Fuller rose beetle (*Naupactus godmanni*) management guidelines: Experiences in California

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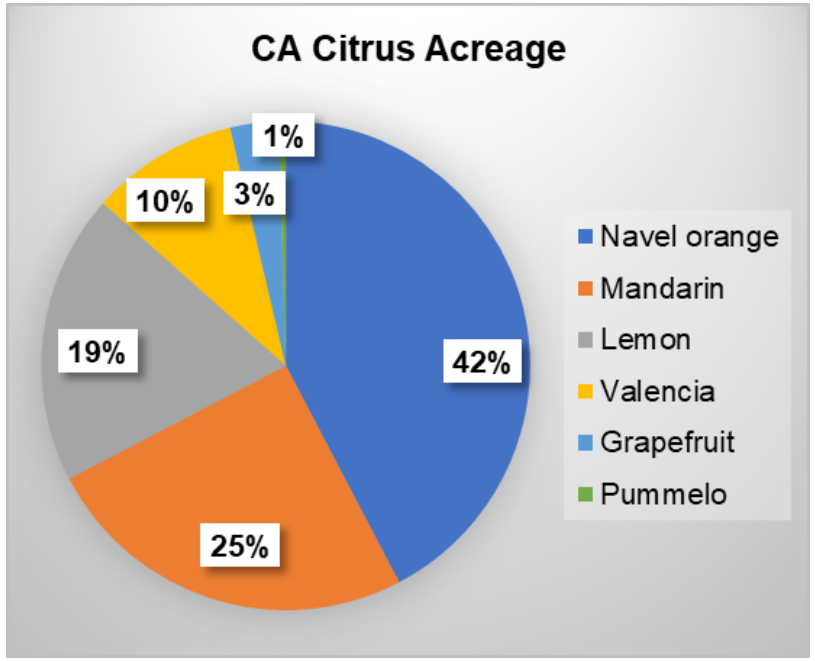
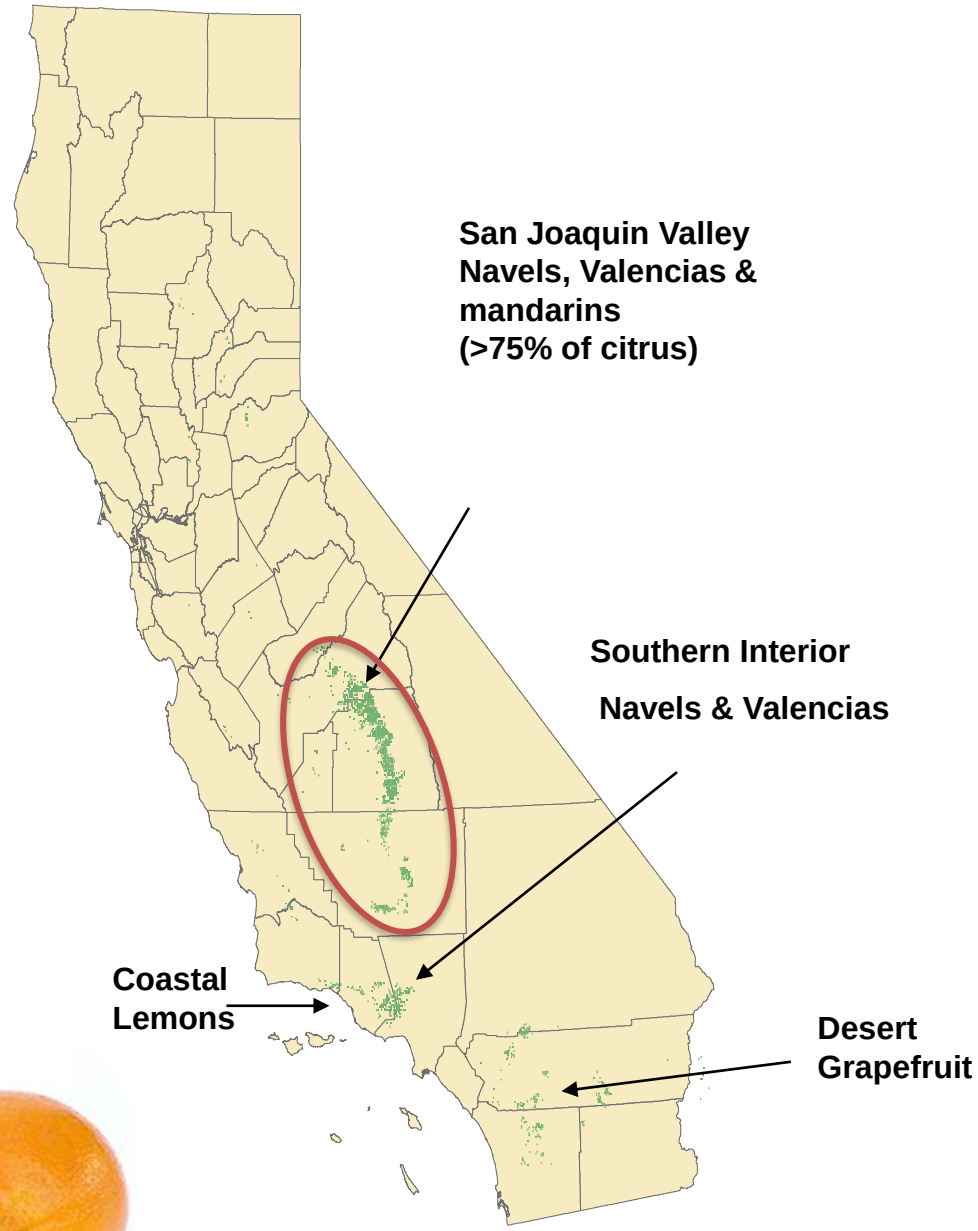
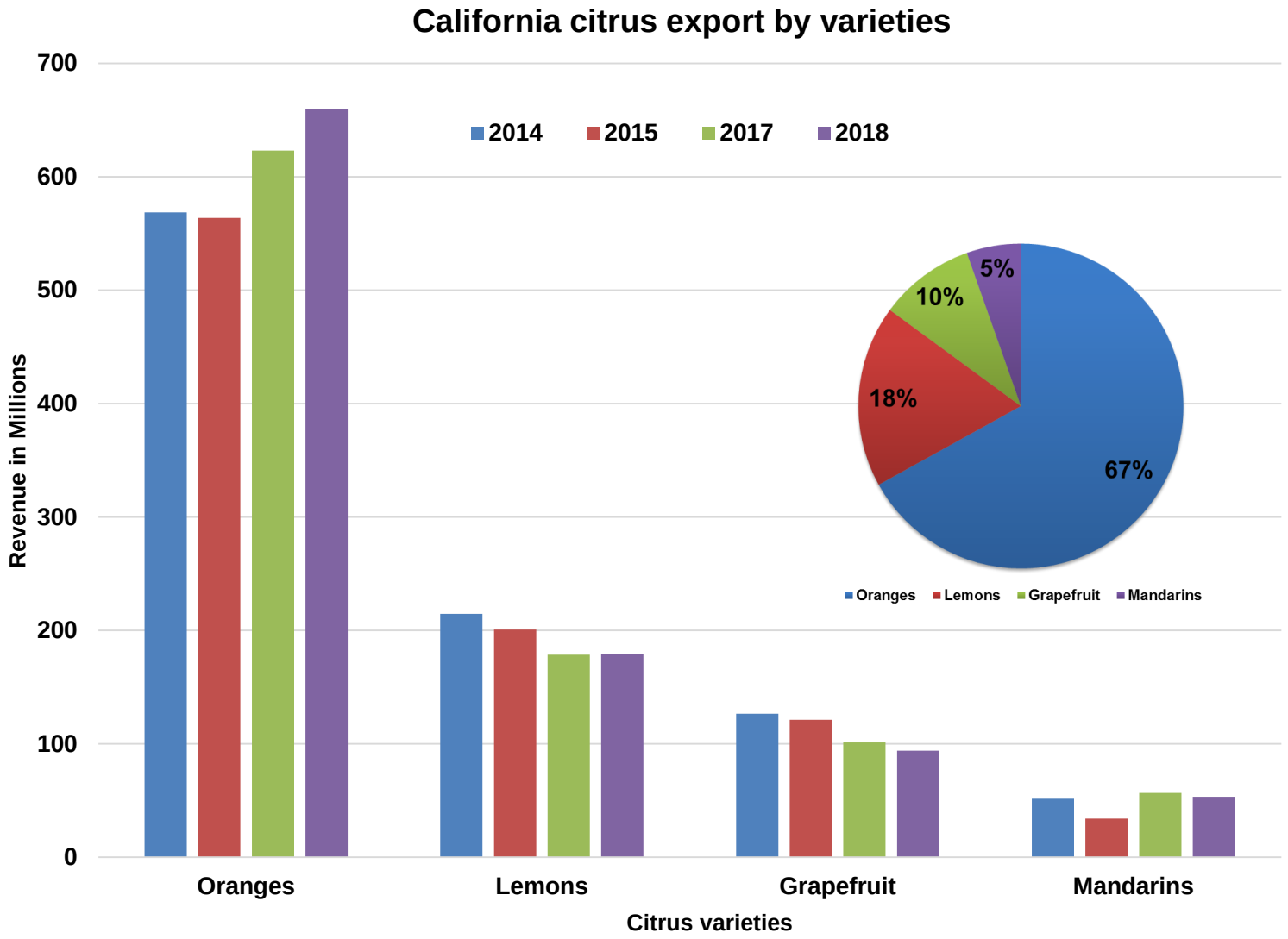
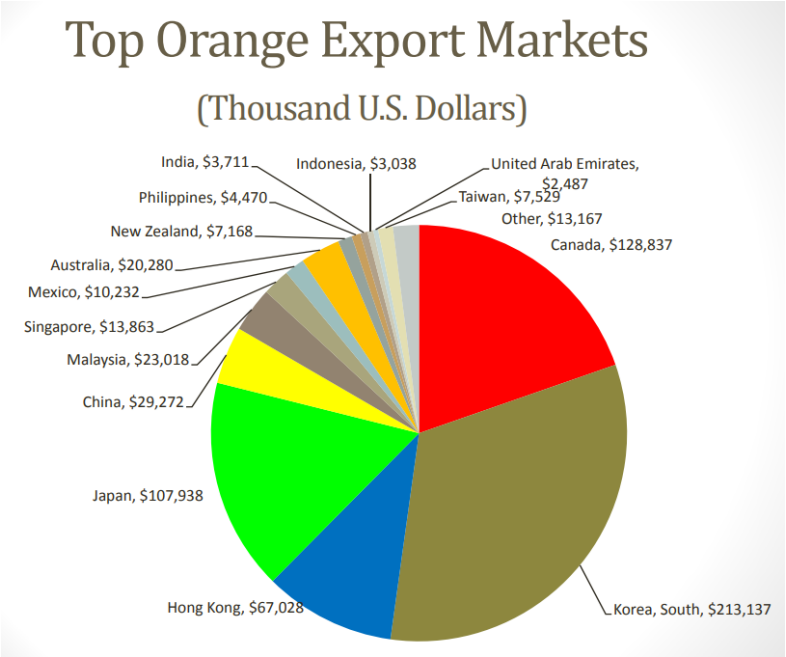
California Citrus

- Citrus is grown in four distinct regions.
- 268,376 acres (108,608 hectares) citrus in CA (CDFA 2022). 210, 356 acres in is the SJV region.
- ~7.8 million tons fresh citrus/year with a farm gate value of ~$2.6 billion
- Unblemished fruit free of surface scar is valued the highest.









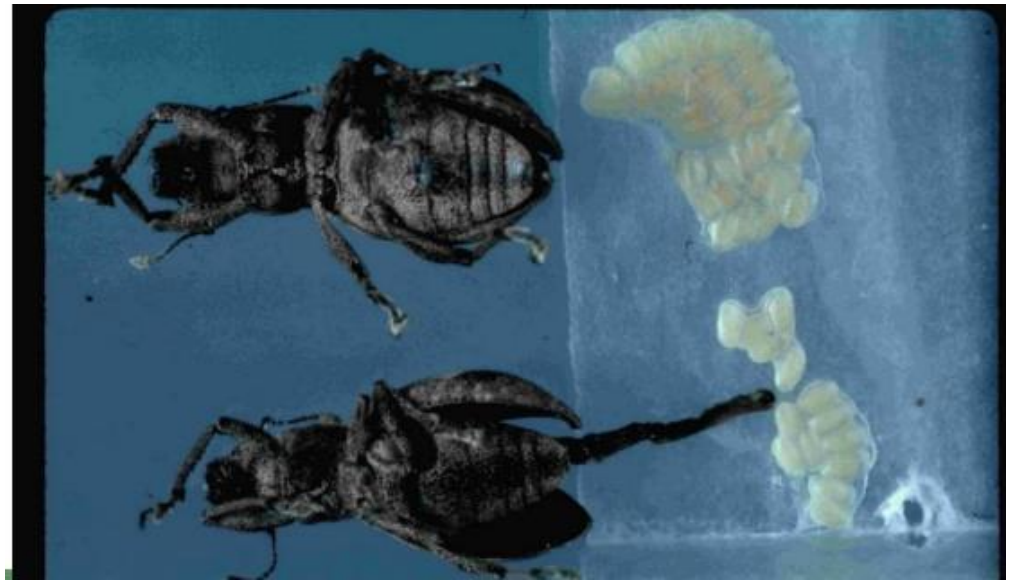
2/3 of export volume is shipped to Asian markets.

Presence of arthropods and pathogens that are not present in importing counties are phytosanitary concern and affect trade.

Fuller rose beetle

- ***Naupactus godmanni* (syn. *N. cervinus, Patomorus cervinus*)**
- **Small gray beetles with a weevil snout, slow moving and flightless**
- **Parthenogenic (no males) and have one generation per year**
- **Hosts: citrus, cherries, apple, persimmon, potatoes, strawberries, and ornamentals**

FRB egg masses



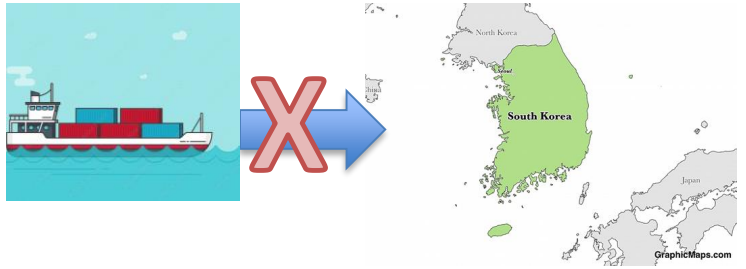
Ovipositor can extend and lay eggs in tight places

Trade barrier pest – Fuller rose beetle eggs

Fruit infested with FRB eggs can be rejected for shipment or rejected upon arrival. Although not a pest for California citrus growers, FRB is an export concern as a trade barrier pest.

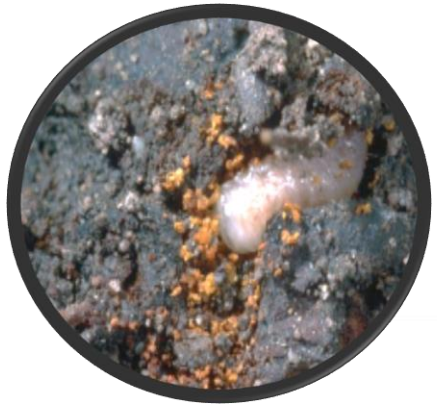
FRB adult depositing egg

If FRB eggs are found at county/USDA APHIS inspection, load rejected



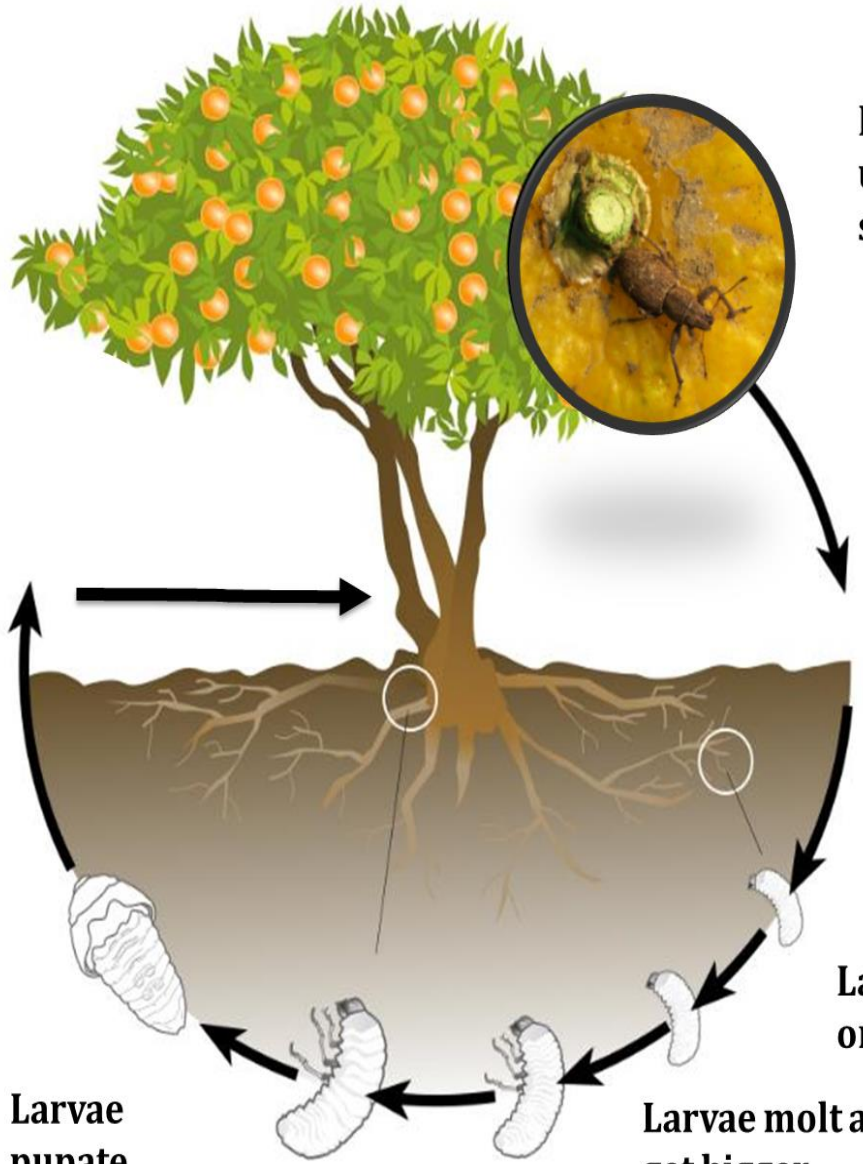
If FRB eggs are found on arrival – shipment rejected

Life cycle of FRB



Larvae pupate

Adult emerges and climbs up the tree



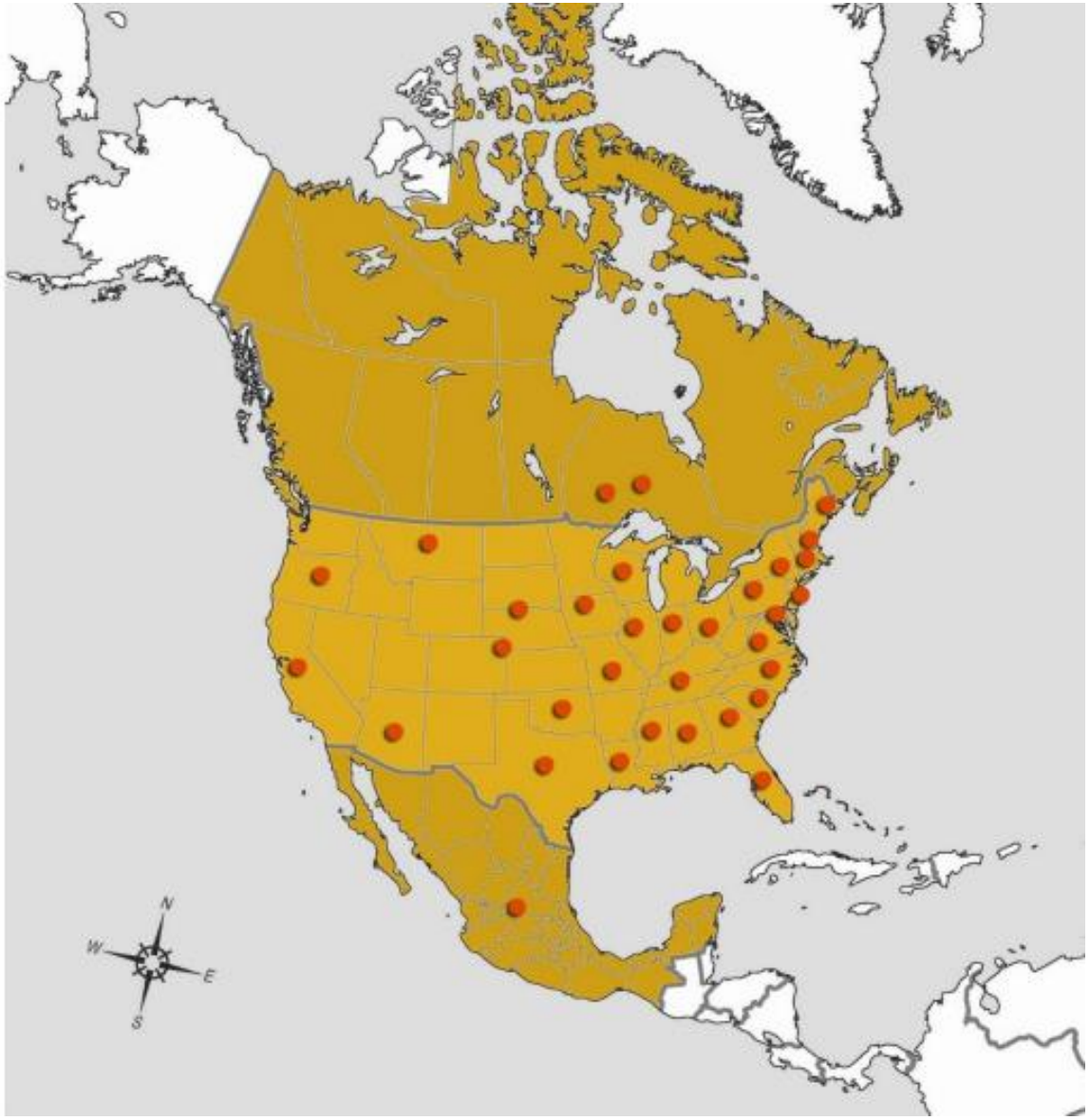
Eggs laid under the sepals

1st instar larvae drop to the ground

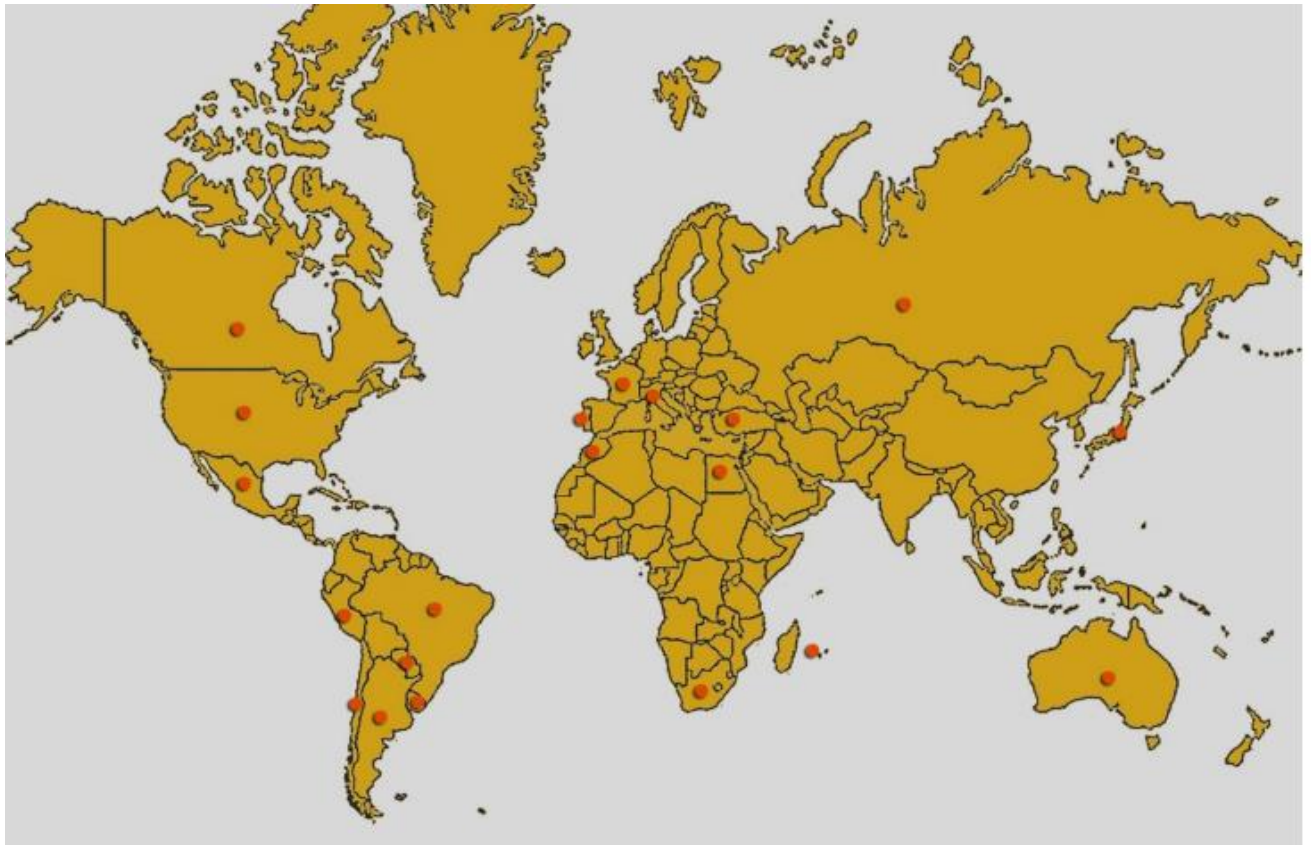
Larvae feed on roots

Larvae molt and get bigger 9 months

Distribution



FRB was first reported in the United States in 1879 in California. Now present in 30 states in the US.



FRB is present in North and South America, Europe and parts of Africa, Australia, and the pacific island. Not known to be present in Asia other than in Japan (first reported in 2005).

FRB was an export concern in Japanese markets until 2005 when it was reported in citrus orchards from Japan.

For many years Asian markets allowed methyl bromide fumigation at destination if live eggs were found under the calyx. Methyl bromide is no longer an available option due to worker exposure issues.

Evolution of the FRB Problem in California

- Serious concerns from Korea during the 2011-12 shipping season
- Blanket methyl bromide fumigation allowed for 2012-13 season but not for foreseeable future.
- Korea anticipated California growers to disinfest fruit before shipping
- Research on FRB re-started during 2011
  - Dr. Joesph Morse – FRB Biology, trunk sprays
  - Dr. Beth Grafton Cardwell: foliar sprays

Bifenthrin trunk sprays as a strategy for Fuller rose beetle (FRB) field control in 2013

Joseph Morse and
Beth Grafton-Cardwell

Editor's Note: Work on Fuller rose beetle is now a part of CRB's core program of Integrated Pest Management research with Drs. Morse and Grafton-Cardwell as lead investigators.

Fuller rose beetle (FRB) (Figure 1) goes by many different names (synonyms) in the scientific literature including *Naupactus godmani* (Crotch) (most correct), *N. cervinus*, *Pantomorus cervinus*, *Asynonychus godmani*, and several others.

FRB is seldom considered a serious pest in California but has re-emerged as problematic because it is considered a quarantine pest in important citrus export markets such as Korea (see the sidebar on page 31).

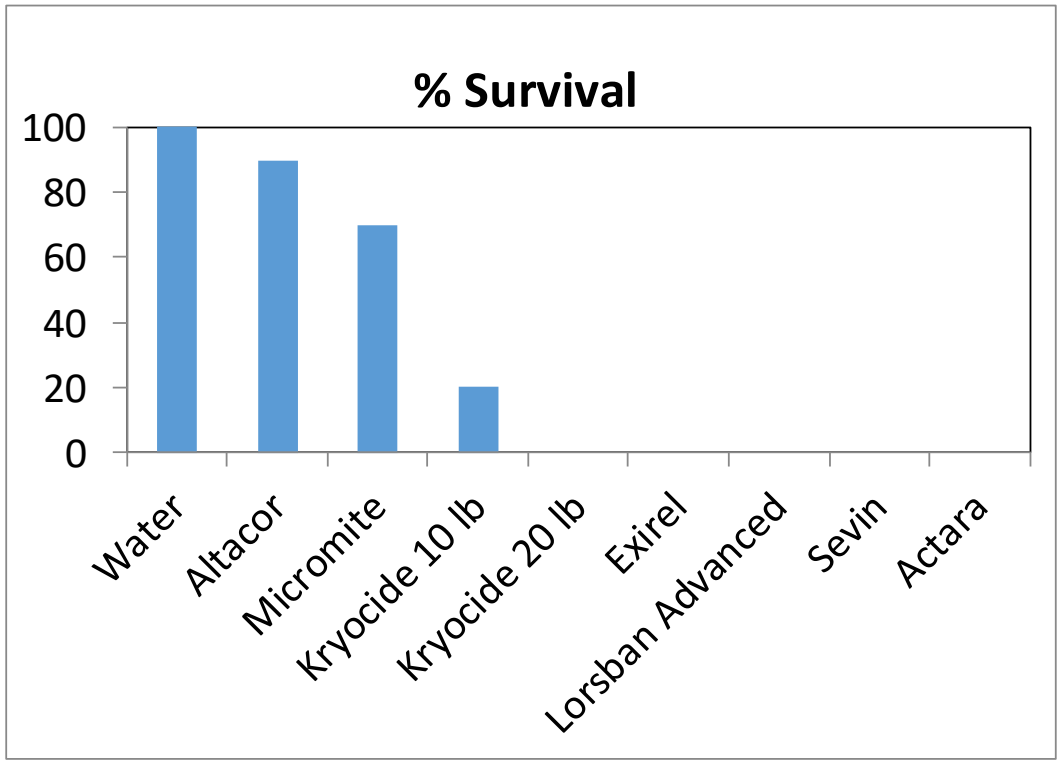
Initial research focused on developing treatments and testing efficacies of materials against fuller rose beetle mortality.

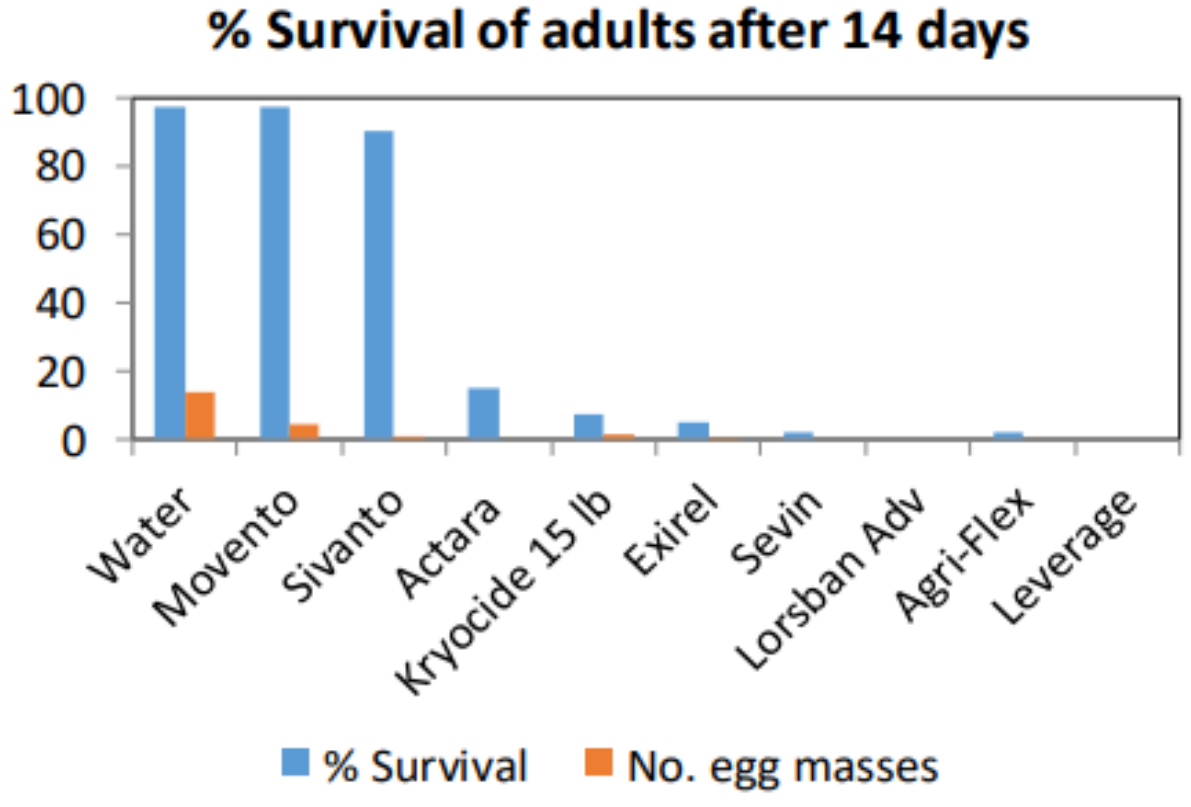
Brigade WSB trunk spray 0.5 lb AI/ acre 1 day after treatment

Cannot get this on fruit (domestic tolerance)

Bifenthrin applications near the base of the tree and trunk lowered FRB emergence but did not eliminate them (Morse et al. 2013)

Laboratory Bioassays of Fuller rose beetle adults - 14 DAT





Effective: Kryocide, Exirel, Sevin, Actara

<u>Not</u> effective: Pyrethroids, IGRs and misc others (Altacor, Movento, Sivanto)

BUT

Insecticide trials: Beth Grafton-Cardwell

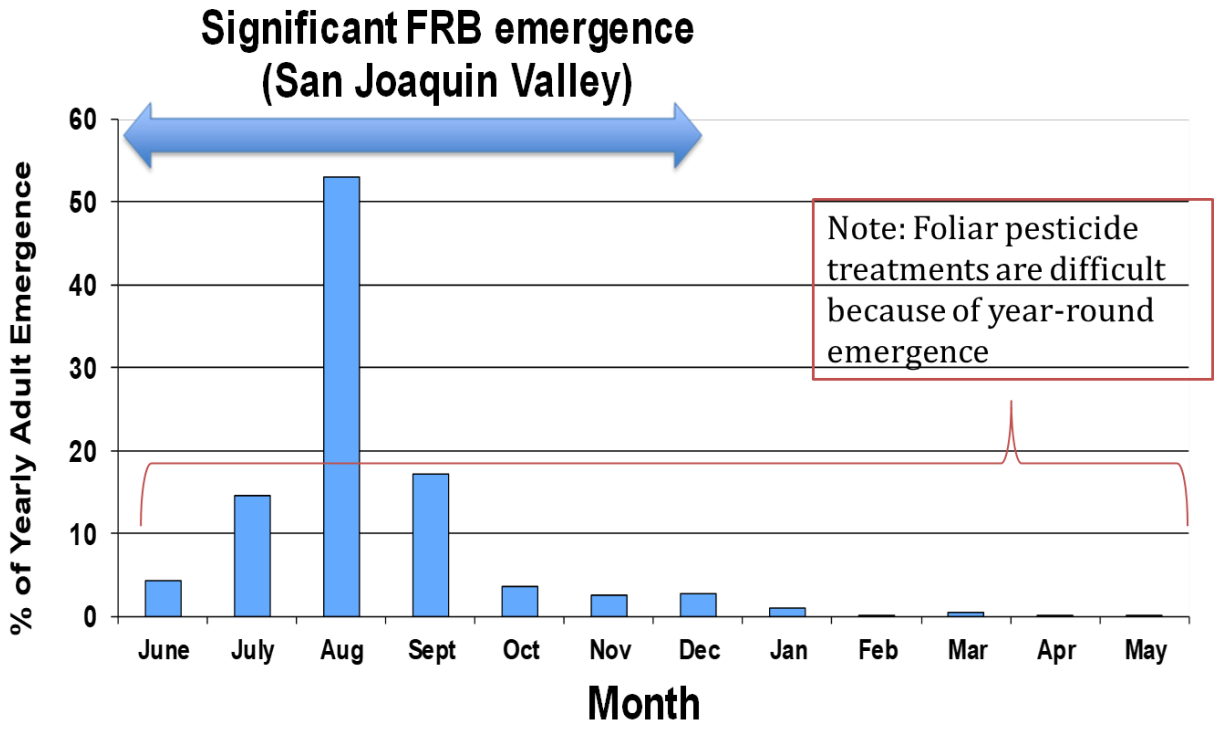
Not all the FRB-effective insecticides had Maximum Residue Limits (MRLs) established or had the MRLs close to or lower than the South Korean MRLs. So, there was a risk of rejection due to residue limits if these products were used too close to harvest.

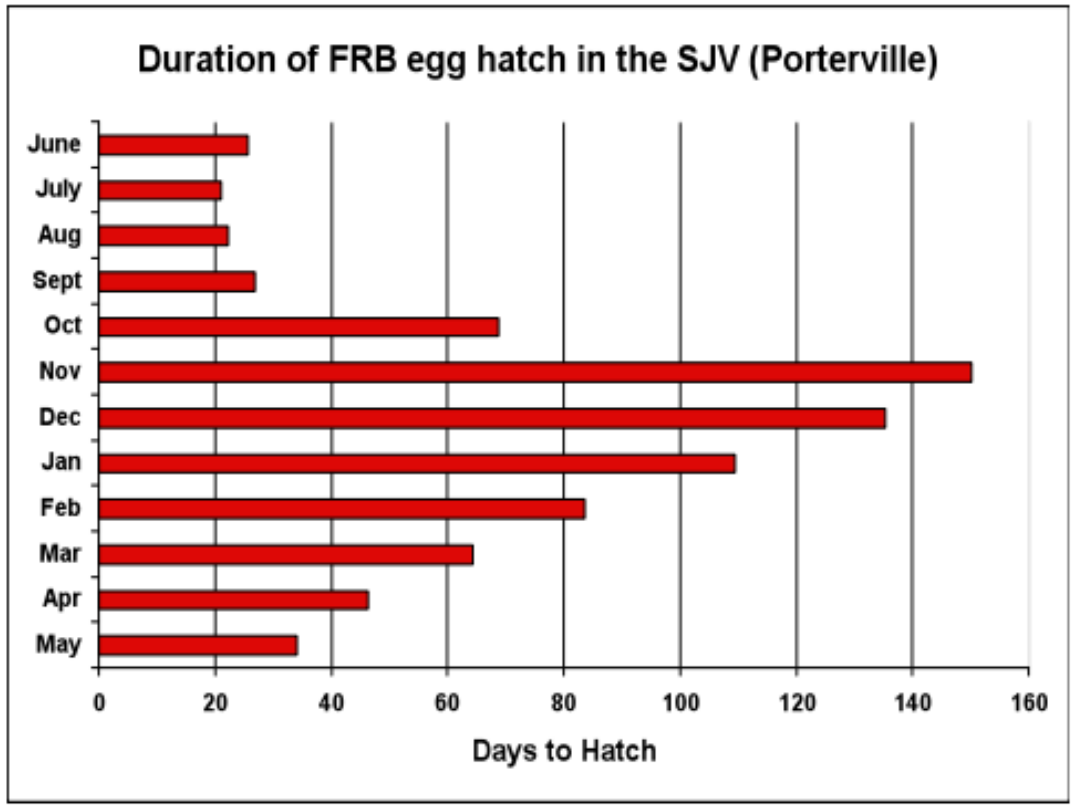
	US MRL ppm	Korea MRL ppm
Kryocide	-	-
Exirel (cyantraniliprole)	0.7	0.6
Lorsban Advanced	1.0	0.3
Sevin	10	7
Actara	0.4	1.0
Leverage (imidacloprid + beta cyfluthrin)	0.7 0.2	0.5 2.0

UCIPM Recommendations for FRB control	US MRL ppm	Korea MRL ppm
Sevin (Carbaryl)	10	7
Actara (Thaimethoxam)	0.4	0.3
Brigade (Bifenithrin)	0.05	0.5
Imidacloprid	0.7	0.7
Beta cyfluthrin	0.2	2.0
Voliam Flexi	1.4	0.6
Kryocide (Cryolite)	7	0.01

Because adults emerge year-round, it is difficult to apply targeted management to eliminate them from orchards. Peak emerge in the San Joaquin Valley (84%) occurs from July to September. Adult control to reduce fruit contamination.

Year-Round Adult FRB Emergence

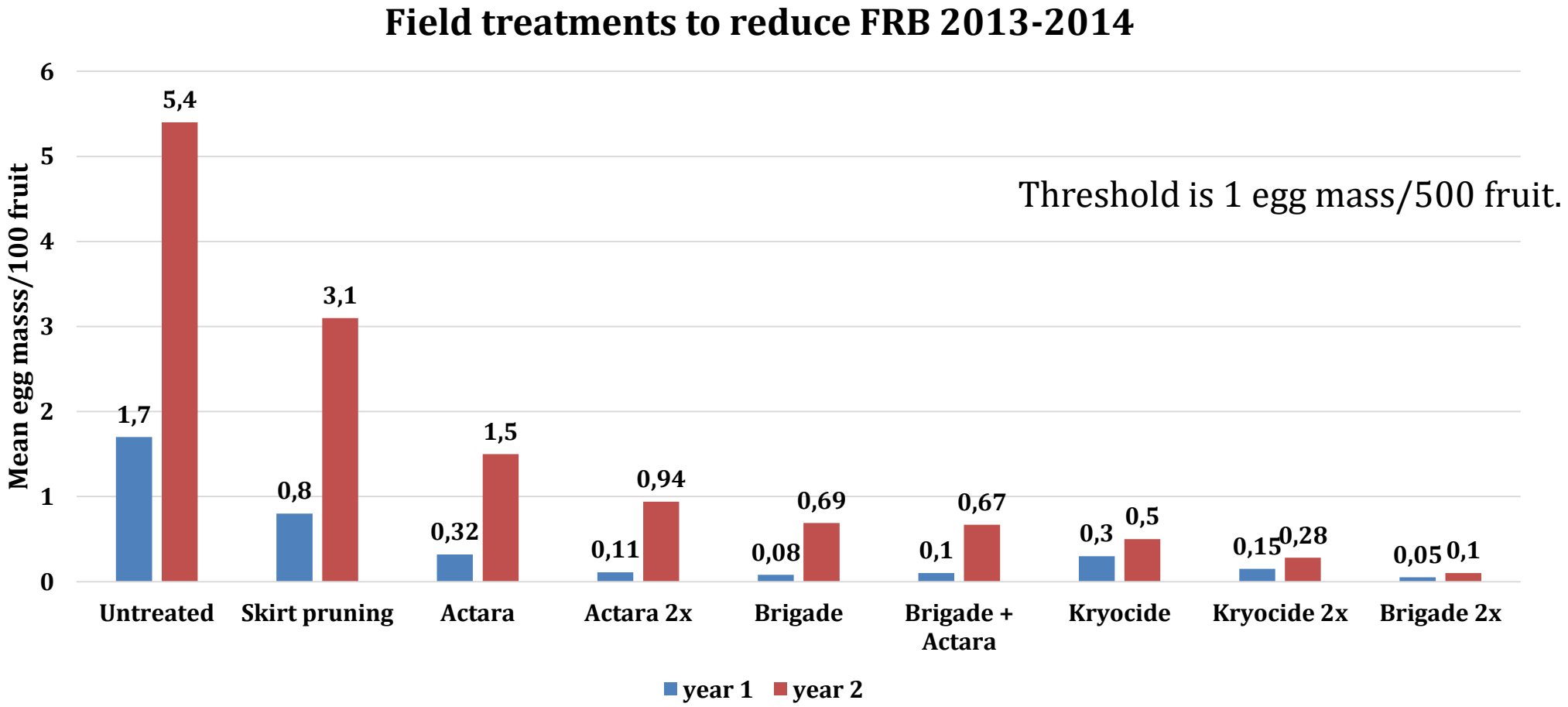




FRB biology and field ecology study by Joe Morse

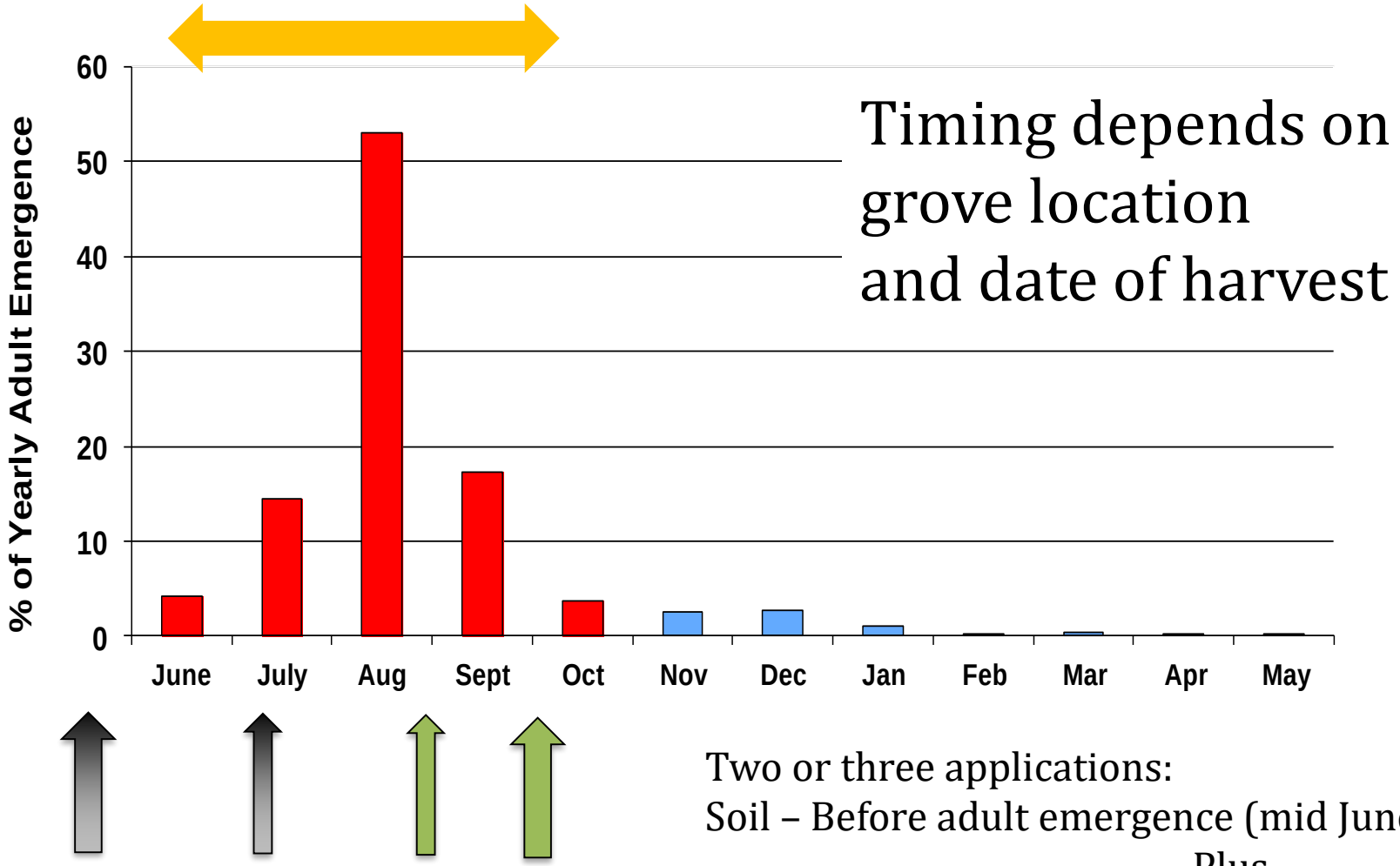
After the weather cools down in October, eggs take longer to hatch. Foliar spray doesn't work on eggs.

It is very difficult to eliminate FRB adults from trees and prevent egg laying Two treatments do a better job than one treatment (Grafton-Cardwell 2014)



Brigade WSB is a 80 oz/acre ground treatment, Actara 25 WG 5.5 oz/acre and Kryocide 10 lb/acre are foliar treatments. All trees except untreated were skirt pruned.

Current recommendations target adults emergence/adults



Two or three applications:
Soil – Before adult emergence (mid June/early July)

Plus

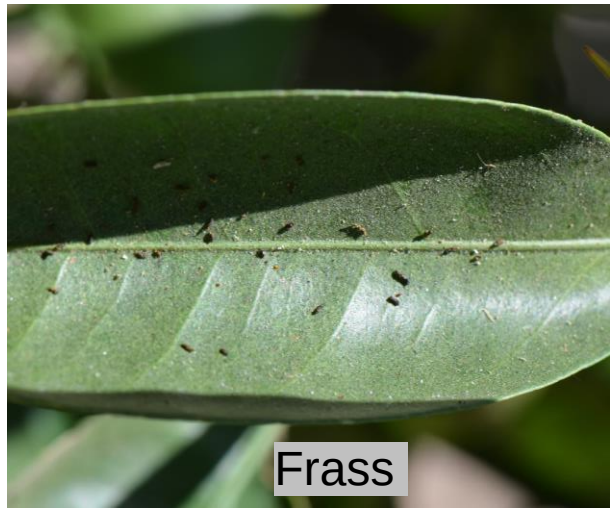
One or two foliar – After adult emergence (August and October)

Export Maximum Residue Limits (MRLs) limit our choices

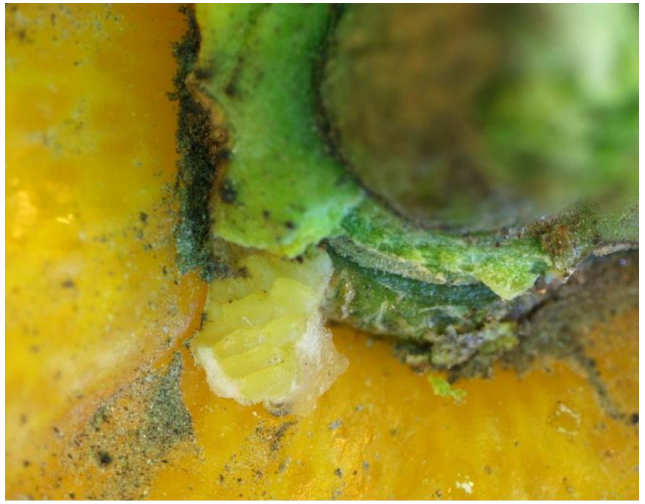
Trade name	Common name	U.S. tolerance (ppm)	Codex MRL (ppm)	Japan MRL (ppm)	Korea MRL (ppm)	PHI (days)
Brigade WSB [a]	bifenthrin trunk spray	**0.05**	0.05	2	0.5	1
Sevin	carbaryl	10	15	7	0.5	5
Kryocide	cryolite	7	--	--	--	15
Actara	thiamethoxam	0.4	0.4	1	1	0

Because of the MRLs, Thiamethoxam is the only foliar material we can use for Korean export. However, neonicotinoids are highly regulated in California and regulators anticipate reduction in coming years.

How to tell if you have FRB in your grove?



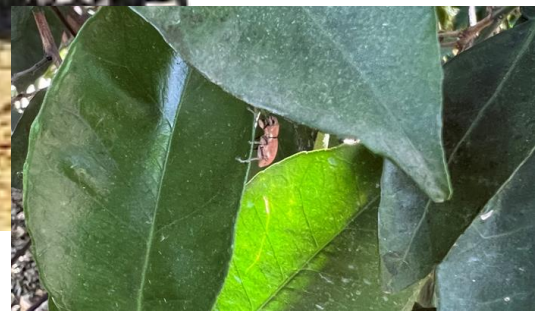
Sample for adult beetles using a beating sheet
Low beetles – apply insecticides
High beetles – avoid shipping to Korea



Live eggs –
whitish or yellowish and plump

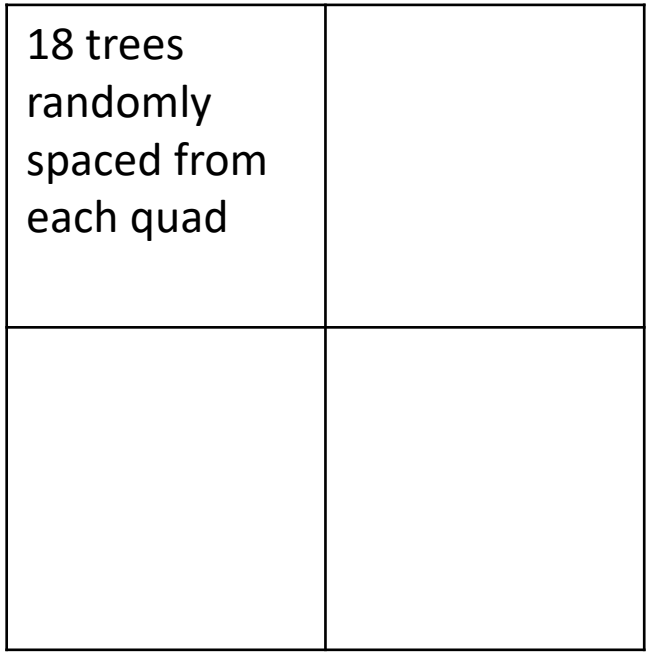
Dead or hatched eggs –
dried out

California growers have followed FRB regulations since 2013-14 season. We are noticing a decline in FRB populations in citrus groves in the San Joaquin Valley.

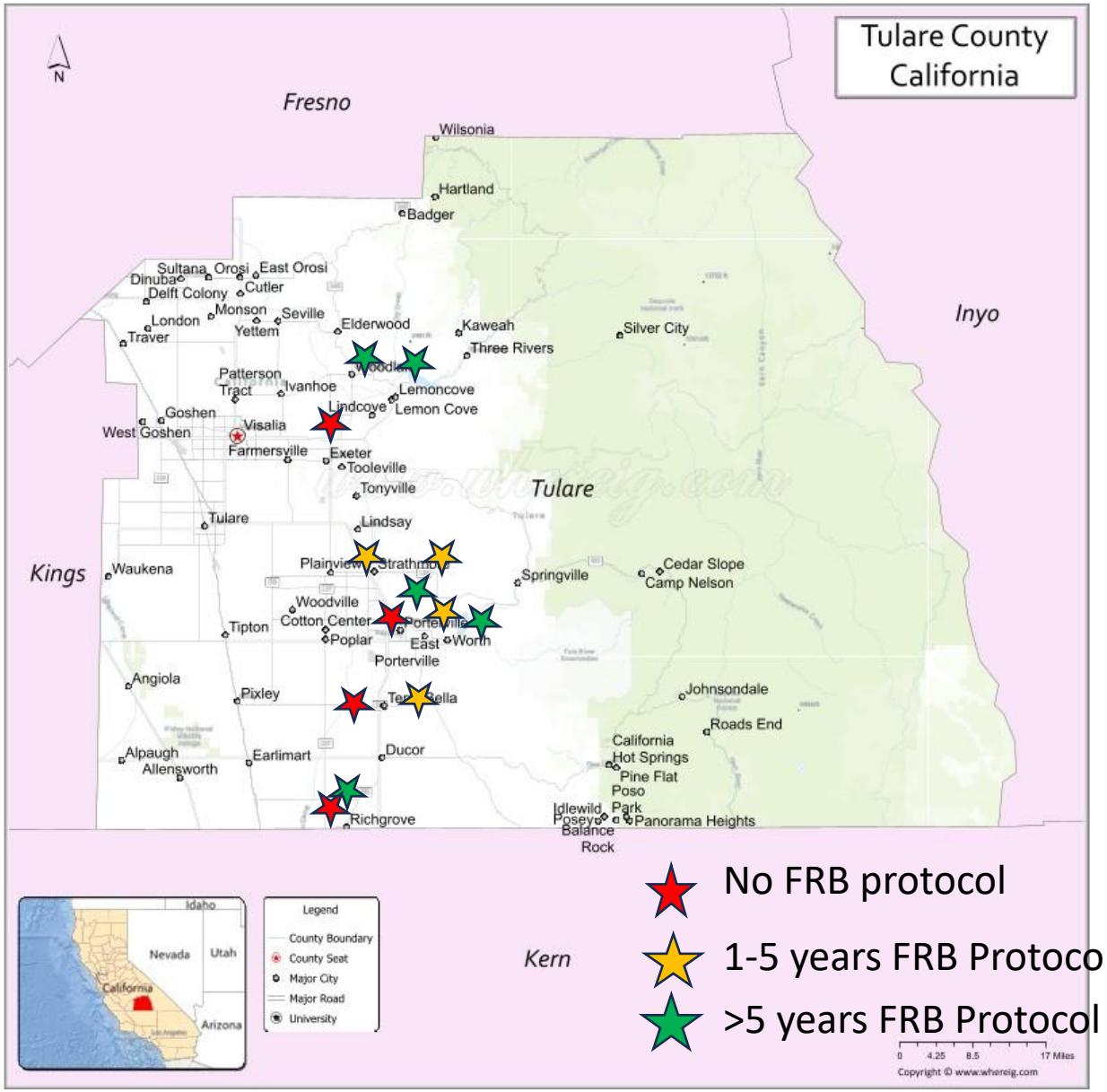


2023 USDA APHIS Approved Sampling Protocol

1. **Timing**: From Aug. 7 – Aug. 31 since that is the peak period of emergence.
2. **Sample** a total of 72 trees randomly.
3. **How**: Check suckers inside the tree for signs of FRB leaf chewing and if beetles are detected the tree is considered infested.
    i. If no beetles are found in the interior, shake two large outside branches over a light cloth and inspect for FRB. If any beetles are found, the tree is considered infested.
4. **Records**: (i) block identification, (ii) inspection date, (iii) name of inspector, and (iv) number of trees infested with beetles out of 72 trees inspected.
5. **Action**: ≤2 trees infested = eliminate the first FRB pesticide application. ≥3 or more trees infested = growers must make a pesticide application in August or early September. Second application is required regardless the sampling outcome.



	Sites	Infested trees	Total FRB found
	1	0	0
	2	0	0
	3	0	0
	4	0	0
	5	0	0
	6	0	0
	7	0	0
	8	0	0
	9	0	0
>5 years	10	0	0
Korea FRB	11	6	11
Protocol	12	0	0
	1	0	0
	2	0	0
	3	1	1
1-5 years	4	0	0
Korea FRB	5	0	0
Protocol	6	0	0
	1	4	7
	2	18	26
	3	7	32
	4	11	14
	5	0	0
No FRB	6	0	0
protocol	7	15	28



26 blocks sampled, block size from 10-40 acres. Tree age: 21-59 yrs

FRB Management

Current recommendations (Field):

- Skirt pruning 24-30 inches above the ground; apply sticky material to the trunk to prevent adults from climbing trees
- Weed control to eliminate pathway, physical barriers like stickem glue to prevent beetles from climbing
- Insecticide applications, June (Bifenthrin), foliar insecticides (Thiamethoxam) August/September and before October 31

Postharvest (if fruit is infested)

- Methyl bromide: 48 mg/l for 2 h control ca 85% FRB eggs (no longer approved option)
- Phosphine: 1,000 ppm for 48 hours, 95% mortality.
- Propylene oxide: 71 mg/liter for 24 hours, 99% mortality.
- Ethyl formate: 62 mg/liter for 5 hours, 97% mortality (not yet available in the US).

California's experience with FRB management

- Year-round adult emergence and egg laying makes targeted management difficult.
- Skirt pruning to a height of 24-30 inches above the ground early in the season before adults begin emerging and weed control limits the pathway.
- Bifenthrin applications applied before FRB adult emergence helps reduce the population pressure.
- Foliar applications should be applied after most of the beetles have emerged and before temperature cools down (between mid July-mid October) in California.
- Insecticide applications seems to have reduced the population pressure in citrus orchards

Acknowledgements

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