

Ganoderma in the almond forest of the central valley

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What is a forest?

dictionary.com

“A large tract of land covered with trees and underbrush; woodland.”

Merriam-webster.com

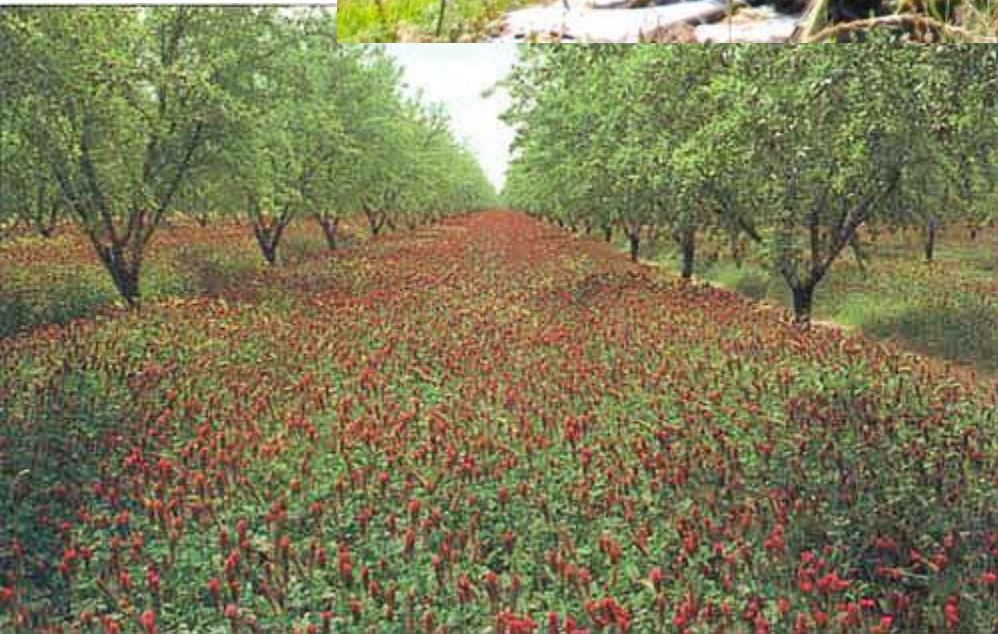
“A dense growth of trees and underbrush covering a large tract”.

en.oxforddictionaries.com

“A large area covered chiefly with trees and undergrowth.”

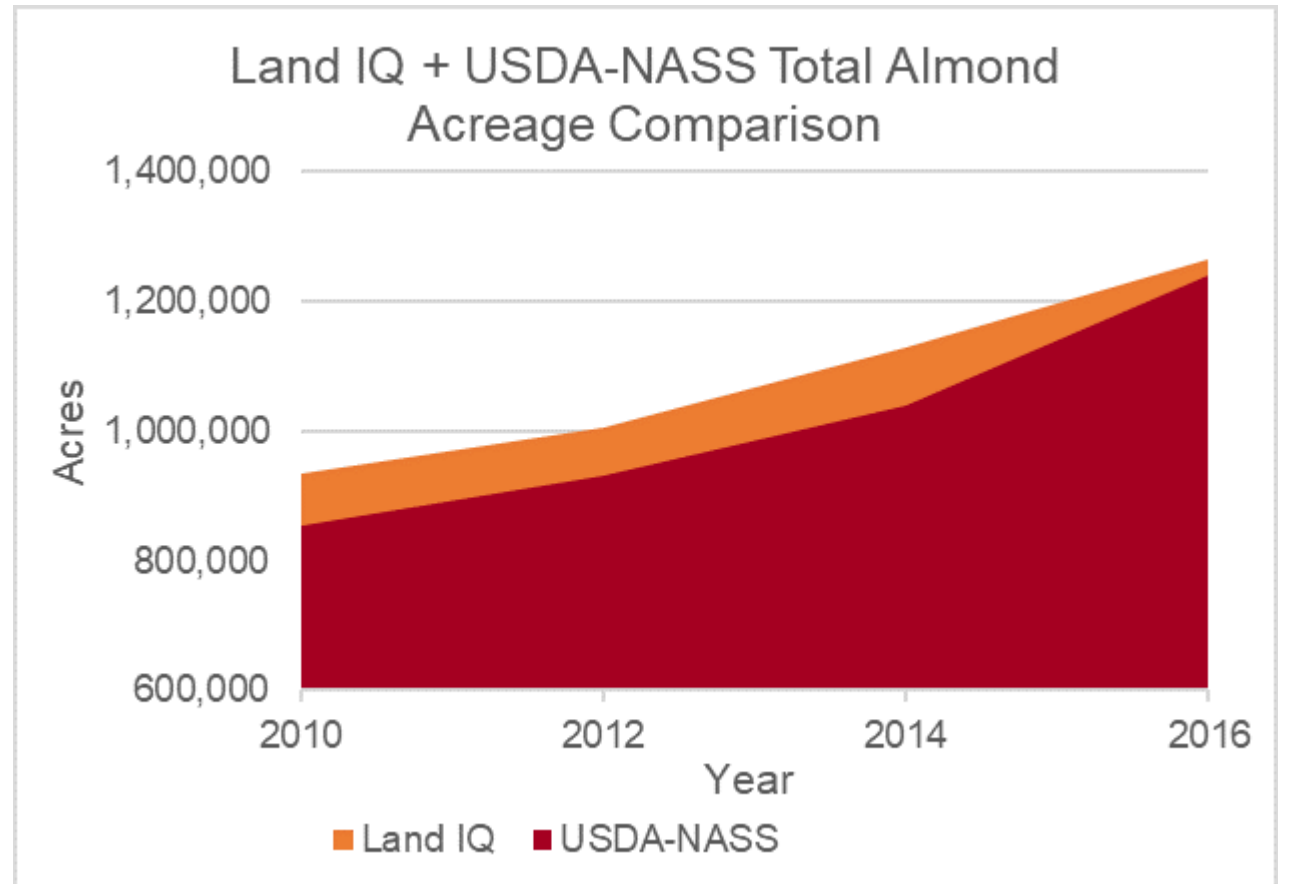


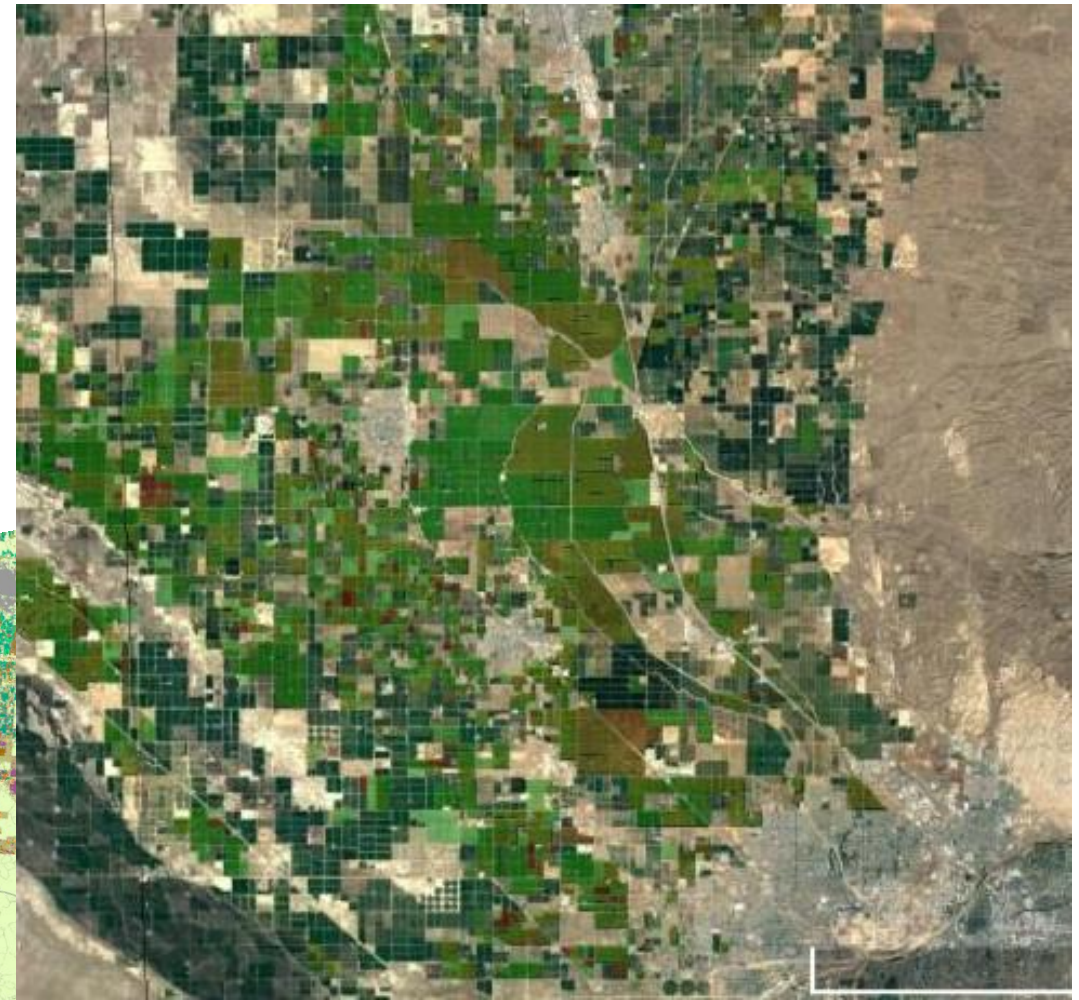
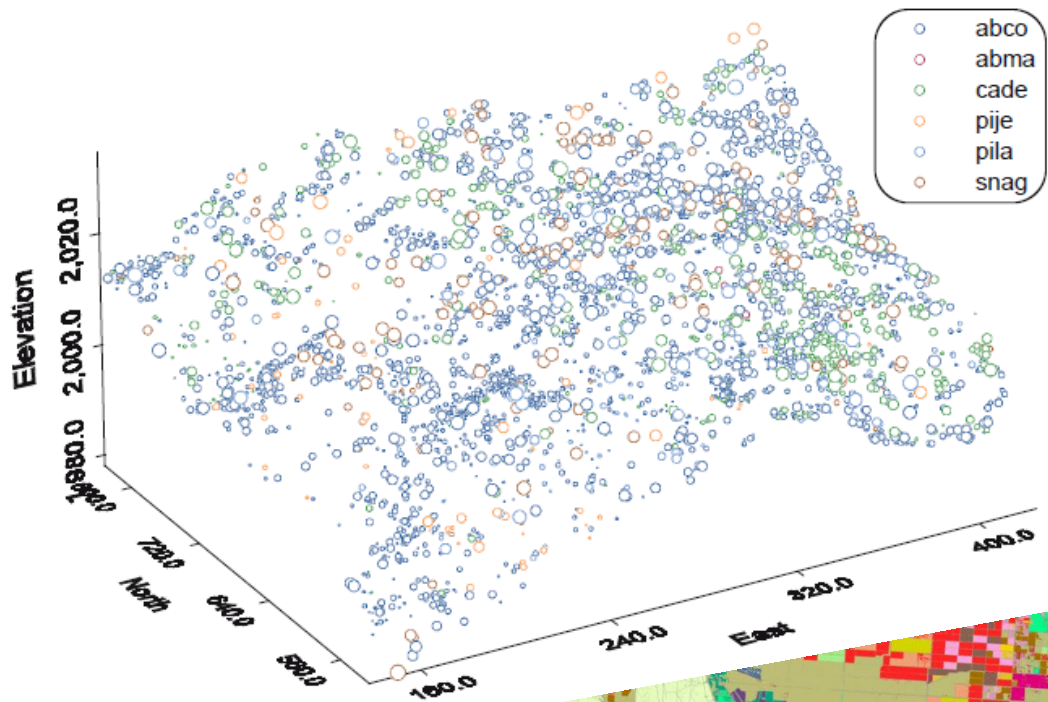




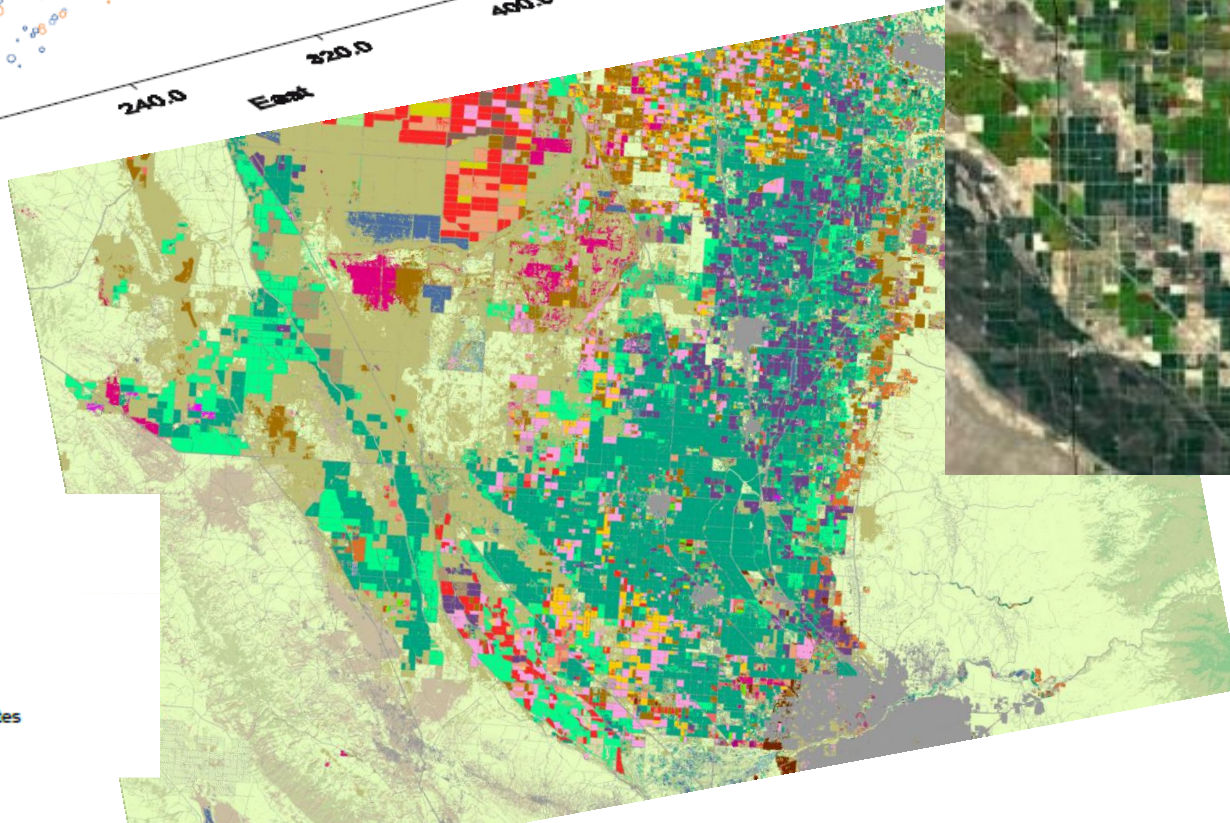


Almond acreage ~1.25 million acres
Other perennial crops ~ 1.95 million acres





- Almonds
- Pistachios
- Grapes
- Oranges
- Pomegranates
- Walnuts



Initial Objective

Identify the main fungi associated with wood-decay diseases of almond in California.



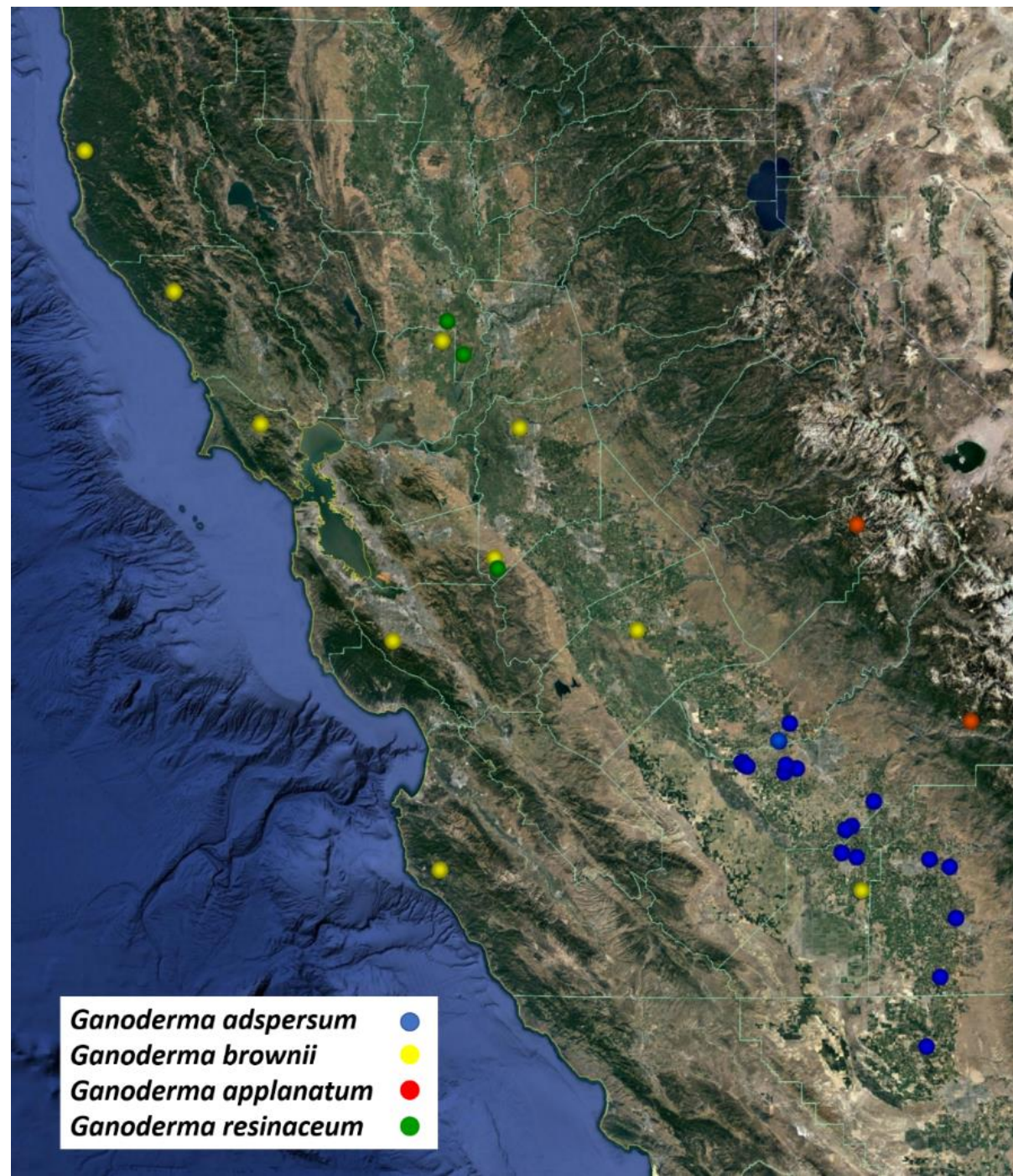
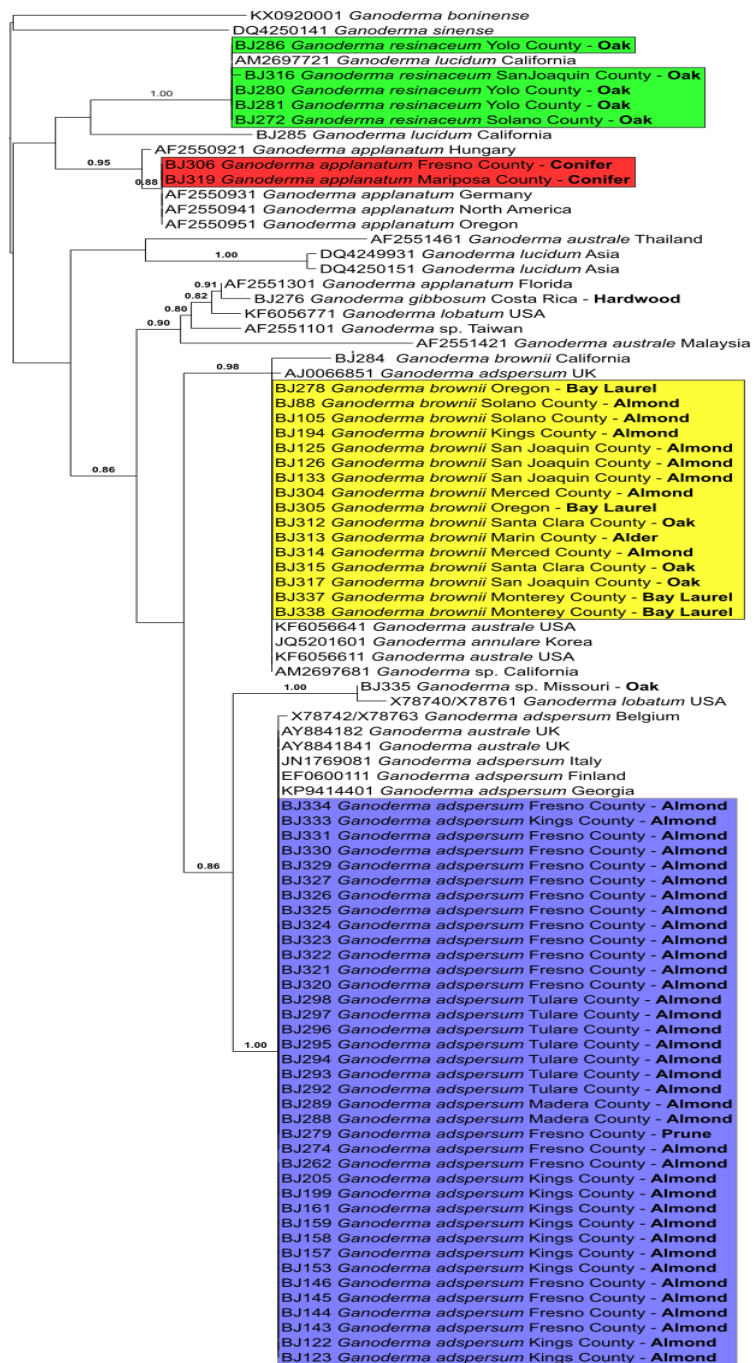
- Two *Ganoderma* species were identified in California almond orchards, *G. brownii* and *G. adspersum*.
- *G. brownii* is endemic to California seems to be less aggressive and infection was limited to a few trees in older orchards or in trees already suffering from some other disease.
- *G. adspersum*, previously unreported in California, is native to Europe and is more aggressive than *G. brownii*. It has been found in orchards as young as 7 years old and incidence of infection tends to be high.



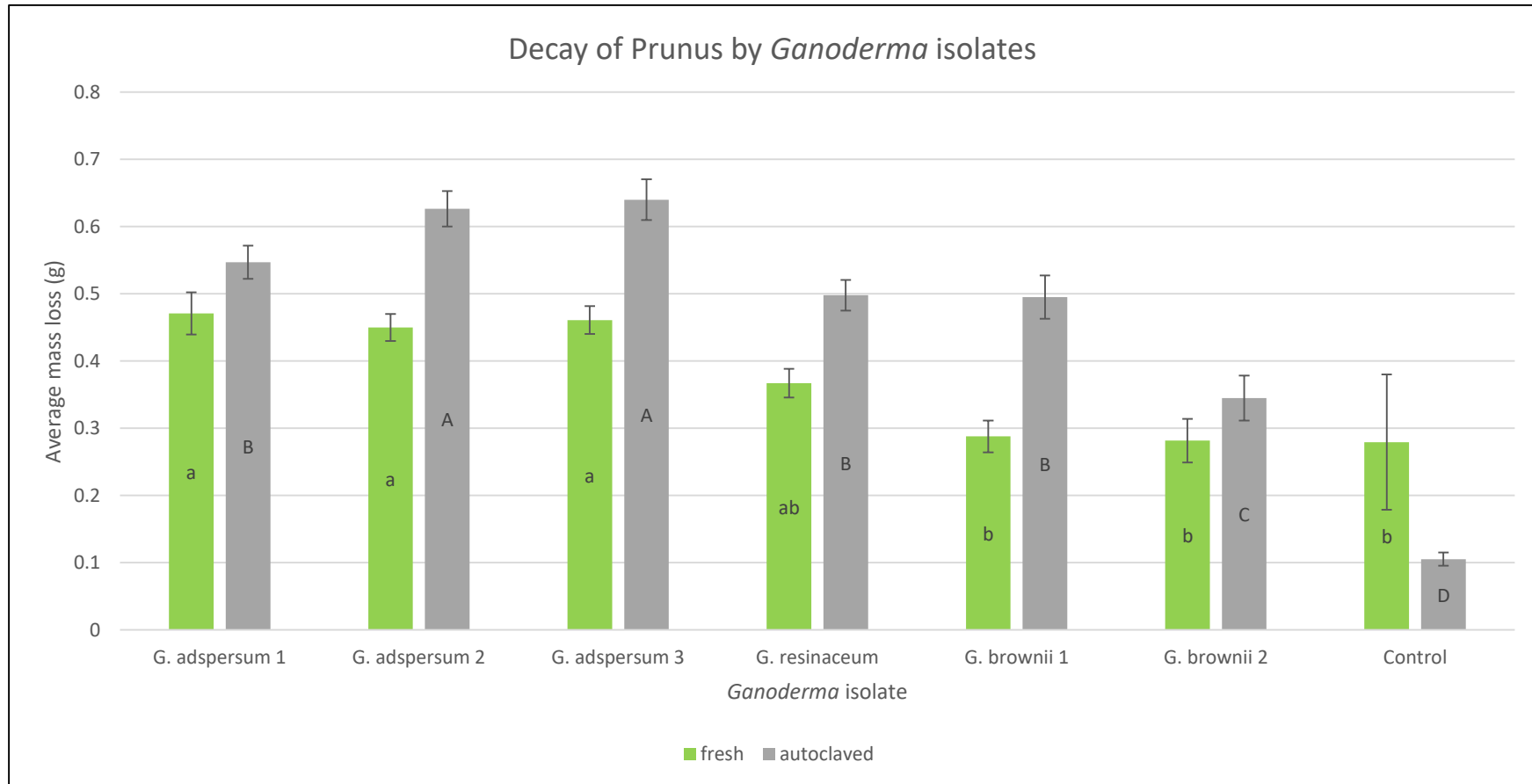
G. adspersum



G. brownii

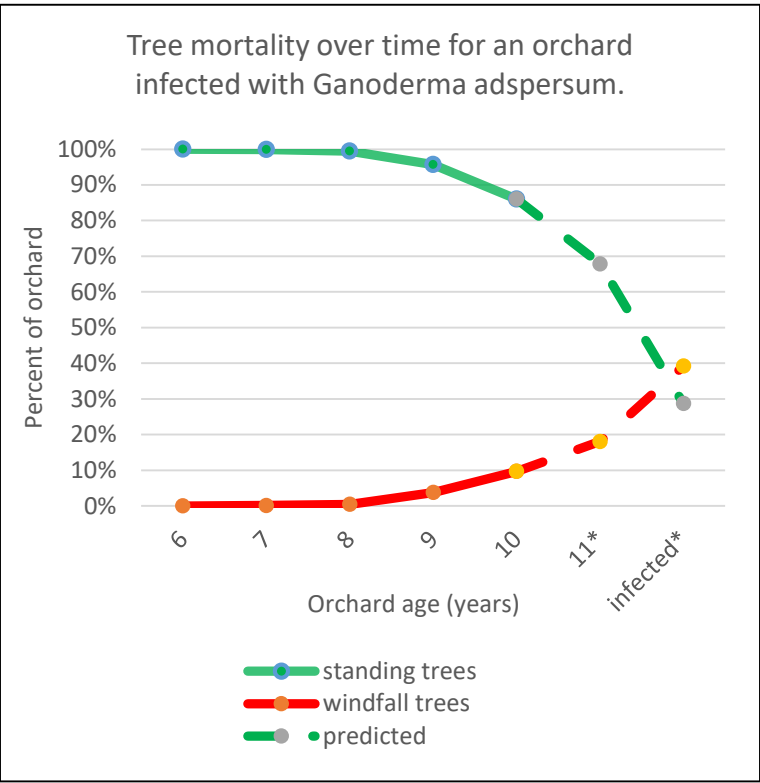
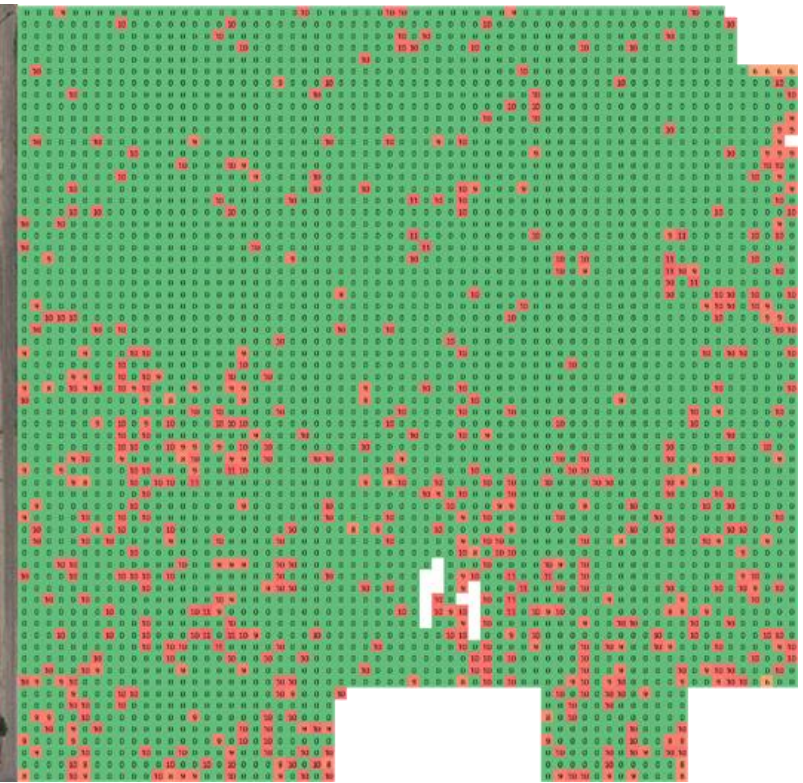


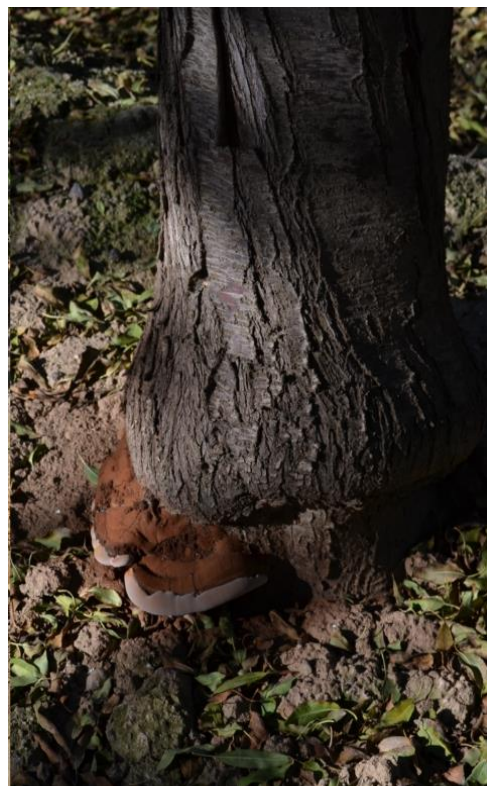
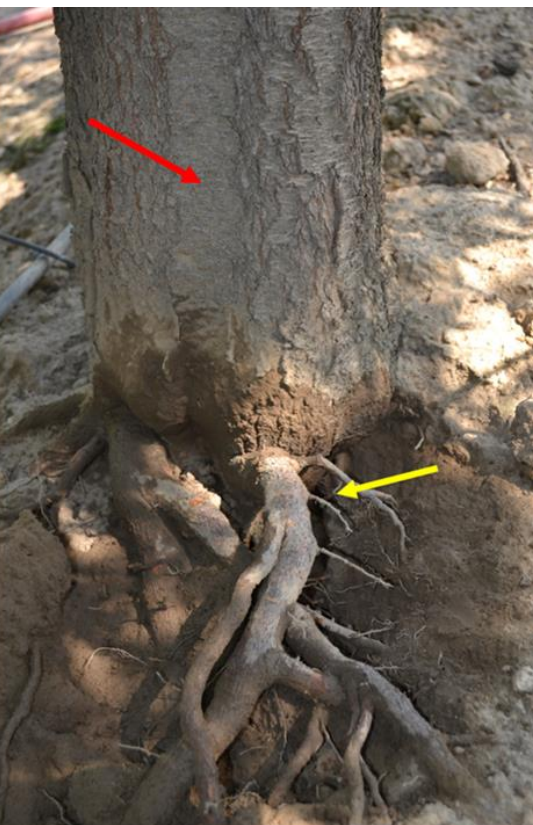
All *Ganodermas* are not created equal



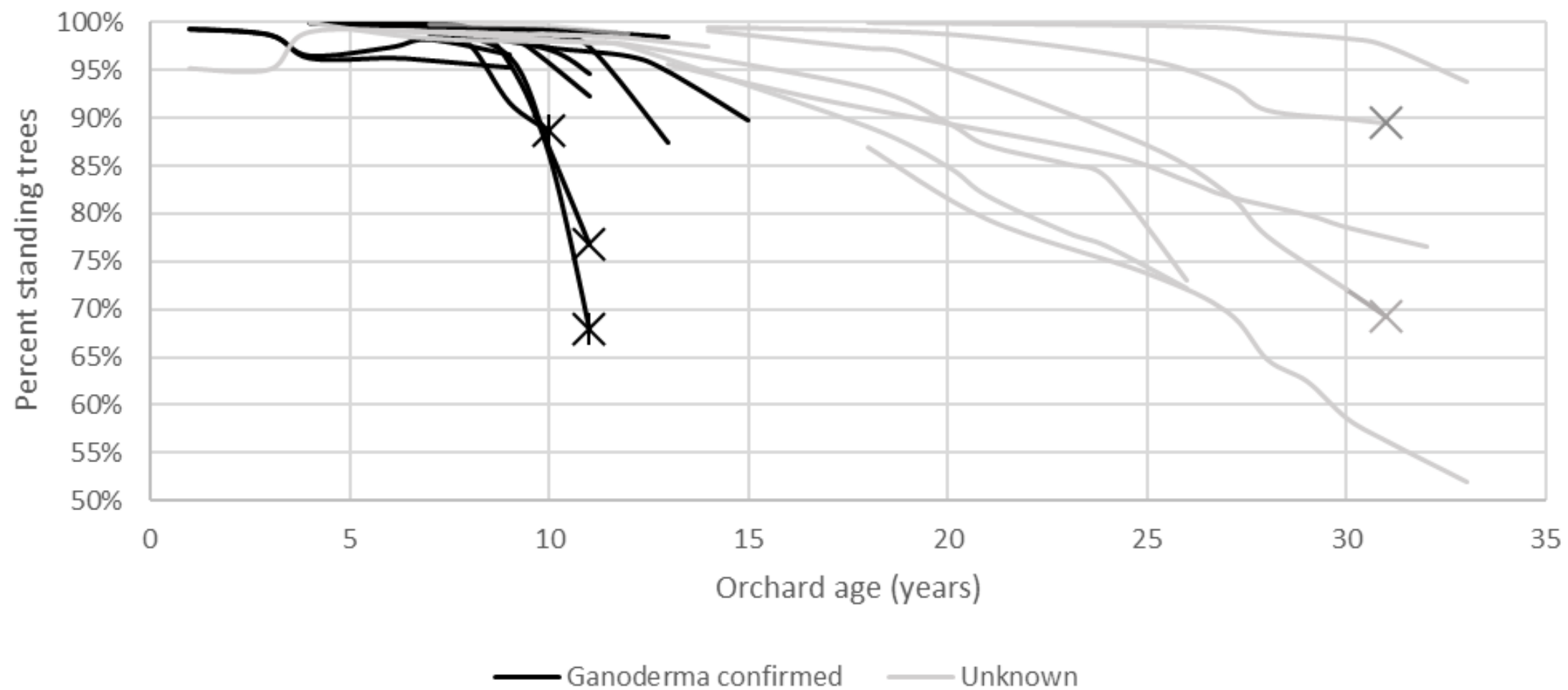
New Objectives

1. Determine patterns of infection in orchards and possible sources of inoculum
2. Deploy molecular techniques for improved diagnostics and early detection of decay fungi in standing trees.
3. Assess rootstock resistance and susceptibility.



[illegible][illegible][illegible]

Orchard decline overtime



Sources of Inoculum

Spores vs. Root contact



Somatic Compatibility groupings

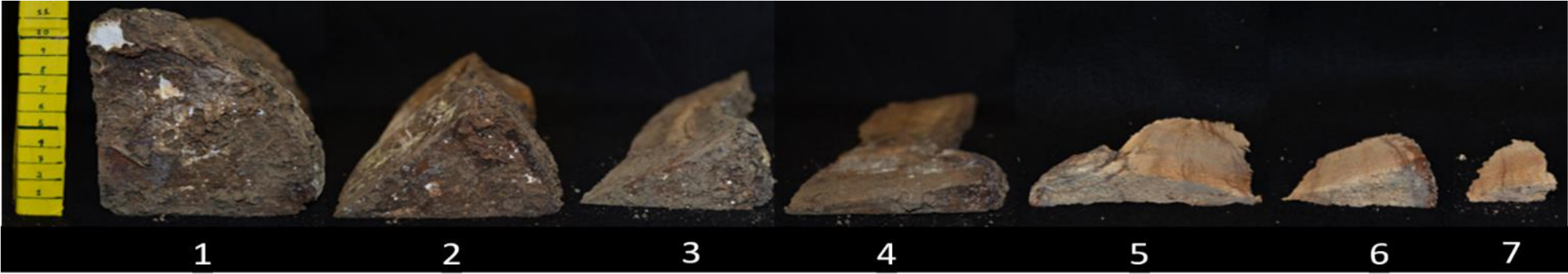
- Pairings of all possible combinations of 30 isolates from an orchard block in Kings county.
- No paired isolates resulted in a compatible reaction.
- Several stumps contained multiple isolates.
- Results suggest spores were the source of inoculum for this orchard.
- DOES NOT rule out the possibility of infection via root contact.



Inoculum survival in soil

- 30 stumps of windfall trees from which *G. adspersum* was isolated.
- Each stump cut in half
- Each half divided into 7 size classes
- Buried in field
- Re-isolate from one half at 7 months and the other at 12 months





size class	1	2	3	4	5	6	7
average volume (cm³)	1820	910	455	228	114	57	28
recovery at 7 months	50%	36%	25%	21%	4%	0%	0%

Harvest practices most likely contribute to spread



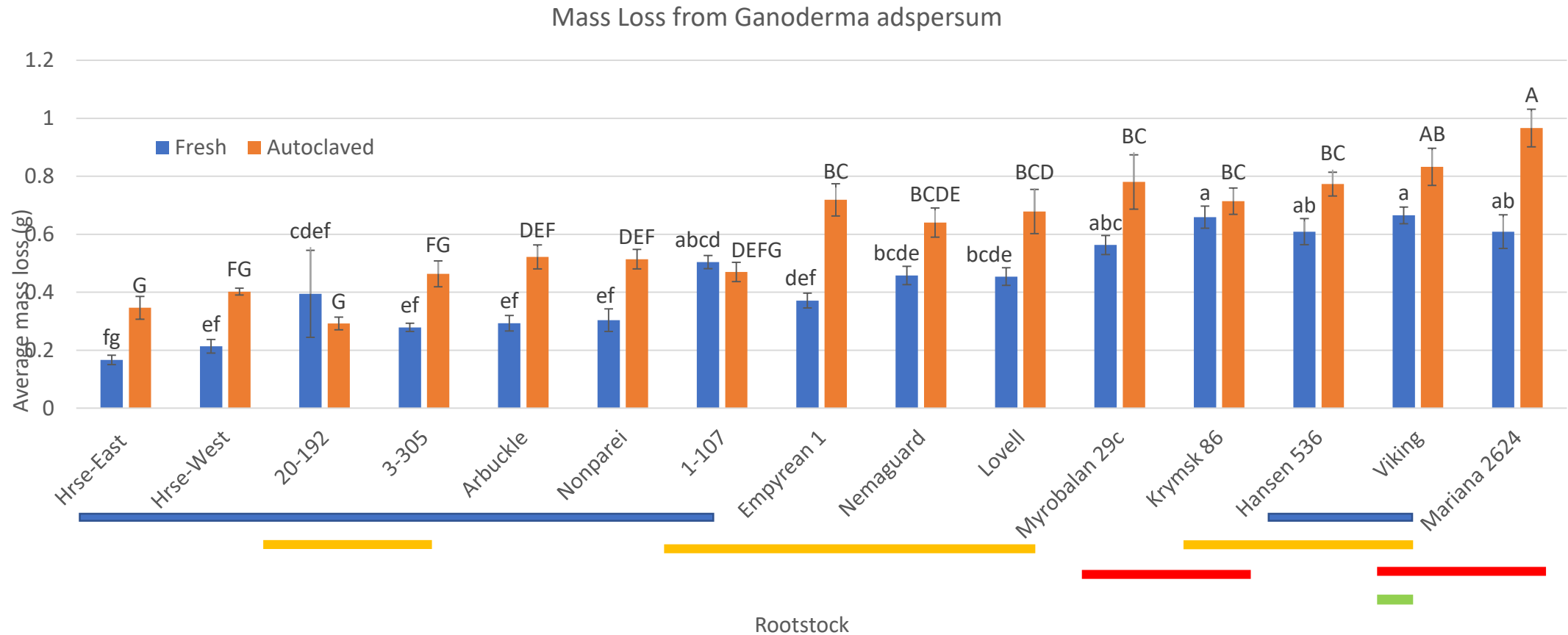
Rootstocks?



Table 1. Rootsock varieties included in wood decay experiments

Rootstock	Parentage	Experiment	Source
Nonpareil	almond	1,2	TG
Hrse-East	almond	2	TG
Hrse-West	almond	2	TG
Arbuckle	almond	2	TG
3-305	almond (P. scoparia) x peach	2	TG
1-107	almond (P. tangutica) x peach	2	TG
20-192	almond x peach	2	TG
Hansen 536	almond x peach	1,2	SG
Viking	almond x peach x plum x apricot	2	SG
Empyrean 1	peach	2	SG
Nemaguard	peach	1,2	SG
Lovell	peach	1,2	SG
Krymsk 86	peach x plum	1,2	SG
Myrobalan 29c	plum	2	SG
Mariana 2624	plum	1,2	SG

Rootstock susceptibility to decay



Future Direction

- Continue surveys and orchard mapping
 - Expand into natural forest
- Spore monitoring
- Root stocks
- Shaker trials
- Bio-controls ?

Thank you

- Rizzo lab
 - Ian Good
- Almond board of California
- California dried plum board

