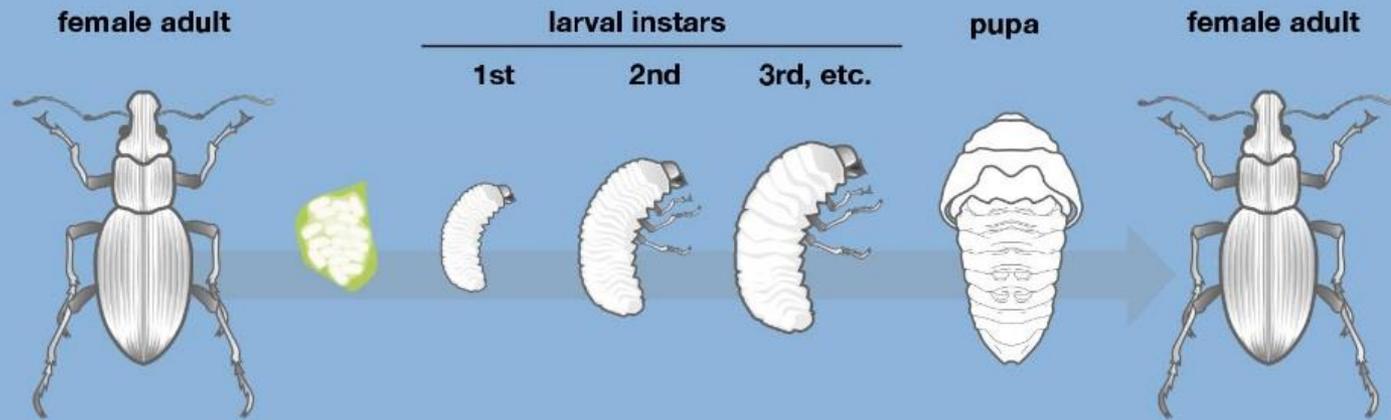


Fuller Rose Beetle (*Naupactus godmani*) biology and management



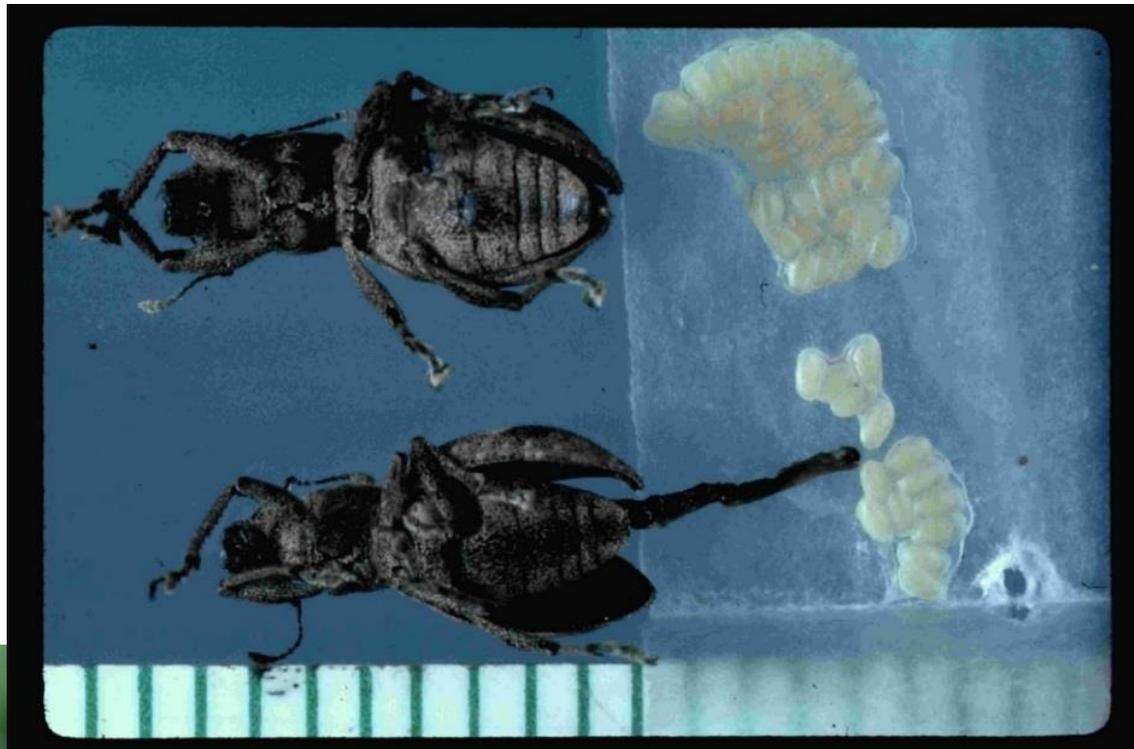
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Fuller Rose Beetle Life Cycle





Small gray beetles with a weevil snout.
Slow moving and flightless – active at night.



The ovipositor is nearly as long as the body of the female

Eggs



Eggs



The eggs may be attached to the calyx (button)

Less commonly the eggs may be attached to the fruit

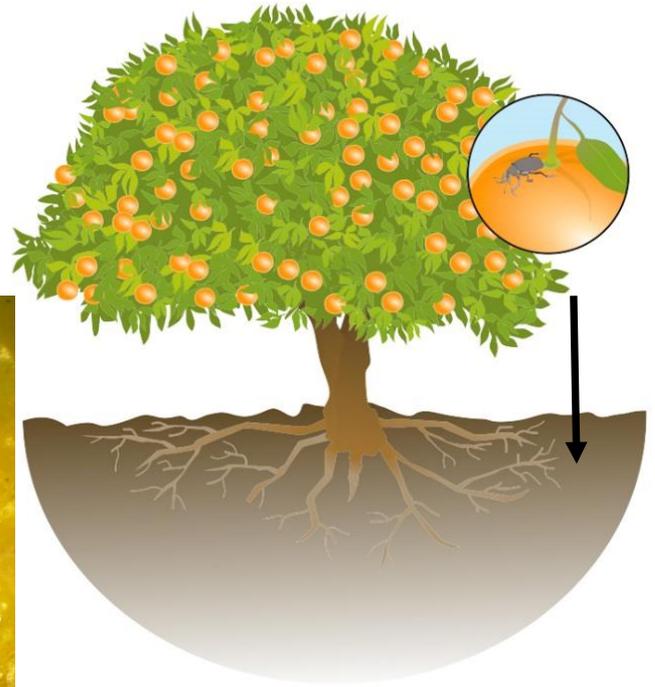
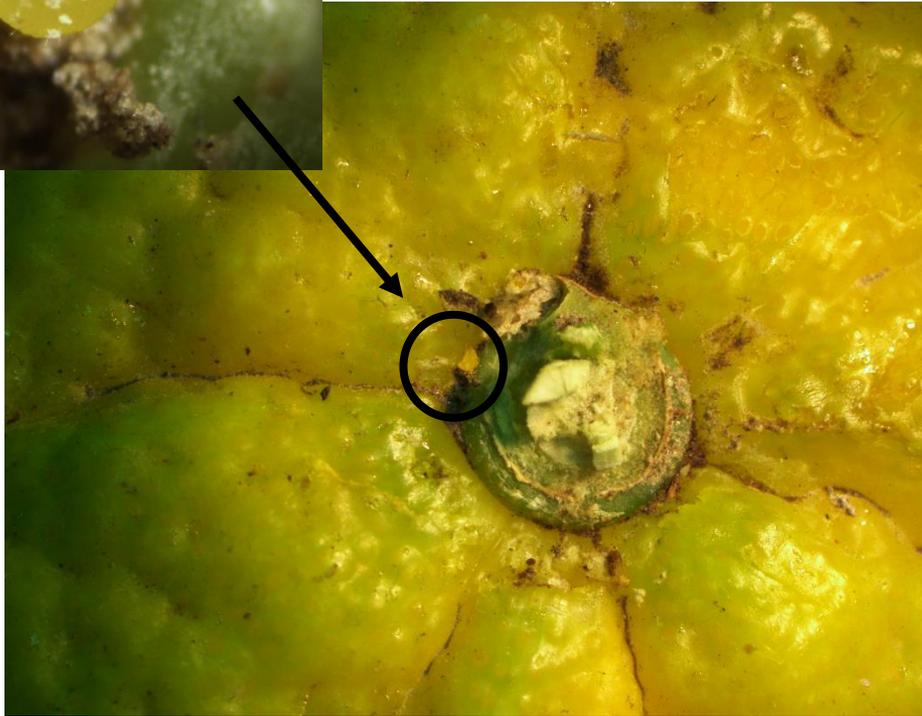
Because they like to tuck eggs in tight places, they can plug up sprinkler emitters

FRB eggs



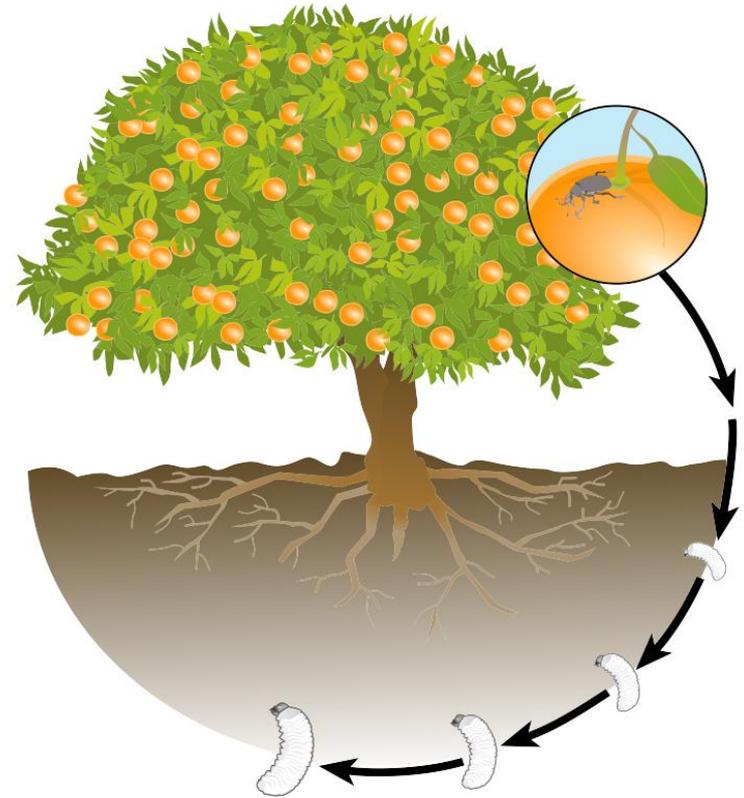
Eggs are laid in clusters of 10-20 and each female produces 100-1000 over her lifetime of 3-5 months





The eggs hatch and the tiny, legless '**neonate**' larvae drop to the ground and wriggle into cracks and crevices of the soil in search of tiny root hairs to feed on.

Larvae live in the soil feeding on roots



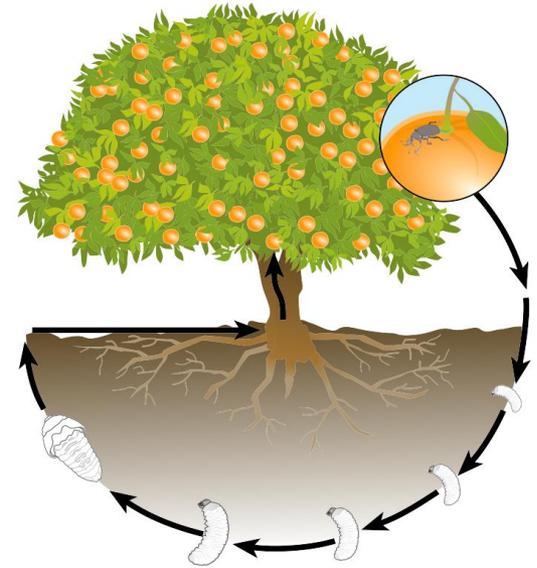
The larvae are active in 3-24" of soil. The larvae molt multiple 5-8? times over a 6-8 month period gradually growing larger and advancing to larger roots as they increase in size. In California, they are not considered damaging to citrus, however, combined with other root damaging factors like *Phytophthora*, HLB etc. it is possible the combination could lead to tree decline.



Larva forming its earthen cell



Pupa (upper) and late stage larva (lower) for comparison



When the larvae are fully mature, they move towards the soil surface, prepare an earthen cell, and pupate. The **pupa** resides in the soil for 1.5-2 months before the adult emerges. Adult emergence is often triggered by rain or irrigation.



Adults chew the leaves in a characteristic fashion, especially the inside water sprouts and suckers.



Leaf feeding damage is generally unimportant unless heavy populations attack topworked or newly planted trees.



Avocado



Strawberry



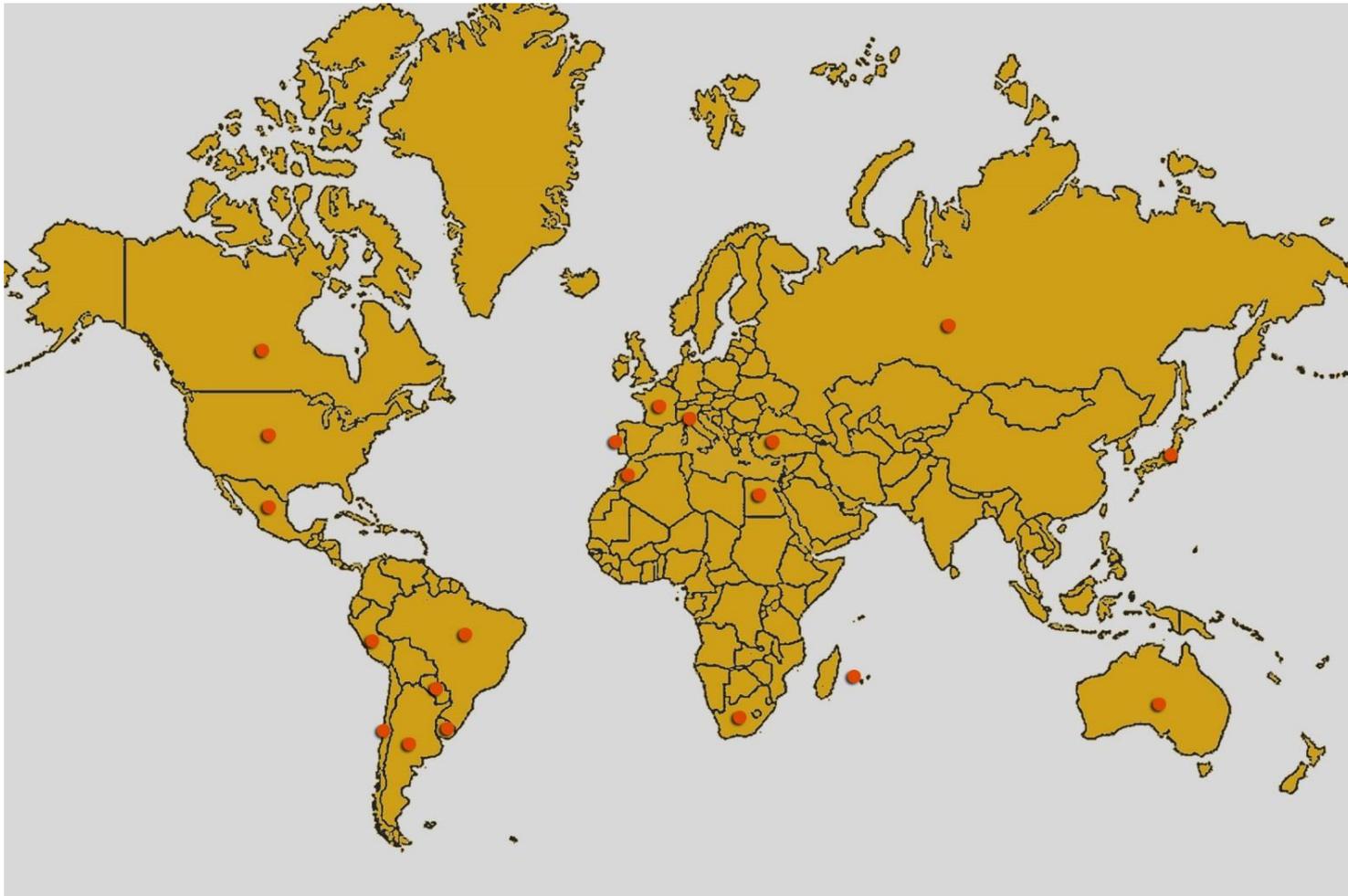
FRB attacks many plants including cherries, persimmon, apple, stone fruit, avocado, potatoes, strawberries, and caneberries as well as numerous ornamentals such as roses, *Photinia*, *Hydrangea*, *Hibiscus*, azaleas, and begonias

Ornamental *Photinia*





FRB was first reported in the United States in 1879 in California. It is now present in 30 U.S. states, and most likely came to the U.S. from South America.



The Fuller rose beetle is currently found in North and South America, Europe, parts of Africa, Australia, Japan and the Pacific Islands. It is not known to occur in Asia, other than Japan.



Fuller rose beetle adult depositing an egg under the calyx



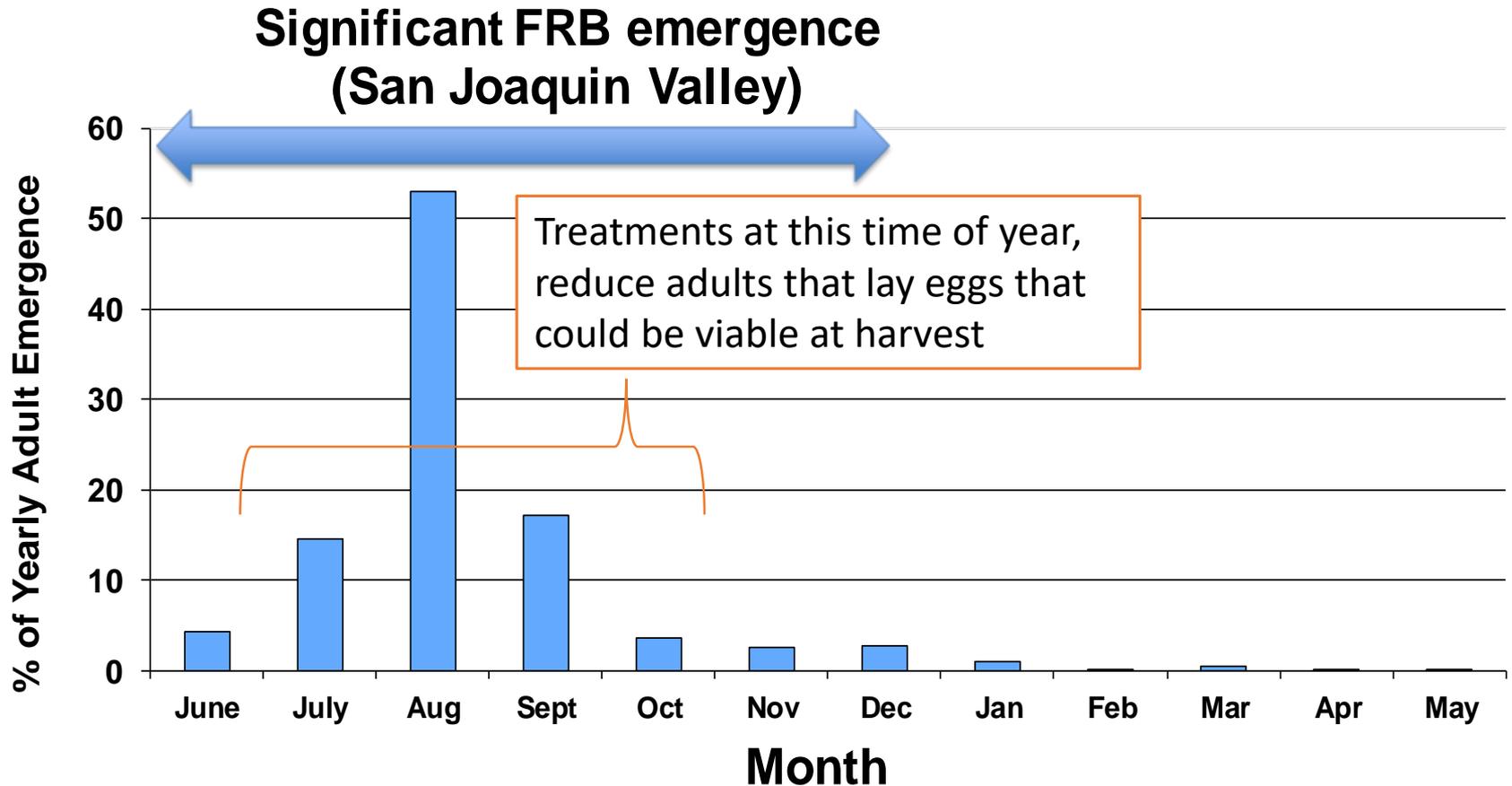
Fruit shipped to S. Korea is examined and if eggs are found, loads can be rejected

While California growers do not consider Fuller rose beetle to be a pest of citrus, it has not been found in S. Korea and that country has considered establishment of Fuller rose beetle to be a **phytosanitary risk** since 2011.



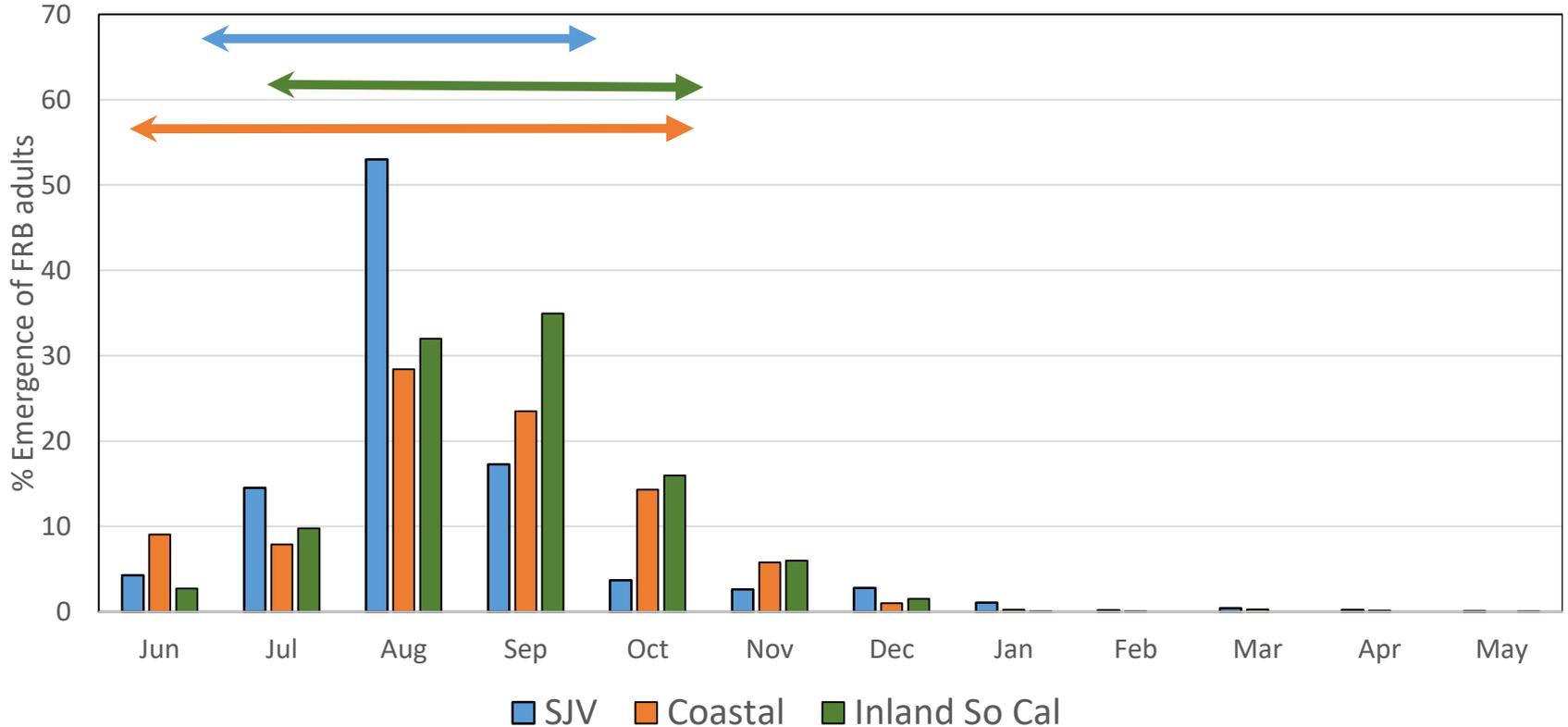
For many years S. Korea allowed Methyl Bromide fumigation at destination if live eggs are found under the calyx of citrus fruit. However, this method of disinfestation may not be available in the near future.

South Korea's expectation is that FRB will be eliminated in California orchards so that methyl bromide use can be stopped.



Because adults emerge year-round, it is difficult to apply targeted management tactics to eliminate them from orchards. However, peak adult emergence in the central San Joaquin Valley of California (84%) occurs during July through September.

Comparison of emergence of FRB adults in various regions of California



Because of differences in soil temperature, peak emergence of adults varies from region to region.

Biological control: *Fidobia citri* endoparasitic wasp



A tiny parasitic wasp lays its eggs in the FRB eggs



When the wasp develops into a pupa inside the FRB egg, the egg looks dark like the wasp



The adult wasp emerging from an FRB egg



Spiders



Predatory assassin bug

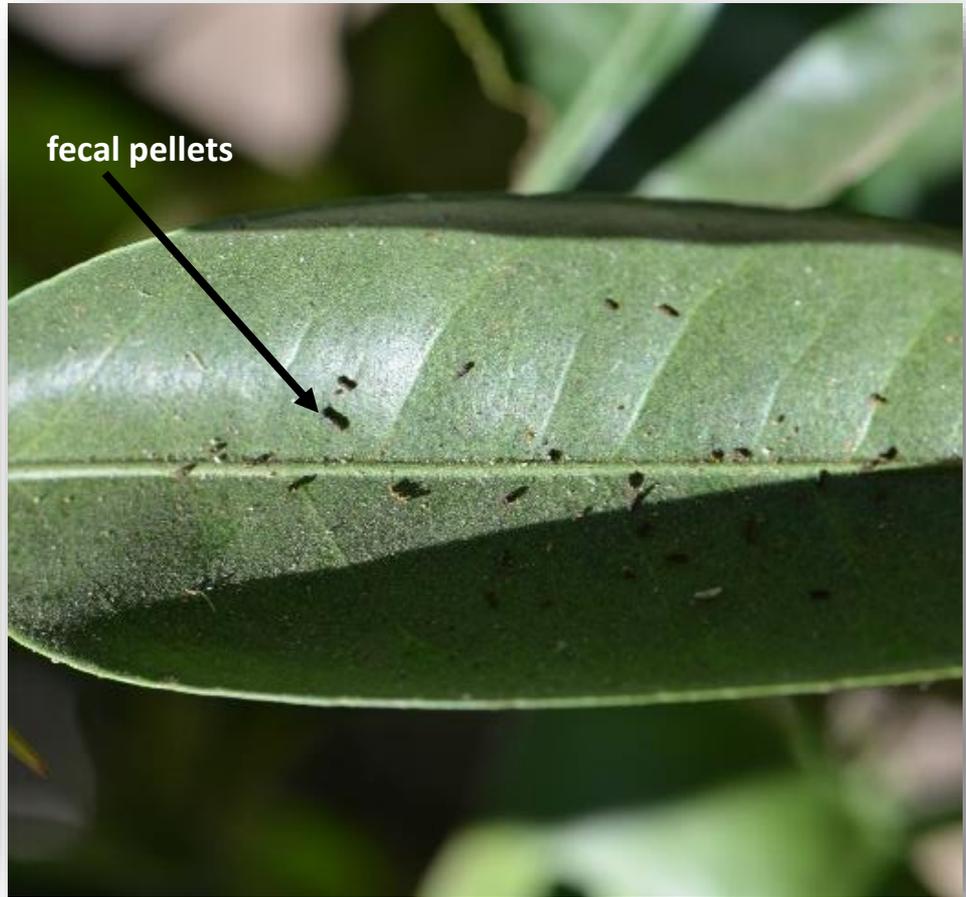


This beetle has been ripped apart and fed on by a predator

Various generalist predators, including spiders and assassin bugs will attack adult beetles. However they don't reduce FRB low enough and so insecticides are necessary.

How to avoid S. Korean rejections of shipments

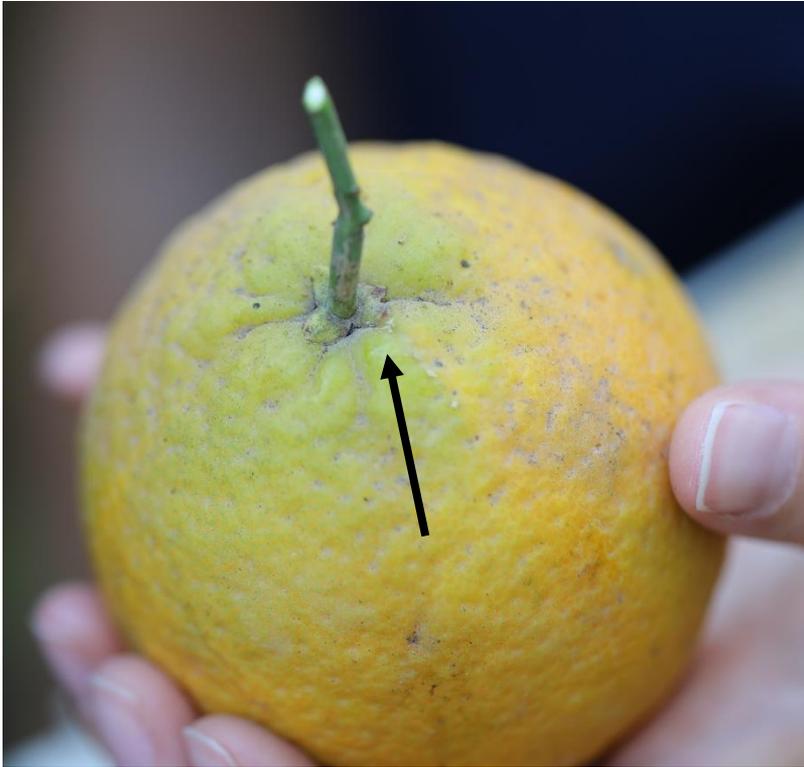
Step 1: don't ship from orchards known to have noticeable FRB



Look for notched leaves and fecal pellets



Use a beating sheet to monitor for adults



Tight sepals would be less likely to have eggs



Open sepals would be more likely to have eggs

Collect fruit from 10 areas of the block and examine a total of 500 fruit (5 fruit per tree from 10 trees in each of 10 areas).



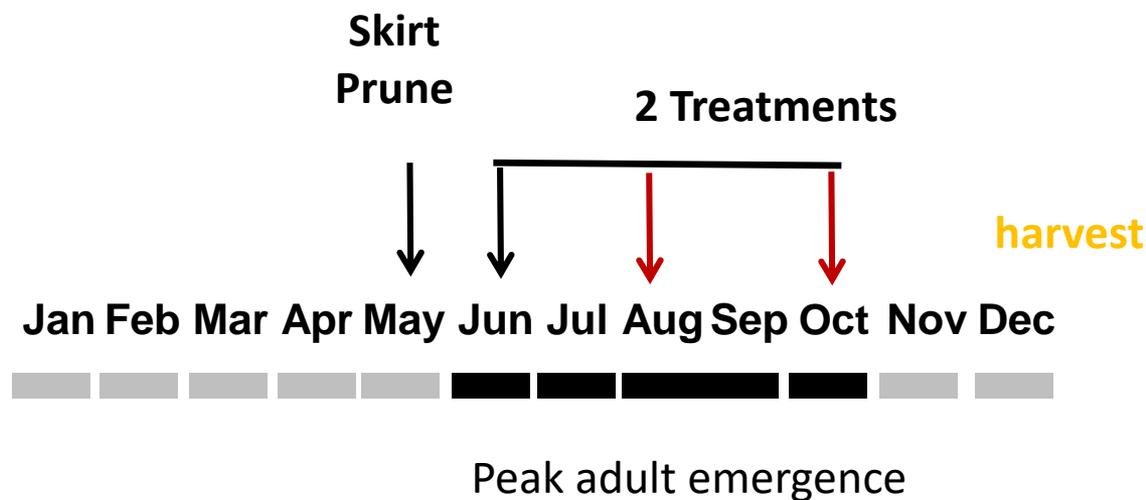
You can search for eggs on harvested fruit by lifting up the sepals of the fruit using a blunt metal instrument.

How to avoid S. Korean rejections of shipments

Step 2: if orchards have low to no FRB, apply mitigations from the CCQC protocol

Current regulations for shipping to S. Korea:

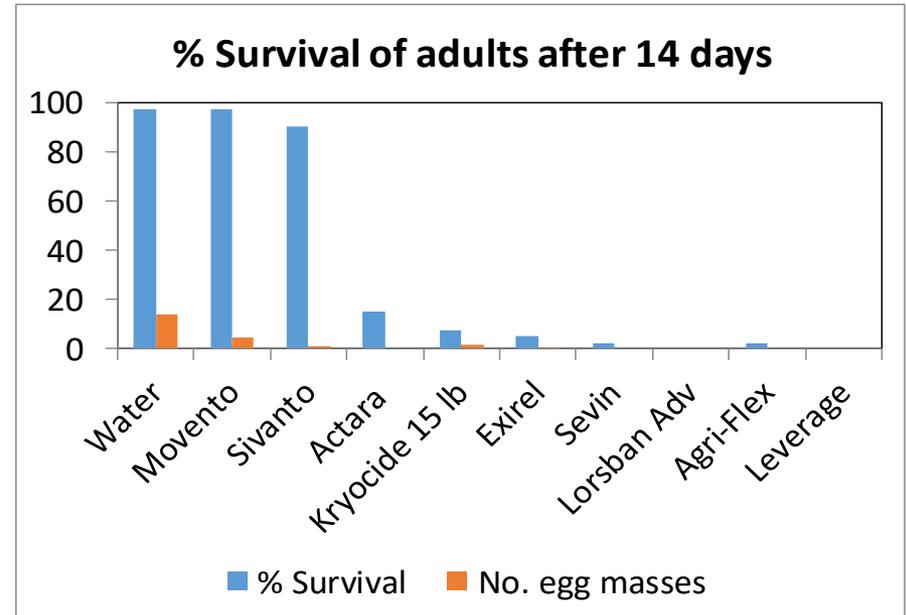
- Skirt pruning
- Weed control
- 2 treatments applied to the ground or foliage





Skirt pruning 24-30" and eliminating weed bridges forces the flightless adults to climb the trunk

| Treatment | | Rate/acre |
|--------------------------|--------------------------------|------------------|
| Movento 240 SC + Omni 6E | spirotetramat | 10 fl oz + 0.25% |
| Sivanto | flupyrifidifurone | 14 fl oz |
| Actara 25 WDG | thiamethoxam | 5.5 oz |
| Kryocide | kryocide | 15 lb |
| Exirel 10 SE | cyantraniliprole | 16.9 oz |
| Sevin XLR | carbaryl | 5 qts |
| Lorsban Advanced | chlorpyrifos | 4 pts |
| Agri-Flex SC | abamectin + thiamethoxam | 8.5 oz |
| Leverage 2.7 SE | beta cyfluthrin + imidacloprid | 10 fl oz |



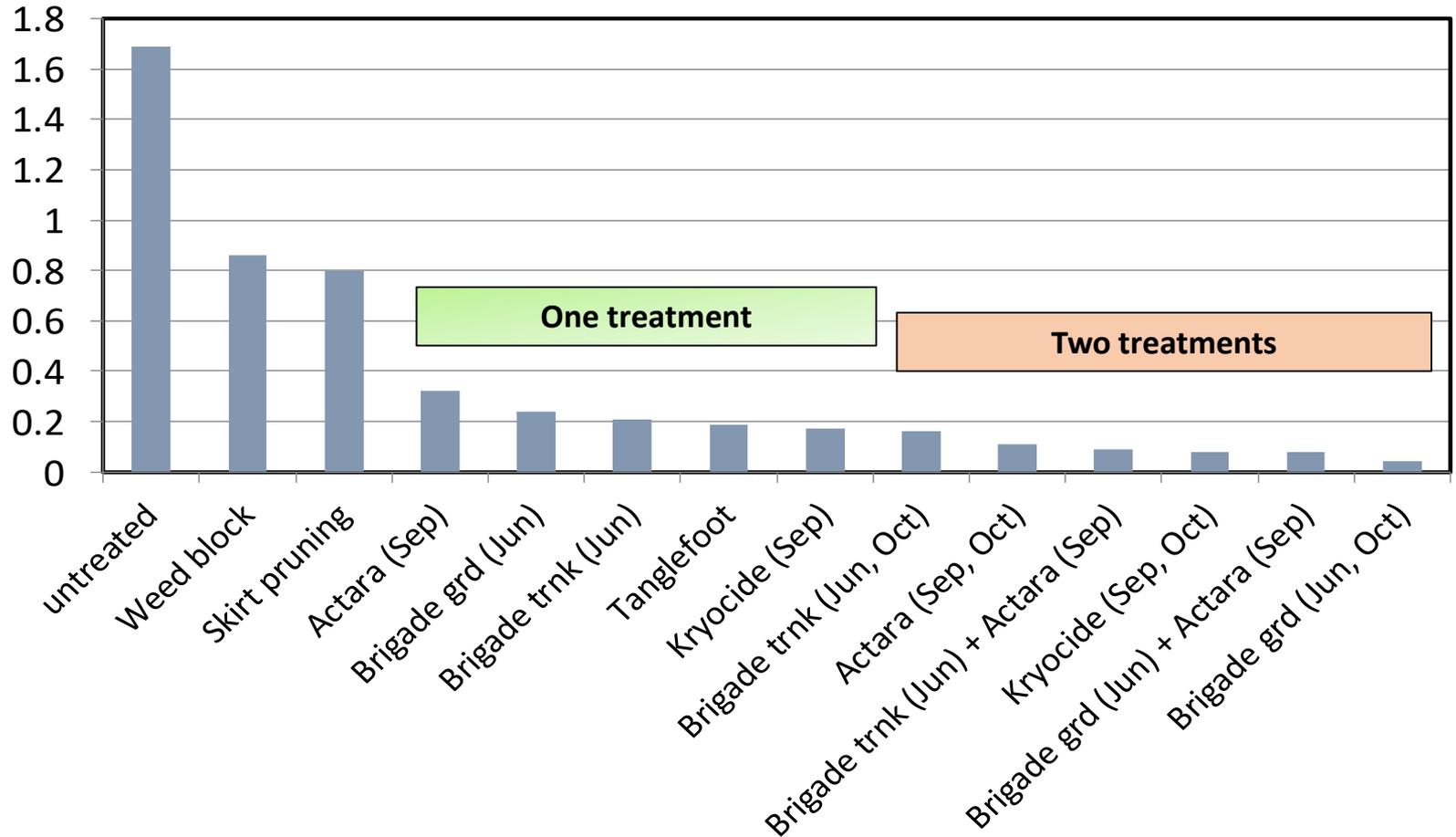
Of the many insecticides screened, these insecticides were the best at killing adults and preventing egg laying. See the [UC IPM guidelines for citrus](#) for details on rates and application methods.

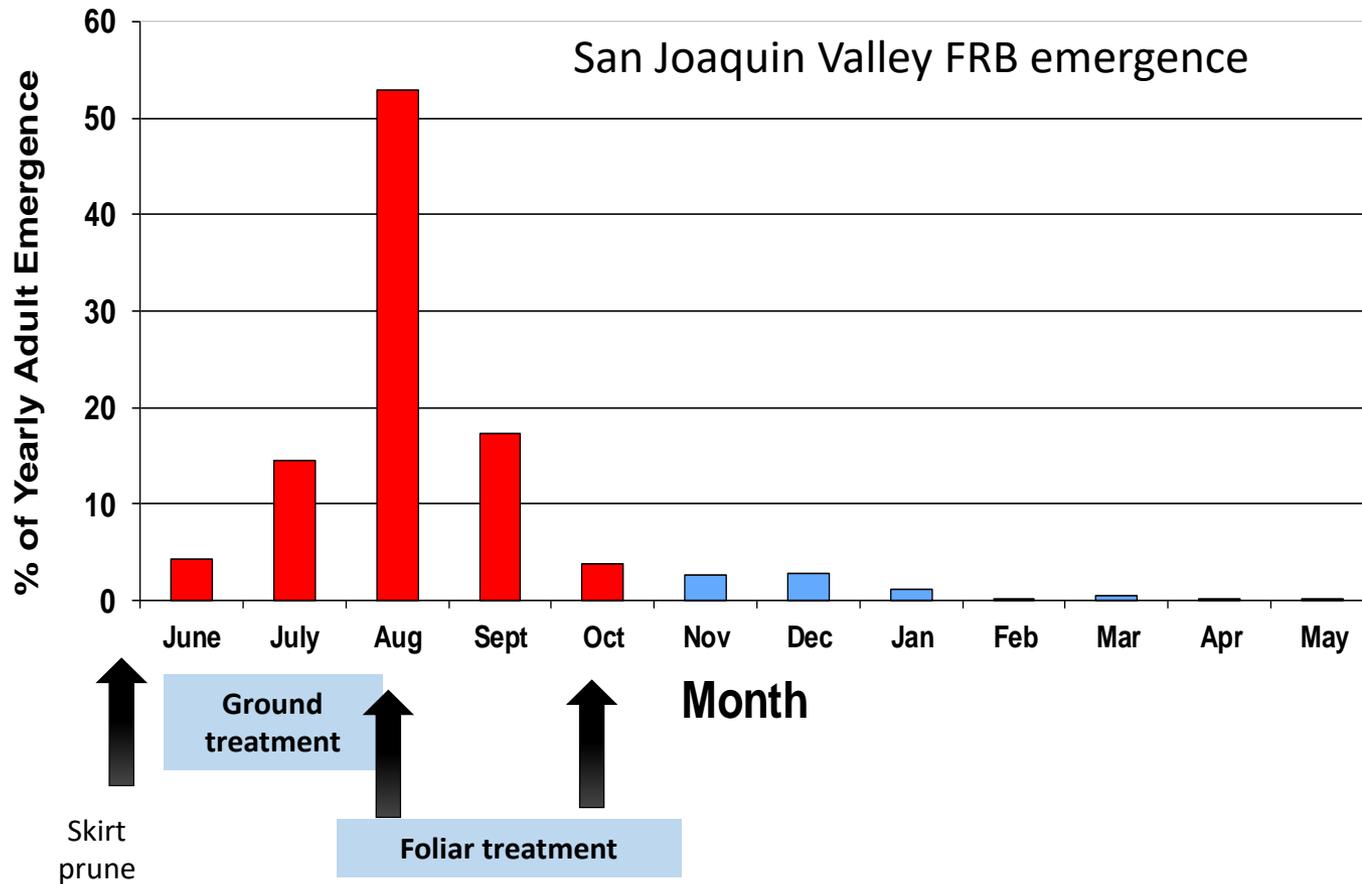
| | US MRL ppm | Korea MRL ppm |
|--|---------------|------------------|
| Kryocide | - | - |
| Exirel (cyantraniliprole) | 0.7 | 0.6 |
| Lorsban Advanced | 1.0 | 0.3 |
| Sevin | 10 | 7 |
| Actara | 0.4 | 1.0 |
| Leverage (imidacloprid + beta cyfluthrin) | 0.7 0.2 | 0.5 2.0 |

Not all FRB-effective insecticides have Maximum Residue Levels (MRLs) established or have MRLs that are close to or lower than the S. Korean MRLs. Thus, there is a risk that if these products are used close to harvest, the residues will be above the Korean MRL, and the fruit could be rejected.

- Skirt pruning and weed block were about 50% effective
- 1 foliar treatment or a trunk or ground treatment of Brigade was 80-90% effective
- 2 treatments (ground, trunk or foliar) > 95% effective

Fuller Rose Beetle Egg Masses per 100 Fruit





Trunk or ground treatments are best applied before peak emergence to kill the adults that are emerging from the soil. Foliar treatments are best applied during and after peak emergence to kill adults that have already climbed the trees.



There are no effective foliar organic insecticides to control Fuller rose beetle. Stickem can be applied to the trunk to block adult beetle access to the canopy. But it must be placed on a wrap and reapplied monthly.

**Time and concentration of fumigants needed
to achieve high mortality of FRB compared to bean thrips**

| Mite species | Phosphine (41°F, 1000 ppm) | Propylene Oxide (60°F) | Ethyl Formate (59°F) |
|---------------------------|---|-----------------------------------|---|
| Bean thrips | 12 hours | 2 h, 14 mg/l | 1 h, 9 mg/liter |
| Fuller rose beetle | 5 days (2 days, 95% mortality) | 24 h, 71 mg/l | 5 h, 62 mg/liter (97% mortality) |

Researchers continue to look for methyl bromide alternatives for post harvest control of FRB, as constant field treatments are not fully effective or sustainable. However, the FRB egg is one of the toughest pests to kill.