arbosana trees
- Stihl SR 450 Backpack Sprayers
- Rating on March 8 2017

	No.	Flag	Product(s)	FP/Acre	FP/Treatment
1a	1	W	Unsprayed control	none	none
	2	YKS	Topsin M	1.5 lb	24 g
	3	RD	Inspire Super	20 fl oz	20.7 ml
	4	BKS	Luna Experience	17fl oz	17.6 ml
	5	GD	Luna Sensation	7.6 fl oz	7.9 ml
	6	RKS	Ziram	24 oz	24 g
	7	YS	Vangard	10 oz	10.4 g
1b	8	YD	Rhyme	7 fl oz	7.2 ml
	9	BS	Tebucon	2 oz	2 g
	10	PKS	Kocide 3000	7 lb	112 g
	11	OS	Bravo/Equus	64 fl oz	66 ml
	12	G	Mertect	5.8 fl oz	6 ml

Single application at harvest: November 18 2016

Fungicide trials 2016-2017 : Corto Olive, Trial 2

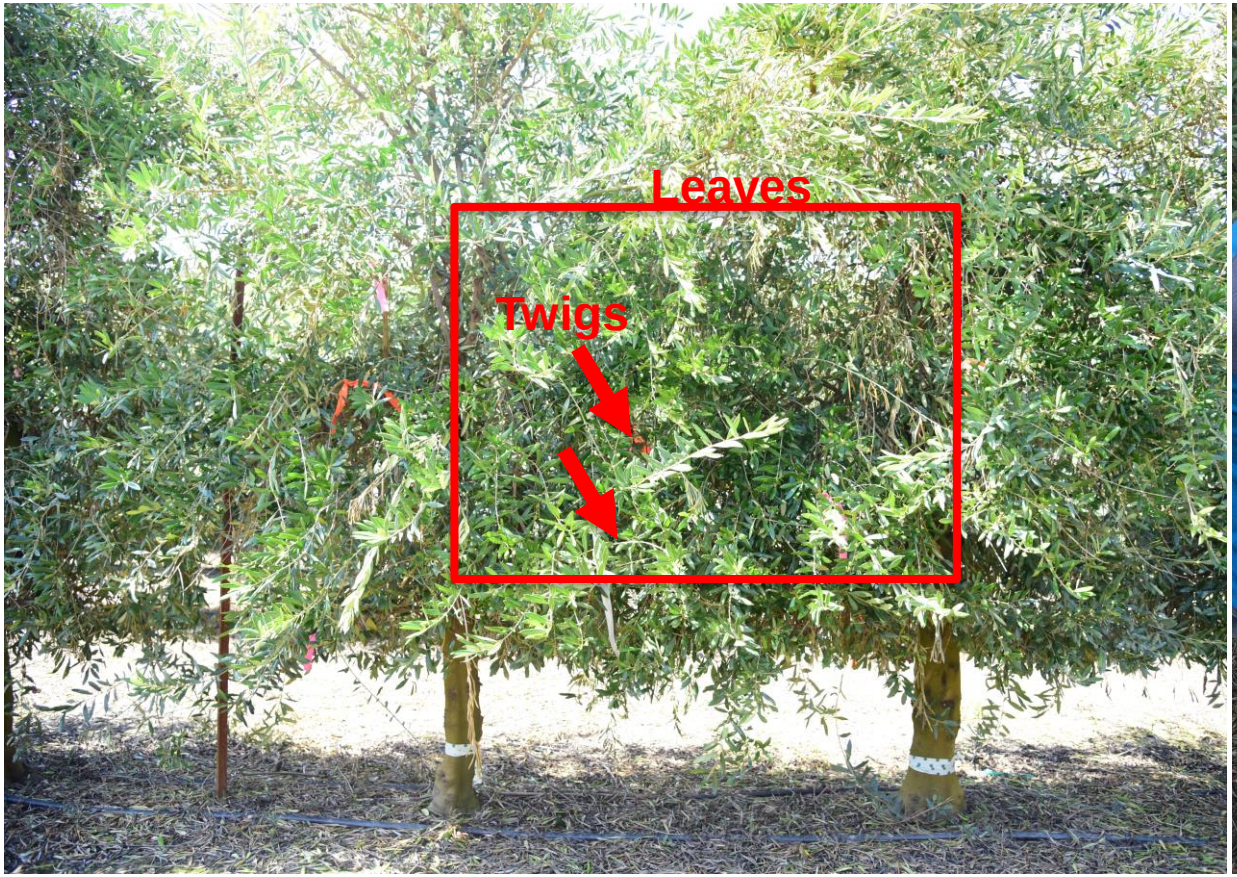
No.	Flag	Product(s)	FP/Acre	FP/Treatment
1	W	Unsprayed control	none	none
2	YKS	Luna Experience	17fl oz	17.6 ml
3	GD	Ziram	24 oz	24 g
4	BS	Tebucon	8 oz	8 g
5	PKS	Kocide 3000	7 lb	112 g
6	RD	Bravo/Equus	64 fl oz	66 ml
7	Pu	Mertect	5.8 fl oz	6 ml

3 applications: Dec 2 and Dec 21 2016, Jan 6 2017

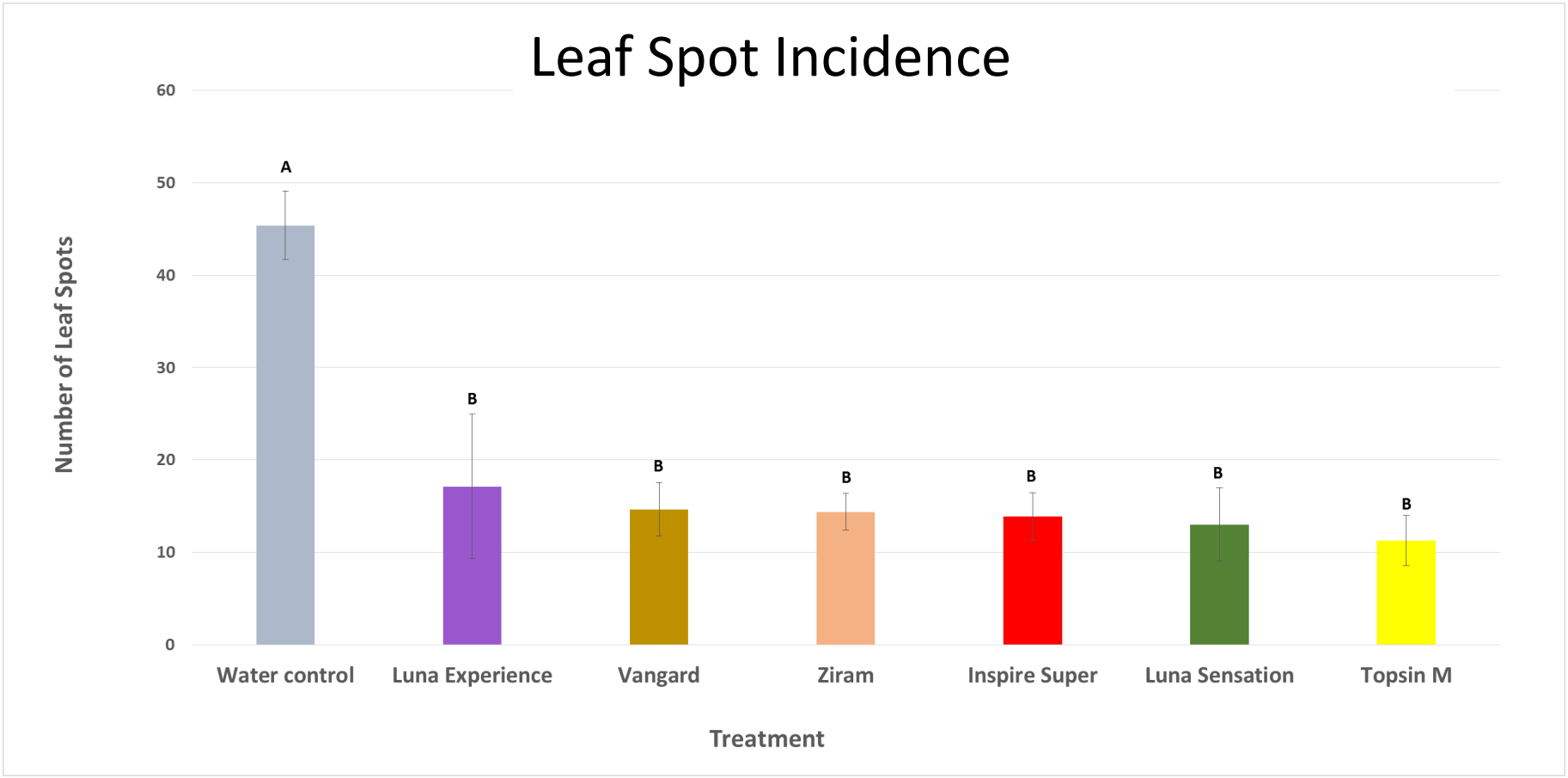
- Arbosana trees
- Stihl SR 450 Backpack Sprayers
- Rating in March/April

2016-2017: very wet years, high disease pressure

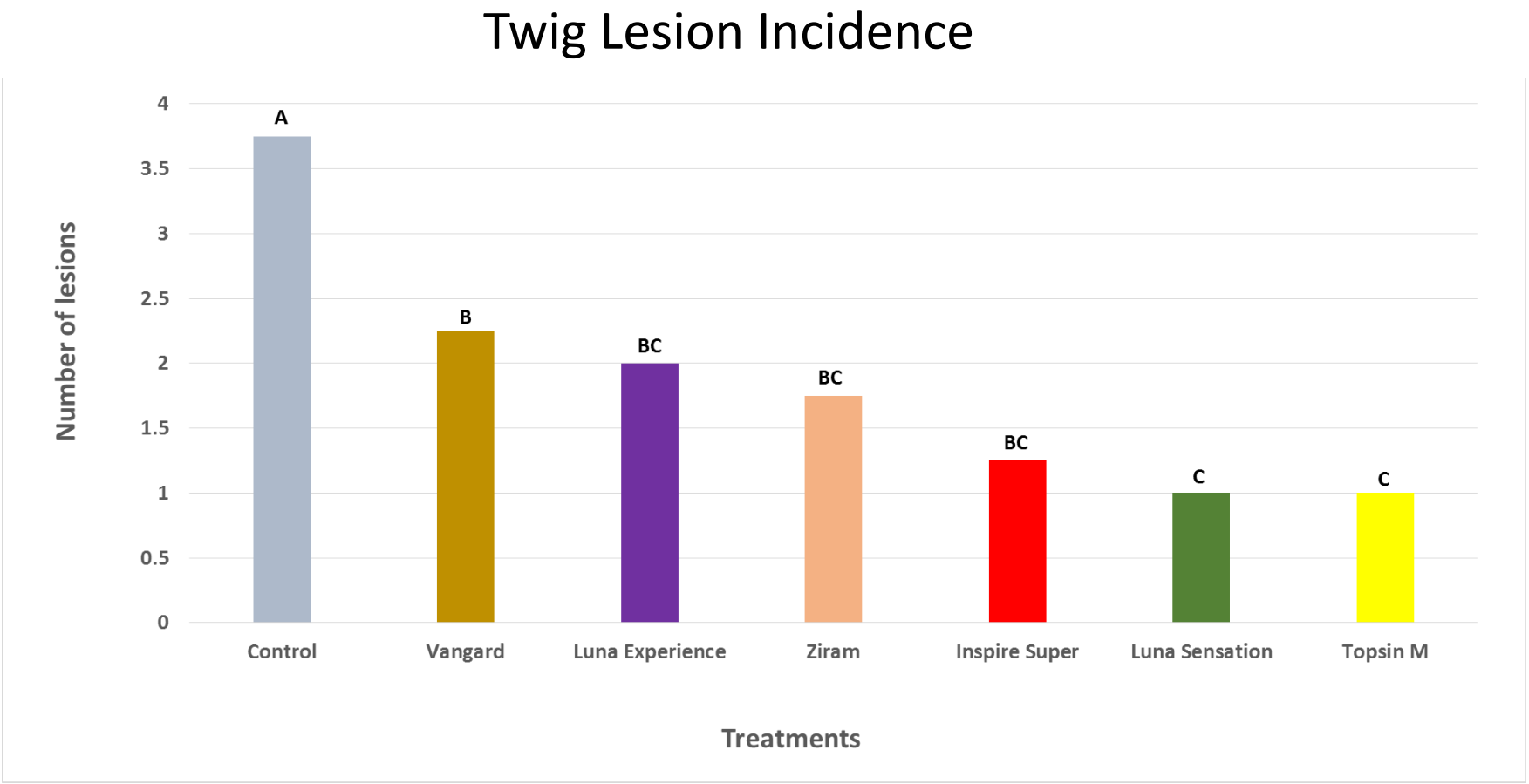
Fungicide trials: Experimental unit = 2 Trees, 4 repetitions



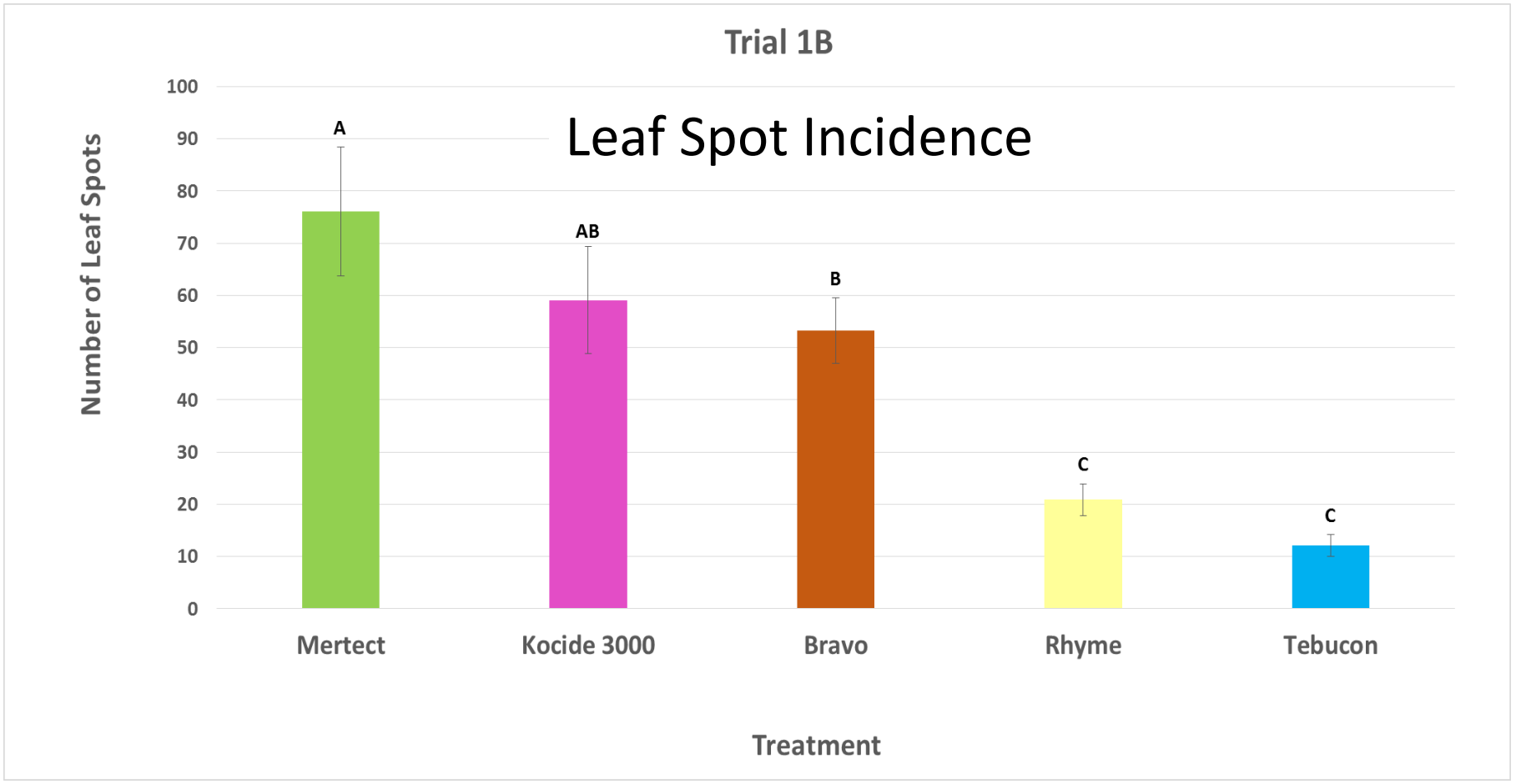
Fungicide trials 2016-2017: Trial 1a



Fungicide trials 2016-2017: Trial 1a

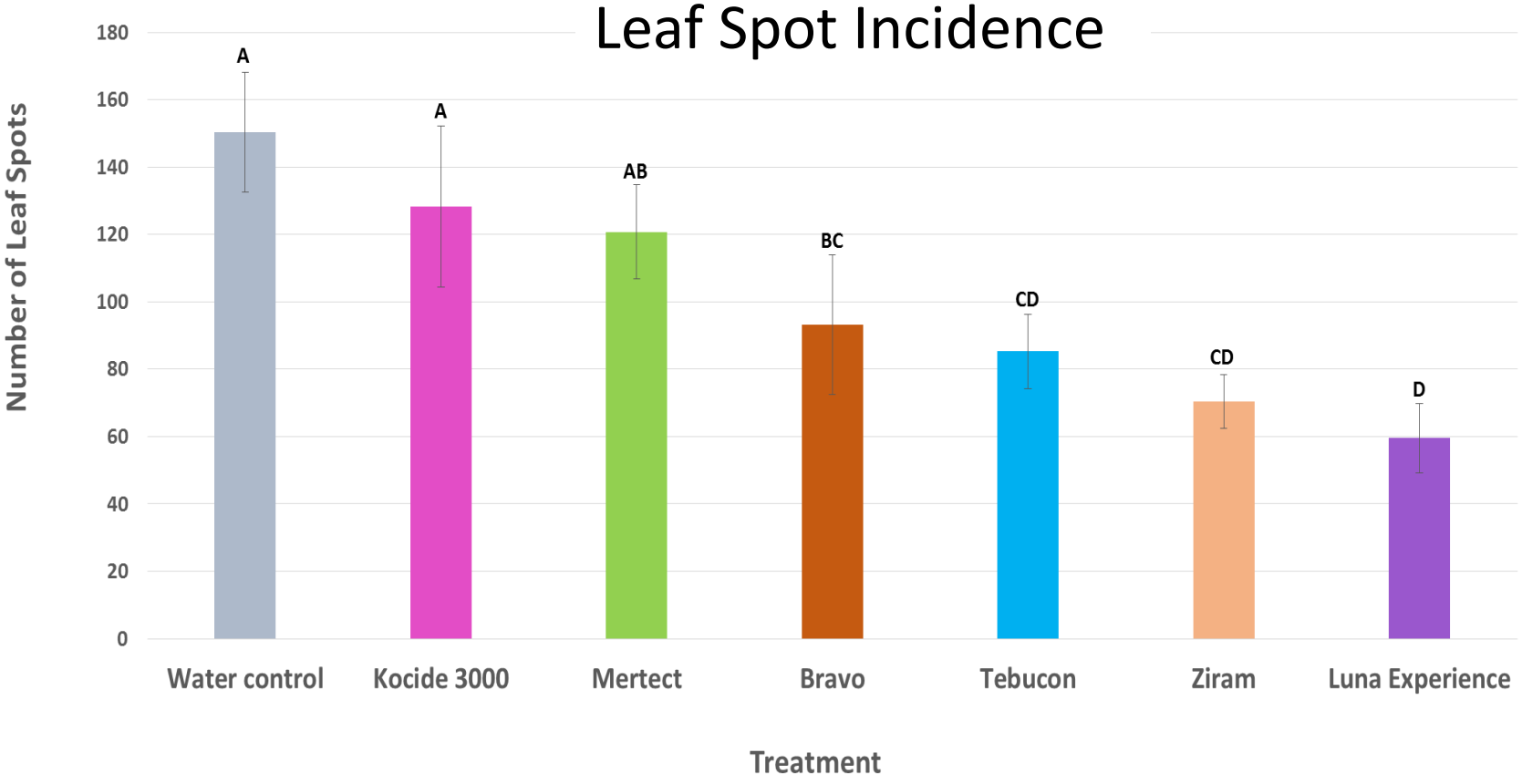


Fungicide trials: Corto Olive, Trial 1b

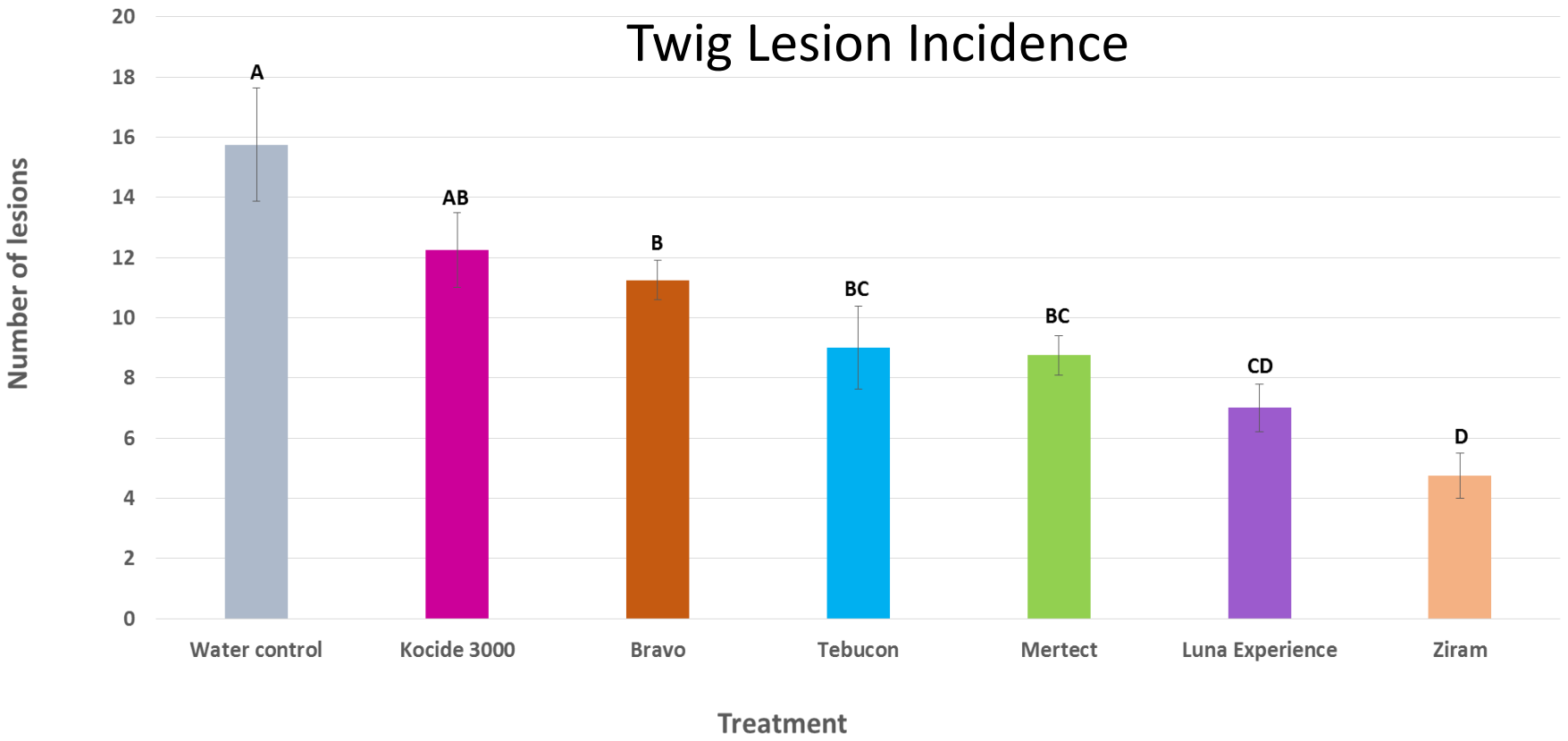


Fungicide trials: Corto Olive, Trial 1b

Fungicide trials 2016-2017: Trial 2



Fungicide trials 2016-2017: Trial 2



Fungicide trials 2017-2018: Trial 1 & 2

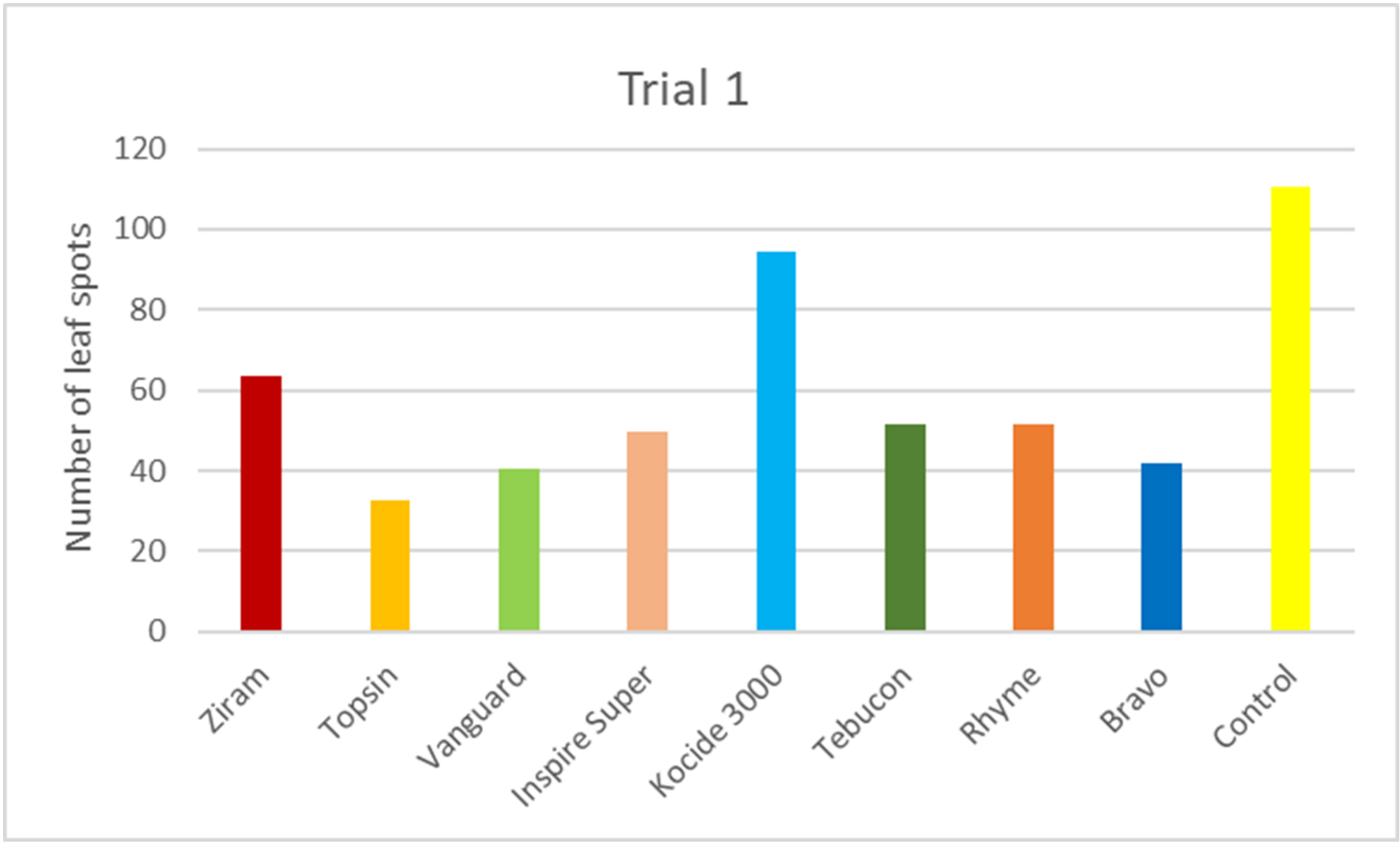
- Arbosana trees
- Stihl SR 450 Backpack Sprayers
- Rating on March 8, 2018

Trt. #	Treatment	Assigned Flag
1	Ziram	O
2	Topsin	P
3	Vanguard	BS
4	Inspire Super	Pu
5	Kocide 3000	LG
6	Tebucon	OKS
7	Rhyme	YKS
8	Bravo	PKD
9	Control	W

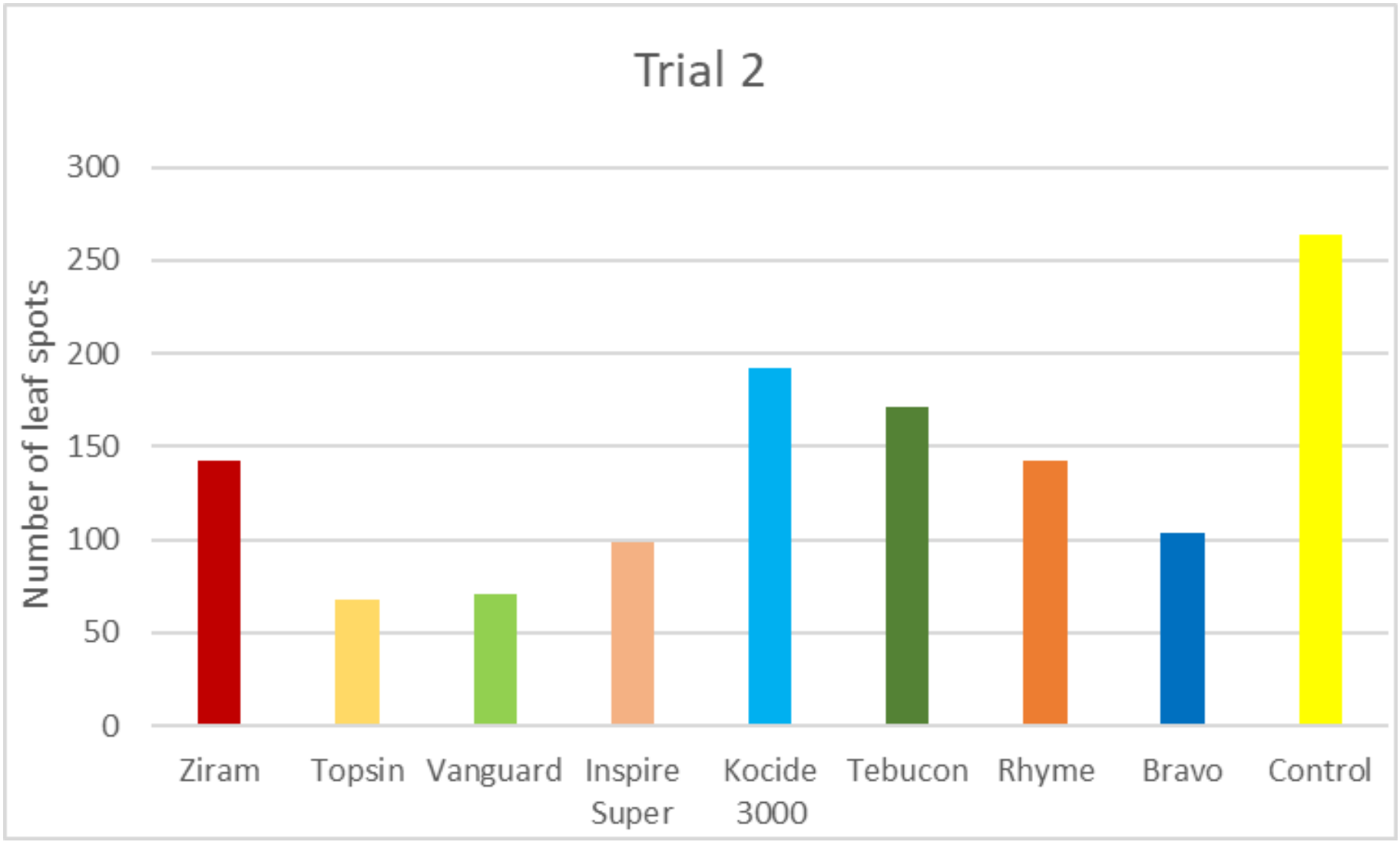
Trial 1: Single application at harvest: November 22, 2017

Trial 2: Two applications, one at harvest: November 22, 2017 and 2nd on January 5, 2018

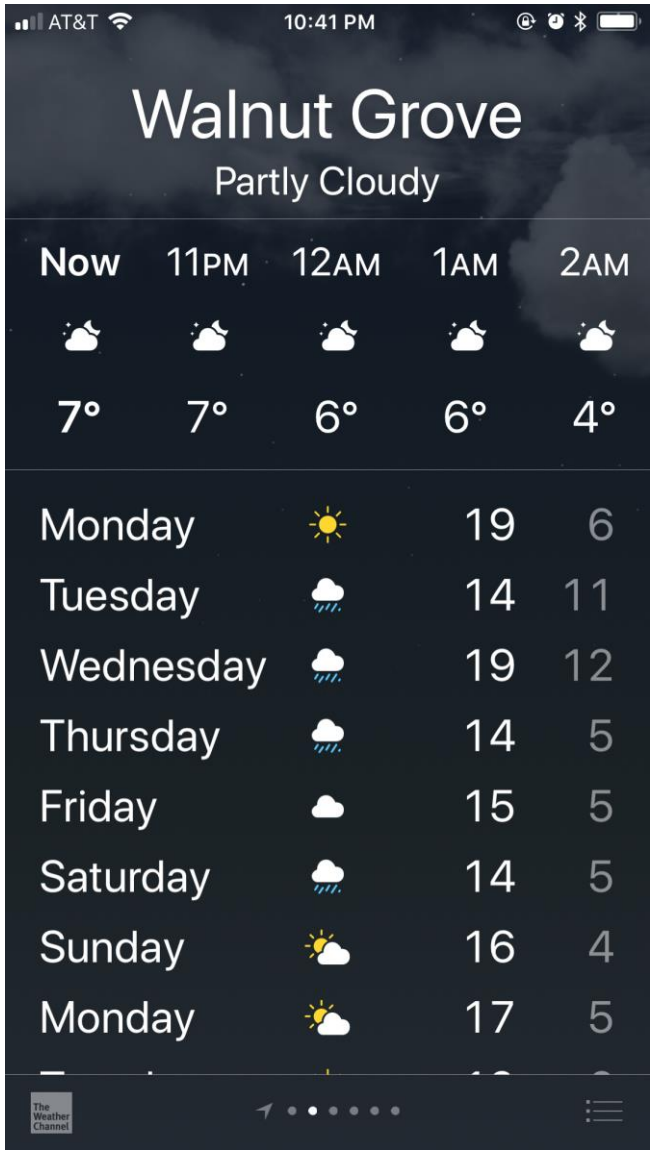
Fungicide trials 2017-2018: Trial 1 & 2



Fungicide trials 2017-2018: Trial 1 & 2



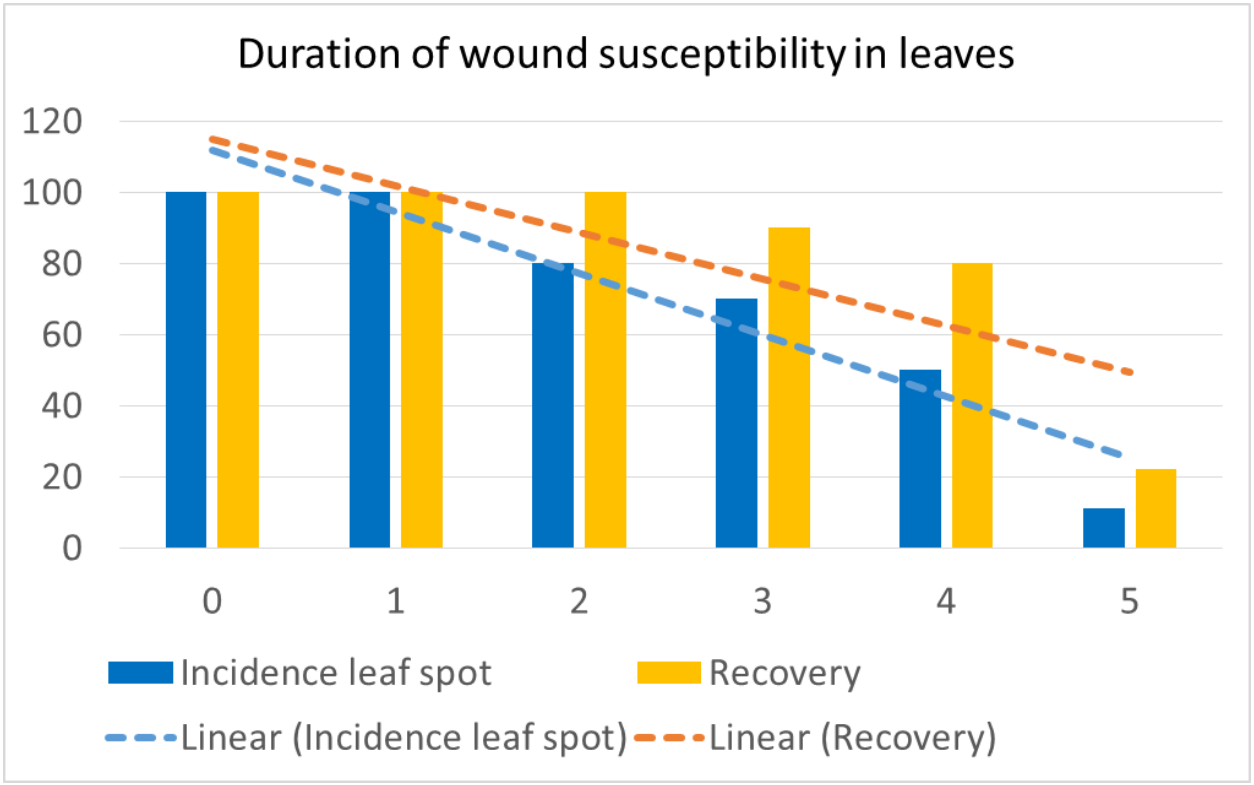
How many time do I need to spray?



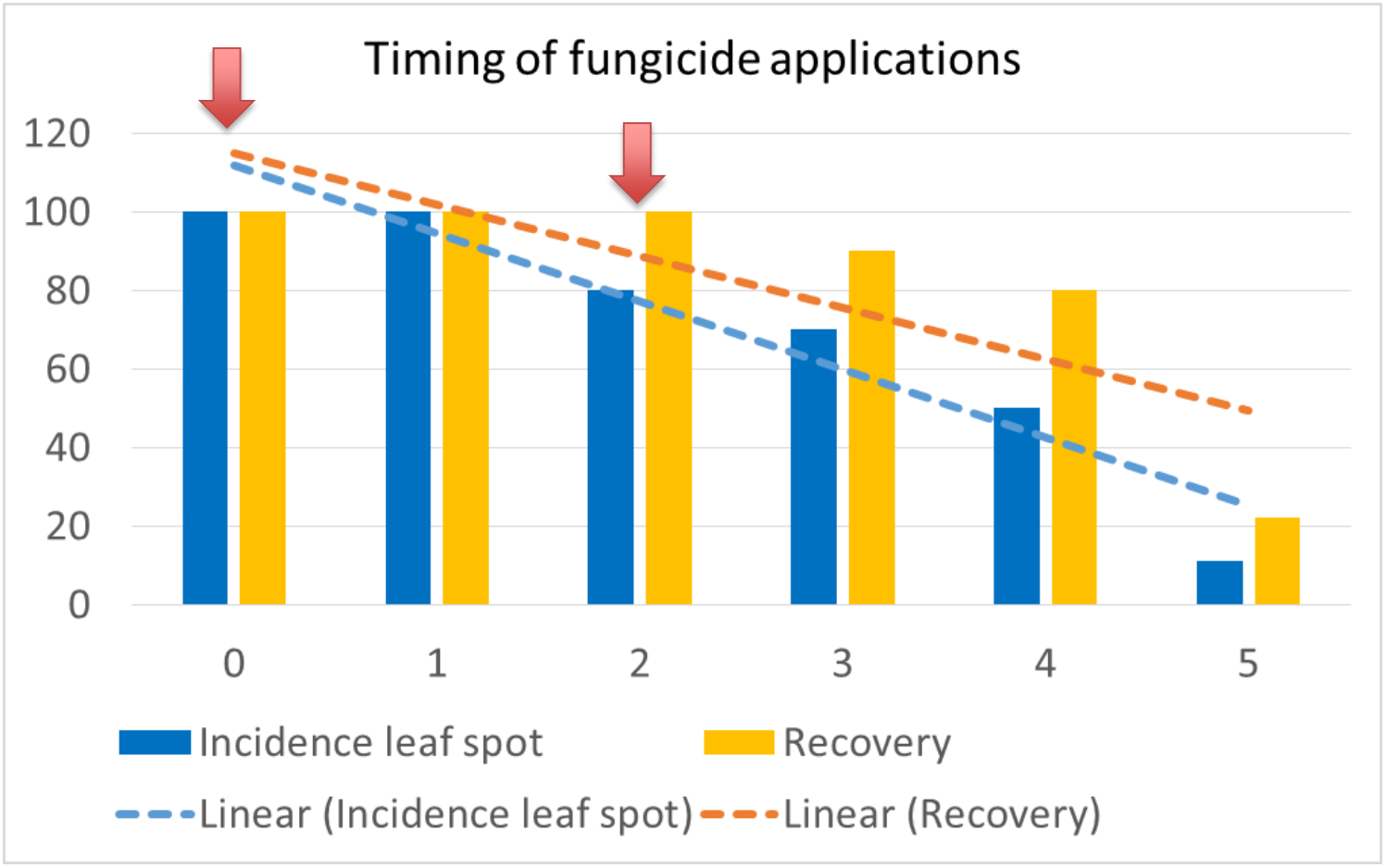
Duration of wound susceptibility: Leaves

Week	Flag color	Inoculation	Record
W 0	Orange	22-Nov	**2/1/2018**
W 1	Blue	29-Nov	**2/8/2018**
W 2	Green	6-Dec	**2/15/2017**
W 3	Purple	13-Dec	**2/22/2017**
W 4	Red	20-Dec	**3/1/2017**
W 5	Yellow	27-Dec	**3/8/2018**

Duration of wound susceptibility: Leaves



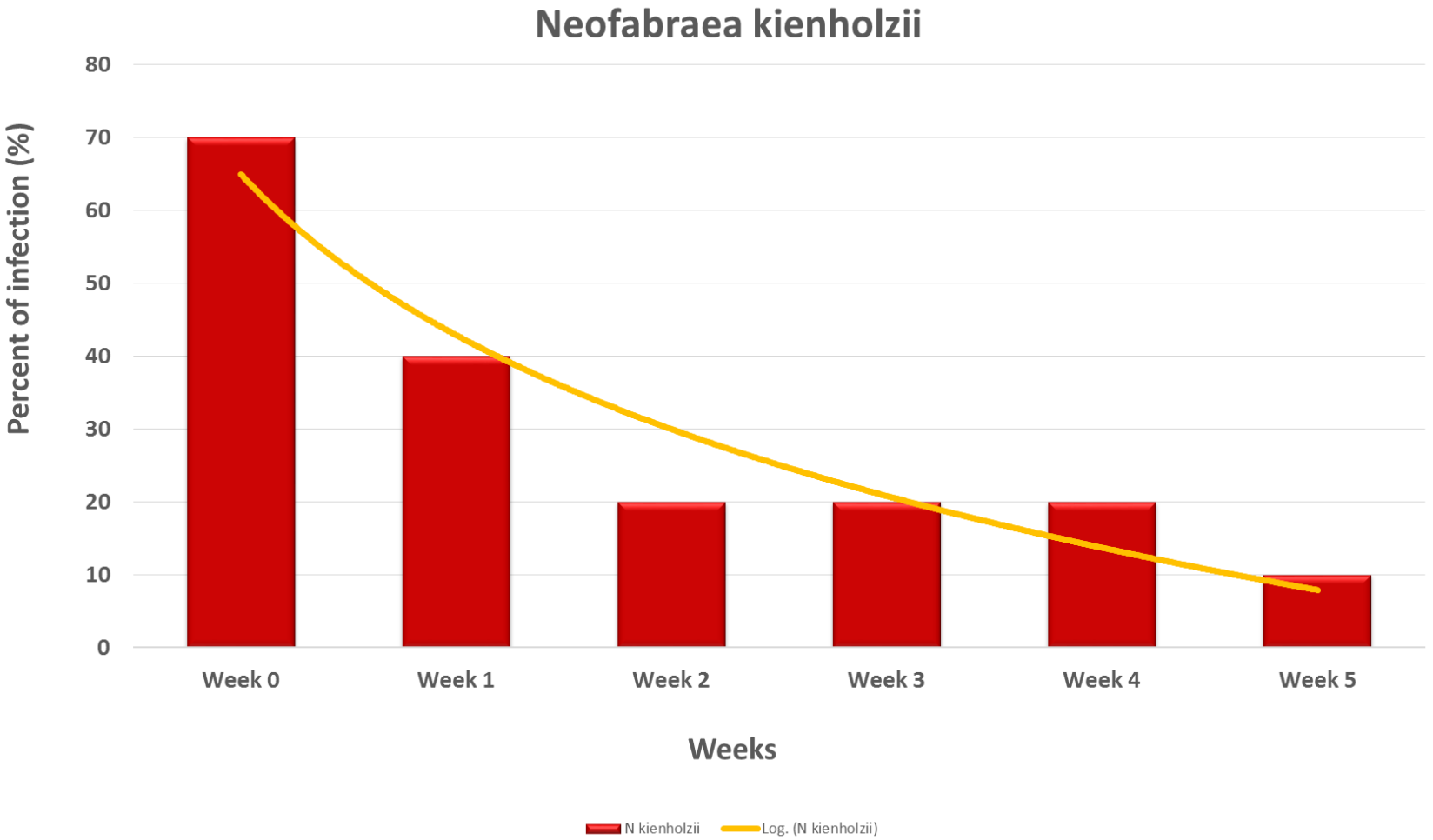
Duration of wound susceptibility: Leaves



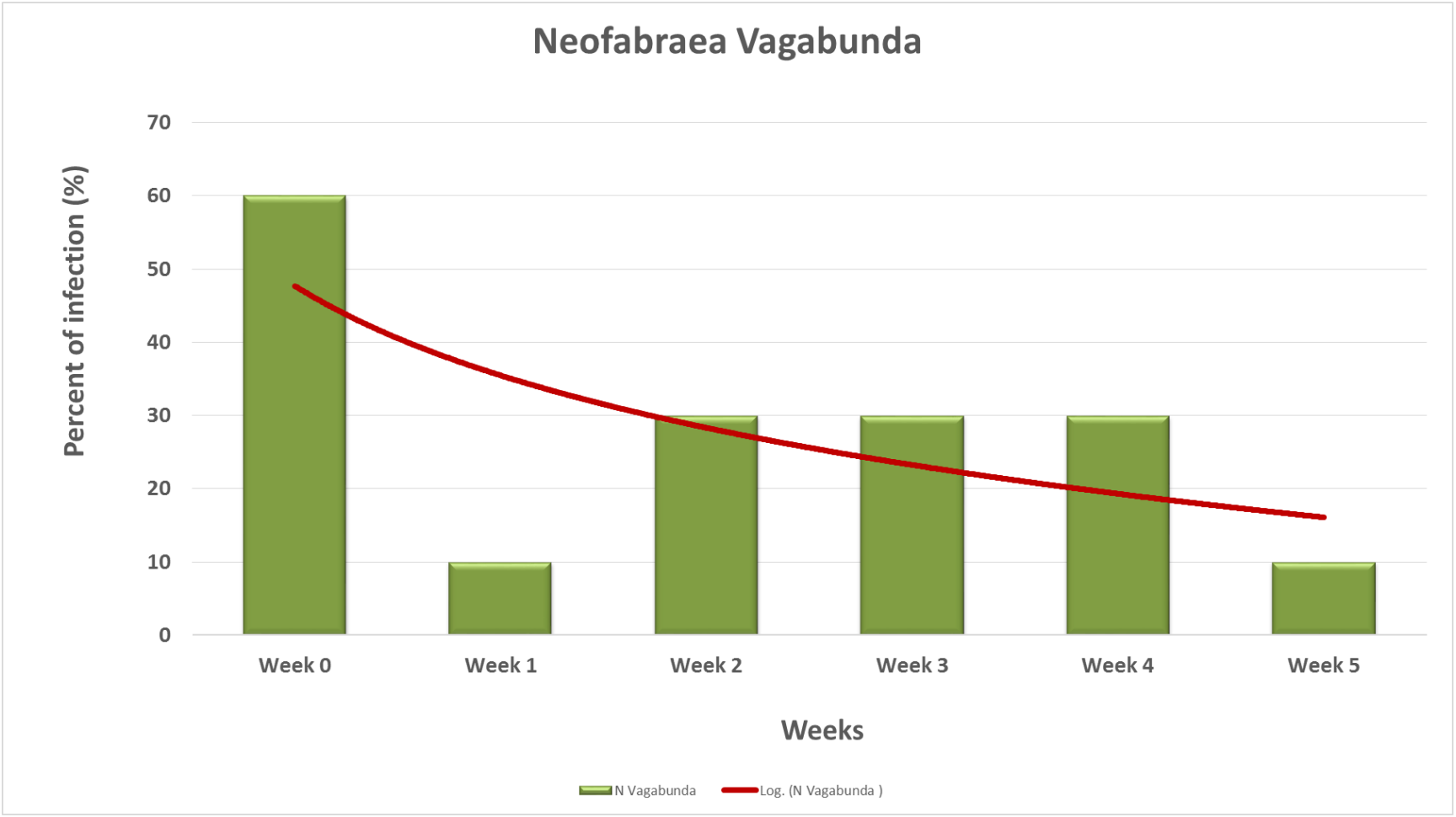
Duration of wound susceptibility: Twigs

- Duration of wound susceptibility following harvest
- How many treatments will be required to protect wounds made at harvest from infection

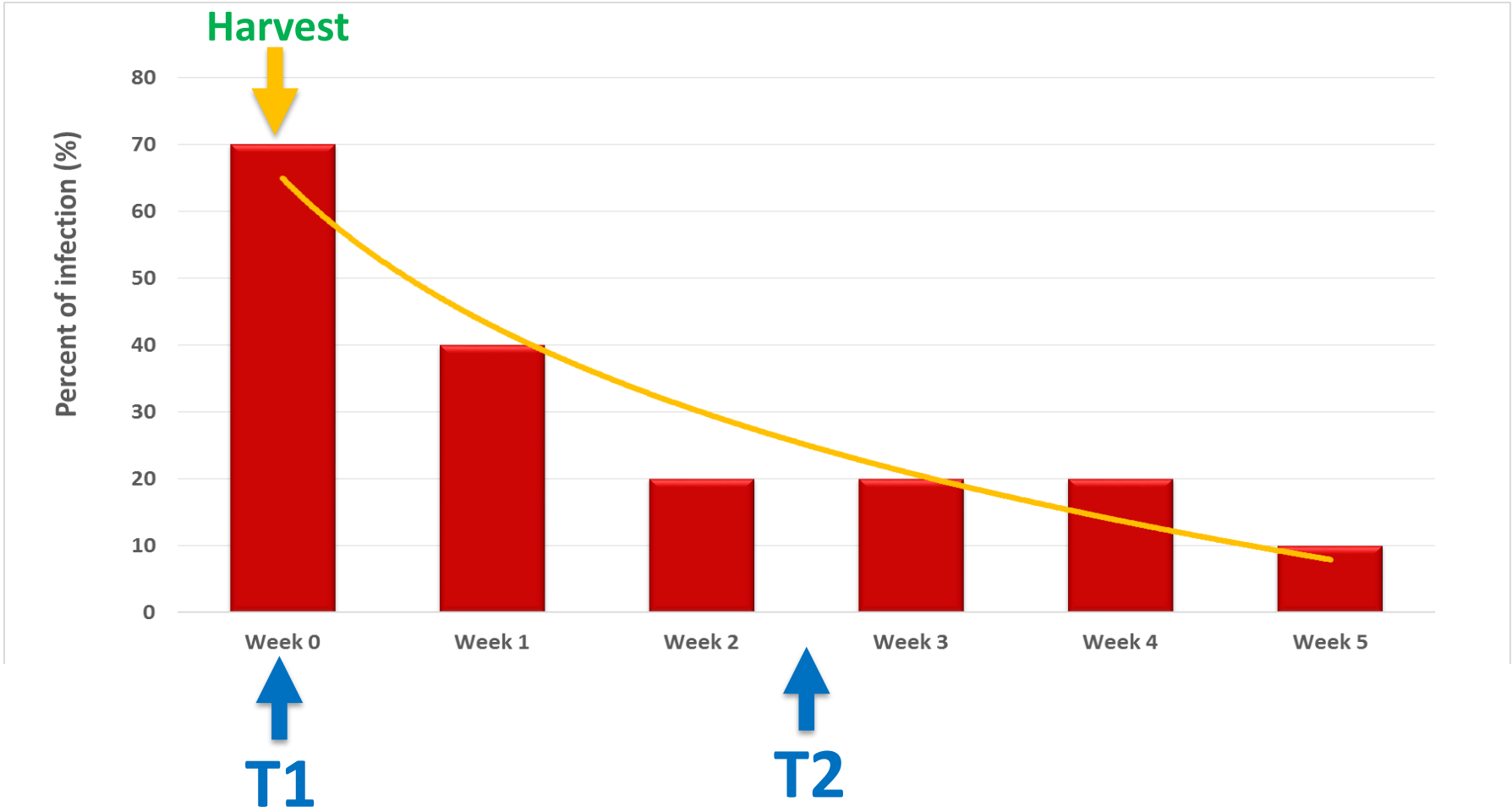
Duration of wound susceptibility: Twigs



Duration of wound susceptibility: Twigs



Timing of fungicide applications:



Section 18: Eradicate the disease

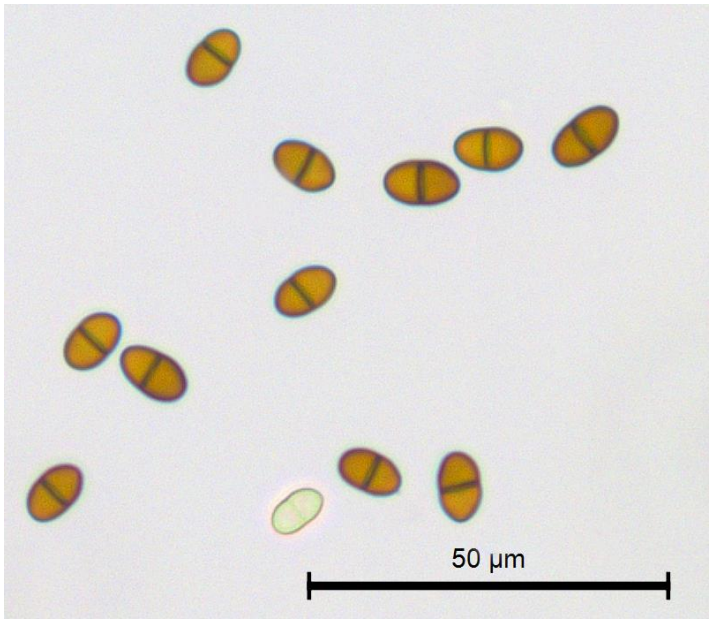
- Section 18 emergency exception on pesticide use
- Requires efficacy data from field trials (UC)
- OOCC would need submit a section 18 request to DPR
- If granted, the Section 18 label would allow growers to use the “new” fungicide for one year

Conclusion:

- Neofabraea leaf spot is an emerging disease of oil olives in CA
- Limited to Super-High-Density orchards
- Two Neofabraea species are involved
- Aggressive pathogens of increasing concern in Spain and Portugal: diversity of symptoms
- Associated with mechanical harvest
- Requires wounds (leafs and twigs) for infection
- Mainly Arbosana cultivar is susceptible
- We understand the disease cycle
- Duration of wound susceptibility: 4 weeks
- Topsin M, Vanguard, Bravo, Luna experience, Ziram, Tebucon
- Section 18 emergency exception on pesticide use
- Provide growers with UC management guidelines

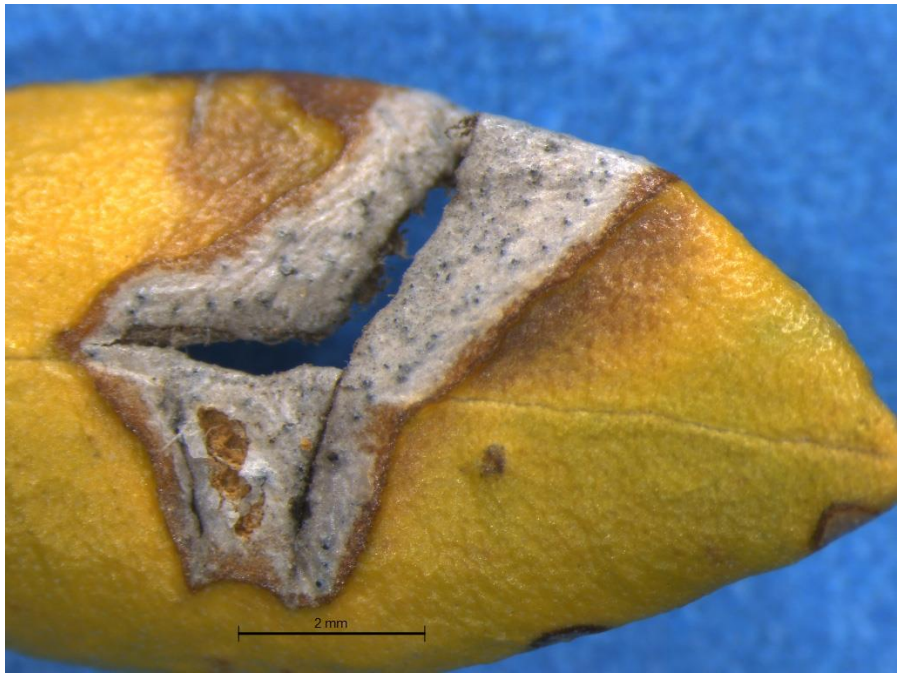
Field observation and disease diagnosis:

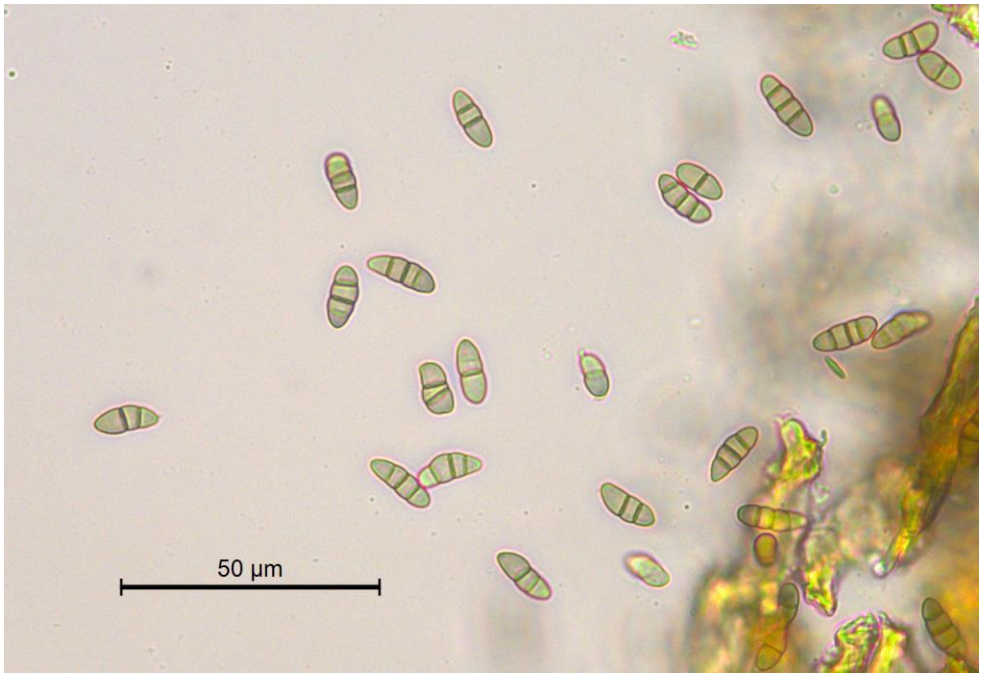
Undescribed fungal species and diseases…



Field observation and disease diagnosis:

Leptosphaeria species and diseases…





Field observation and disease diagnosis:

Undescribed diseases…

Field observation and disease diagnosis:

Undescribed diseases…

Field observation and disease diagnosis:

Pleurostomophora richardsiae

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RESEARCH PAPERS

Pleurostomophora richardsiae, *Neofusicoccum parvum* and *Phaeoacremonium aleophilum* associated with a decline of olives in southern Italy

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Thank you!

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