Integrated Pest Management of Redberry Mite, *Acalitus essigi*, on blackberries

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Hort Innovation Strategic levy investment

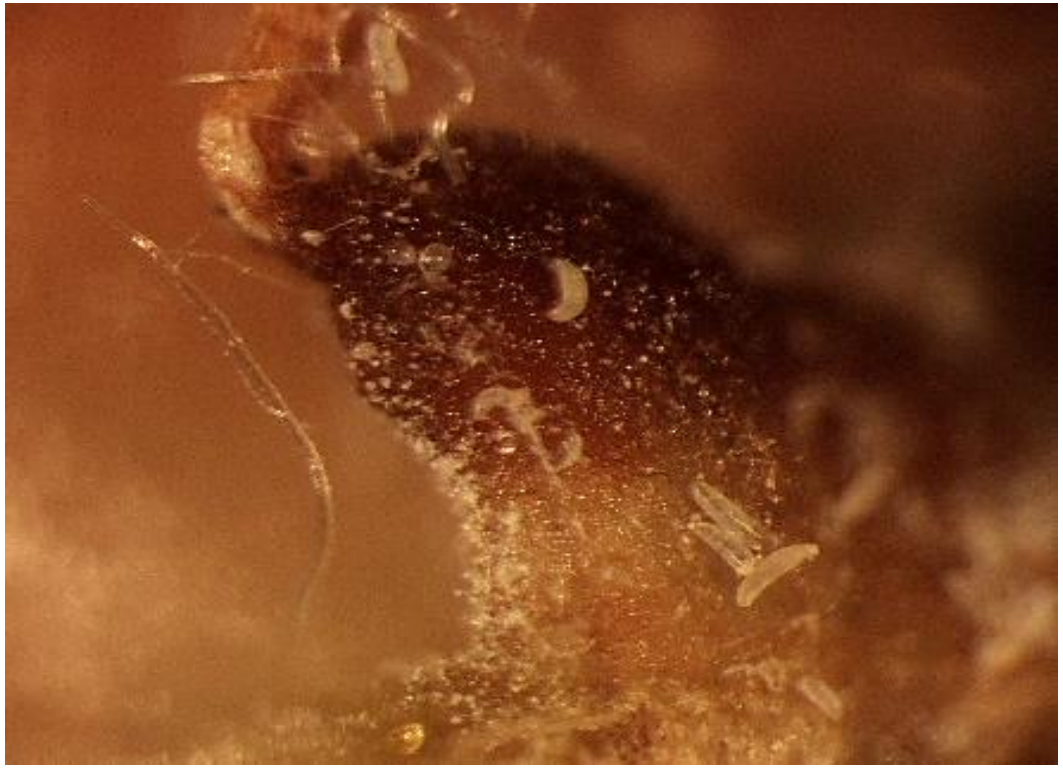
RASPBERRY AND BLACKBERRY FUND

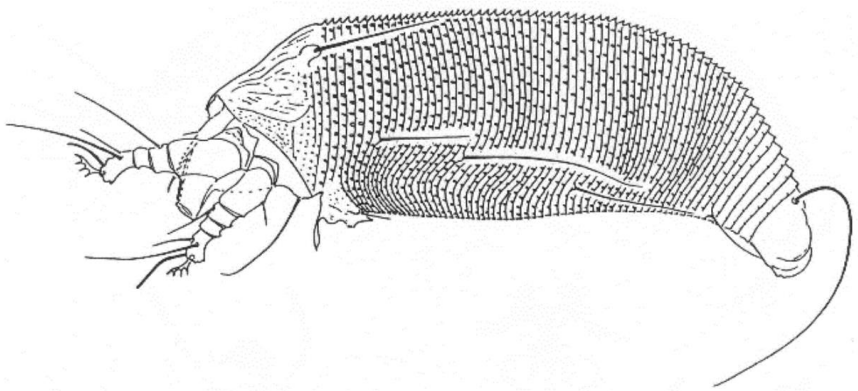
Overview

- Redberry mite and disease
- The project…
- IPM overview and results so far
  - Cultural
  - Biological
  - Chemical
- Sampling

Redberry mite

- *Acalitus essigi*
- Colour: whitish
- Size: 0.5 mm long
- Shape: wormlike, with legs at one end of the body long
- Little is known about their lifecycle





RBM lifecycle

1. Overwinter in bud scales or deep in buds.

2. In spring, the mites move onto the developing shoots. The cane growth moves them through the canopy

3. Then under bracts on stems and beneath flowers

4. As flower buds appear, the mites work their way into the buds

5. During ripening, move into the developing drupelets, generally under the calyx and around the core

Redberry Disease

- Drupelets, remain green or red and hard whilst the remaining drupelets ripen normally
- Often around the calyx
- Enzymes in the mite's saliva stopping ripening
- Disease levels increasing in some areas and with some varieties

Fruit Quality - Delayed Ripening

- Observed in both Tas and Vic.
- Red drupelets soft
- Signs red drupelets will ripen
- Drupelets at tip over-ripe → not marketable
- No RBM found
- Environmental???

Fruit Quality - Poor Pollination

Uni Of California Extension: https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=7561

Tasmanian Victoria – Feb 2020

Cultural Control

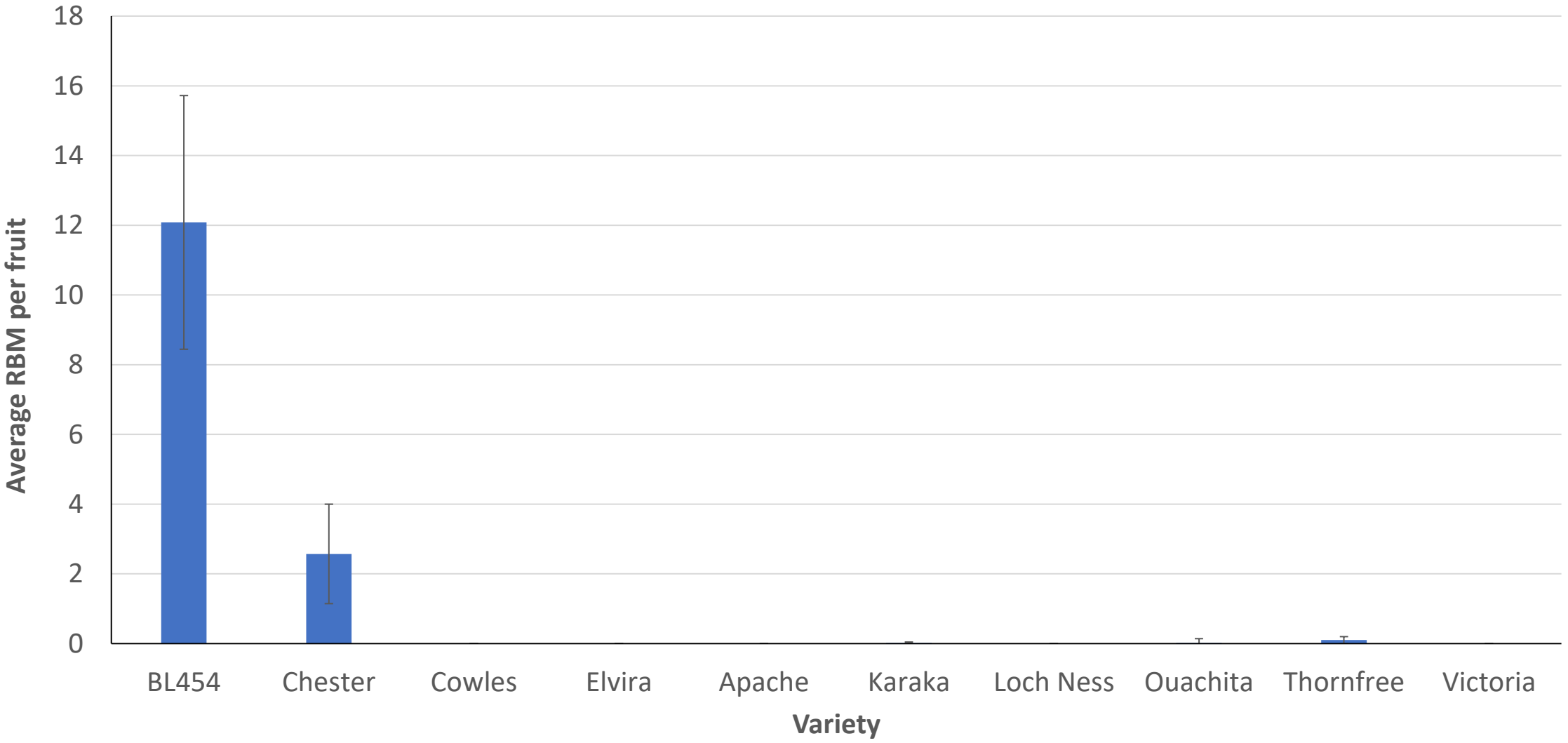
- Practices that discourage pest invasion or make the crop less suitable

- Prevention is better than cure!

Examples

  - Varieties
  - Pruning/canopy management
  - Farm Hygiene
  - Weed management
  - Plant nutrition

Variety v's RBM



Cultural - varieties

- Further complicating variety differences is canopy management
- Floricane versus primocane
  - Pruning reduces over wintering populations
- Remember: Elvira → no RBM

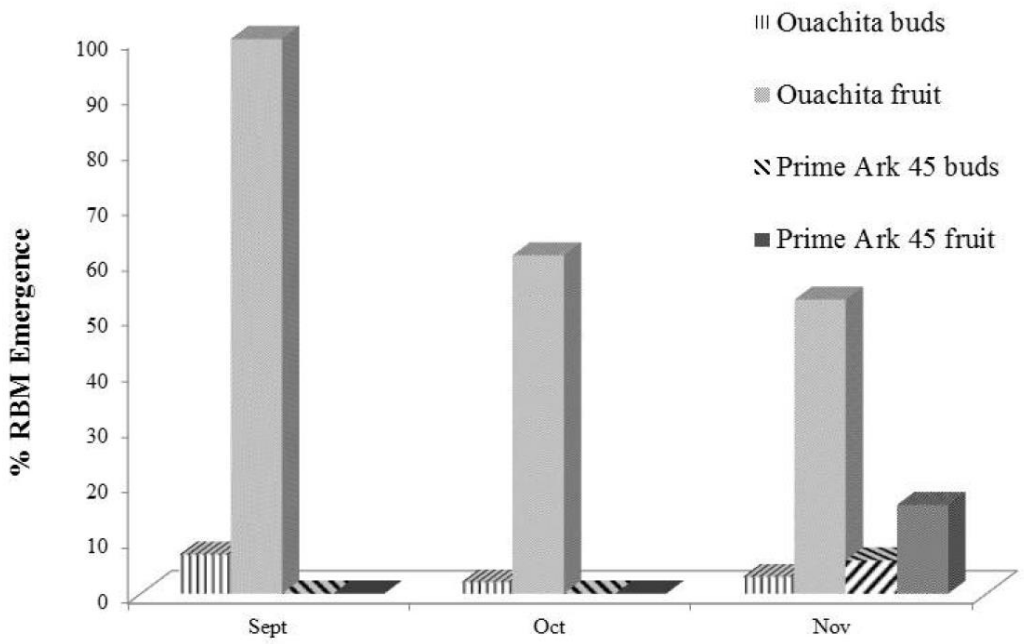
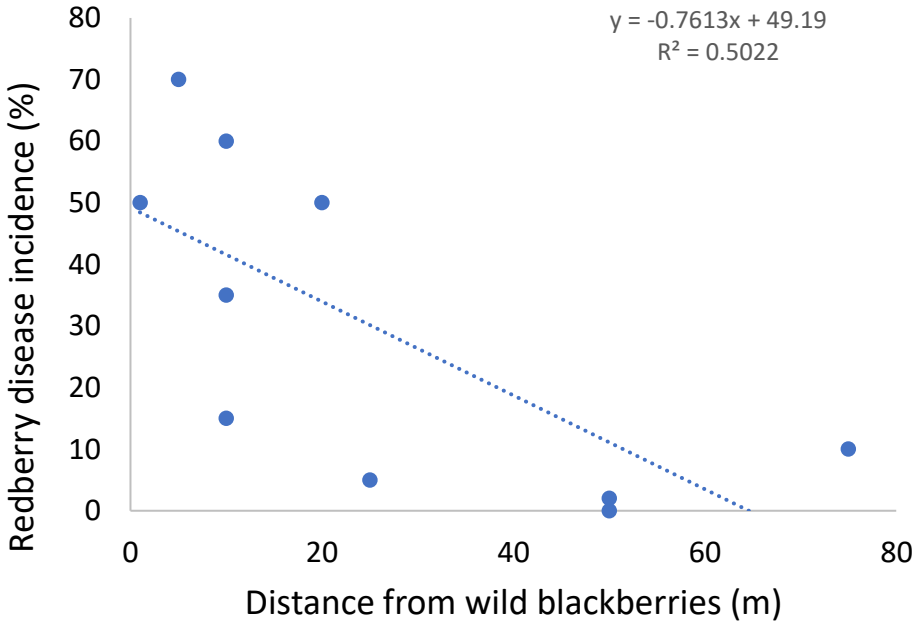


Figure 1. Percent of redberry mite emergence from vegetative buds and fruit from 'Ouachita' and 'PrimeArk® 45'. 'Ouachita' sampling began in September 2014, 'PrimeArk® 45' sampling began in October. Sampling was suspended in December when 'Ouachita' was taken out of production.

From Murrietta and Gaskell (2016)

Hygiene & Wild Blackberries

- All growers reported the removal and burning on pruned canes
- 75 % of growers reported having blackberries on or near their farms
- Crops with wild blackberries > 80 m away appear to show no signs of damage
- Reducing wild blackberries on-farm maybe an easy way to reduce pest pressure!



Biological control

- You are probably currently using:
  - *Californicus* and *Persimilis* for two-spotted mite
  - *Neoseiulus cucumeris* for broad mite and western flower thrip

- No known predator for RBM
  - 2018/19 season
    - Occi and Lailae
  - 2019/20 season
    - Lailae and Doreen

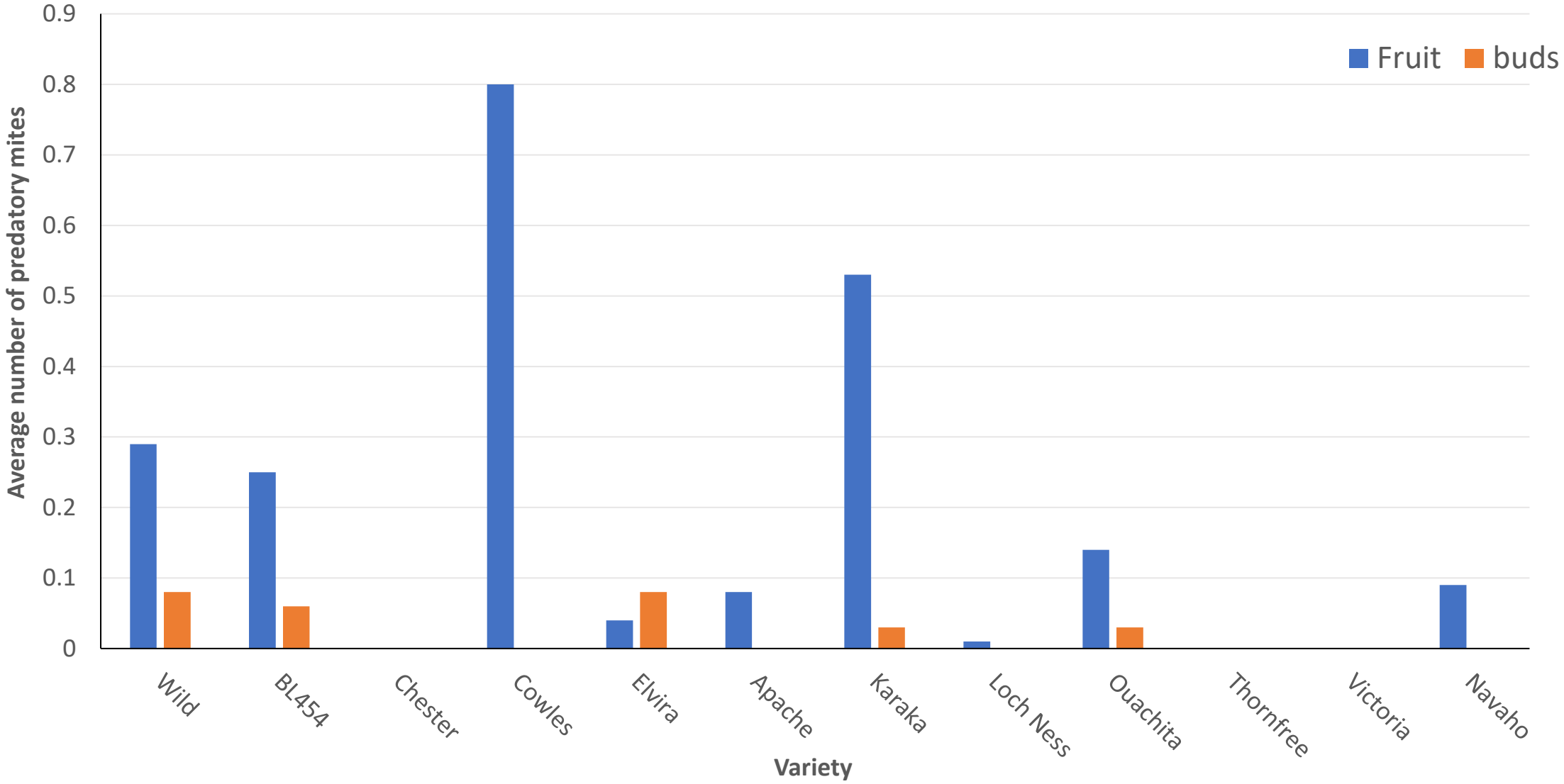
Biological control of RBM

- There are currently no known biological controls for RBM

- Commercially available species assessed:
  - *Thyphlodromus occidentalis* (2018/19)
  - *Typhlodromalus lailae* (2018/19 & 2019/20)
  - *Thyphlodromus doreenae* (2019/20)

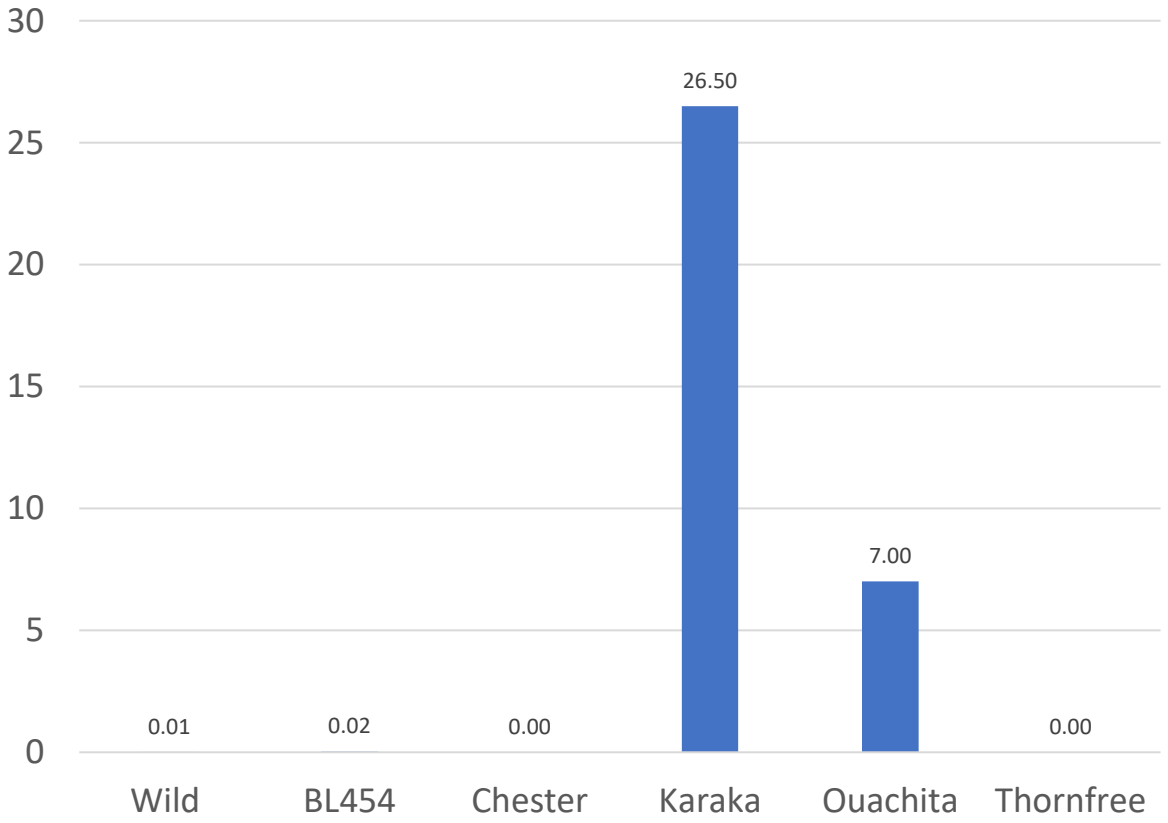
- Druciarek et al. (2018) propose that *californicus* may help control RBM???

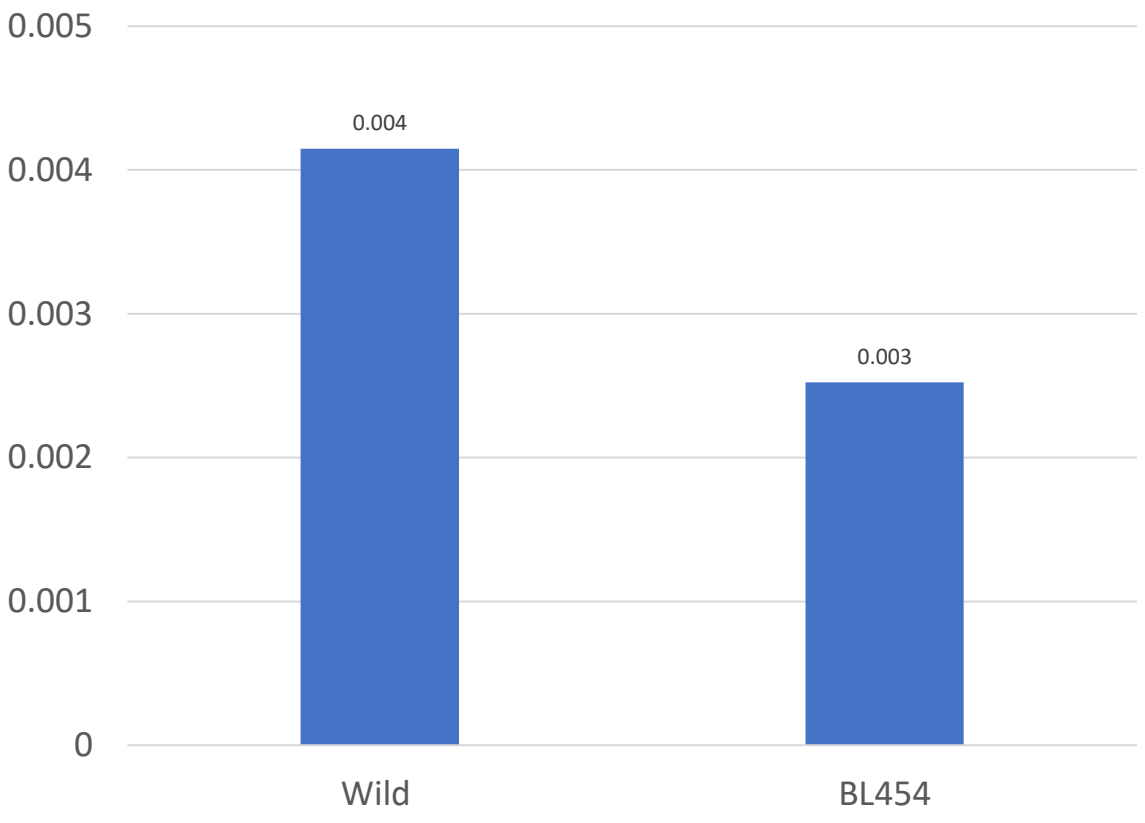
Beneficial species in blackberry buds and fruit



Ratio of RBM to Predators

- Recommended ratio for broad mite control > 0.1 (Johnson and Garcia 2015)
- No ratio for RBM

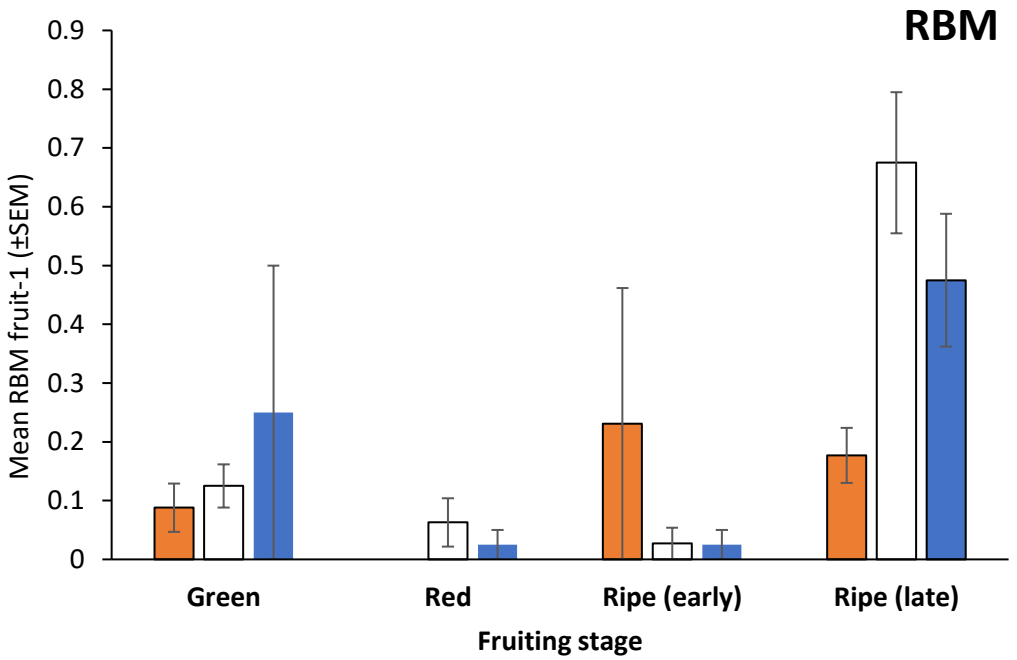


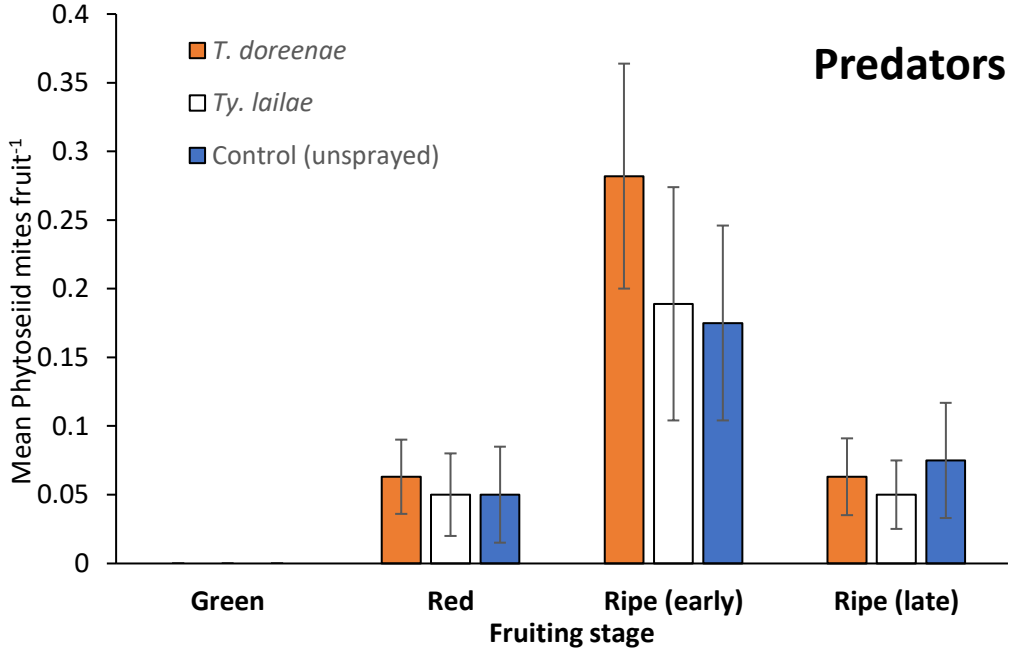


http://www.smallfruits.org/assets/documents/reaserch/2015/2015-06.pdf

Biological control of RBM *cont…*

- Neither occi or lailae seen on fruit so far
- Lailae and occi rows also had higher RBM
- But ‘Doreen’ looks promising!
  - Ratio nearly 1:1 (0.194 : 0.136)
- Another species (*T. dossei*) being isolated from Victorian fruit
- Tasmanian samples yet to be identified





Chemical management strategies

- Applications of pesticides that are highly toxic to predators have the most devastating effect on biological control of mites.
- Can take several months for predator populations to build up again after the pesticide application
- So **any** pesticide applications should be consider and potential negative effects
- Two windows have been highlighted for successful RBM control:
    - End of winter
    - From bud formation to first flowering

Chemical management *cont…*

- All but 1 grower used a fungicide program throughout the growing season, primarily aimed at *Botrytis*.
- The most frequently used fungicides included:
  - mancozeb
  - captan
  - pyrimethanil (Scala)
  - boscalid + pyraclostrobin (Pristine)
  - chlorothalonil (Bravo)
  - fenhexamid (Teldor)
  - azoxystrobin (Amistar)
  - cyprodinil (Switch)

Fungicide toxicity and RBM

- Although there are obvious insect issues in blackberry, fungal control may the key to reducing RBM
- Mancozeb known to be highly toxic to predatory mites (Bernard et al. 2004)
- Sulphur (Kumulus) known to be less toxic (Thompson 2012)
- Impacts vary between species and products
  - Cucumerus susceptible to OPs
  - Occidentalis tolerates OPs and resistant to azinphos-methyl

Bernard et al. (2004) https://doi.org/10.1093/jee/97.3.891
Thompson (2012) http://www.mvwi.com.au/items/511/2012-05-FS-Pesticide-Impacts2.pdf

NZ Boysenberry Program

- The application of sulphur (Kumulus) or lime sulphur 2 to 3 times from early September to the end of October.
- Kumulus IMF (800 g/kg S) is applied at varying rates and water rates with the most common being 450 g/100 L in 600 l/Ha of water.
- Lime Sulphur (200 g/L S) applied at 5 L/Ha in a water rate of 600 to 650 L/Ha.

RBM chemical control – other recommendations

- Cross et al. (2012) (East Malling) - recommended 2 abamectin applications at 5% flower and again 2 weeks later
  - Achieved good mite control with abamectin but still observed damage - other causes???
  - Didn’t assess the impact of earlier applications

- Colleagues went on to examine whether viruses could be responsible
  - Found several viruses but none are mite transmitted

Other chemical recommendations *cont…*

- UC IPM Extension: lime sulphur application depends upon variety and RBM severity.
  - *For blackberry varieties that retain a leaf through winter,* begin lime sulphur applications at bud break and continue at 3-week intervals up to 12 days before harvest.
  - *For blackberry varieties that naturally defoliate over the winter,* apply lime sulphur at bud swell (80 lt/1000) and again at first bloom (25 lt/1000)
- Lime sulphur: more toxic to apple rust mite than to Occidentalis
- No permit for Lime Sulphur on Rubus in Aust. Wettable S?

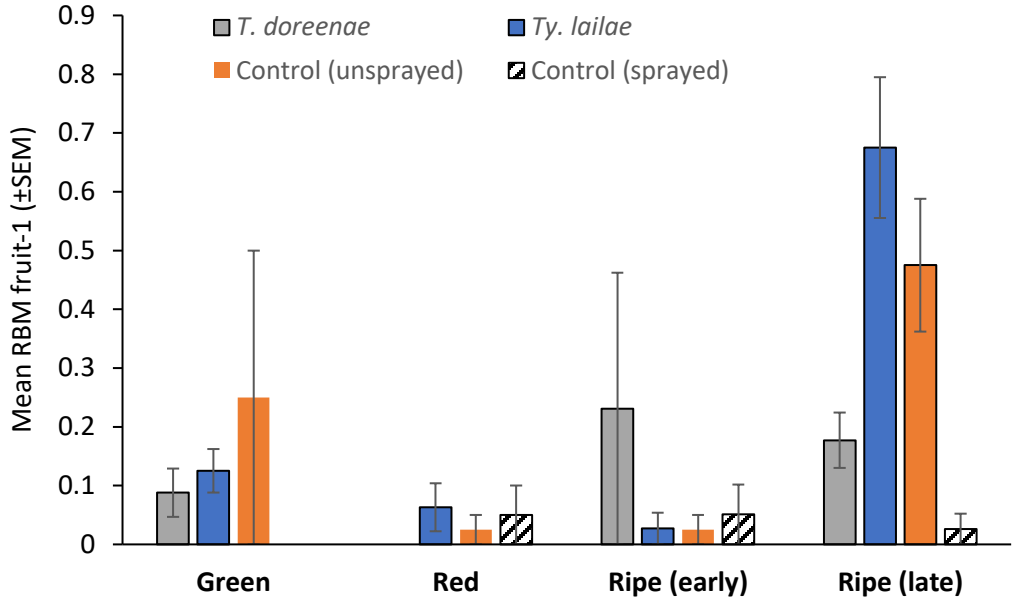
Spray reduction Trial 2019/20

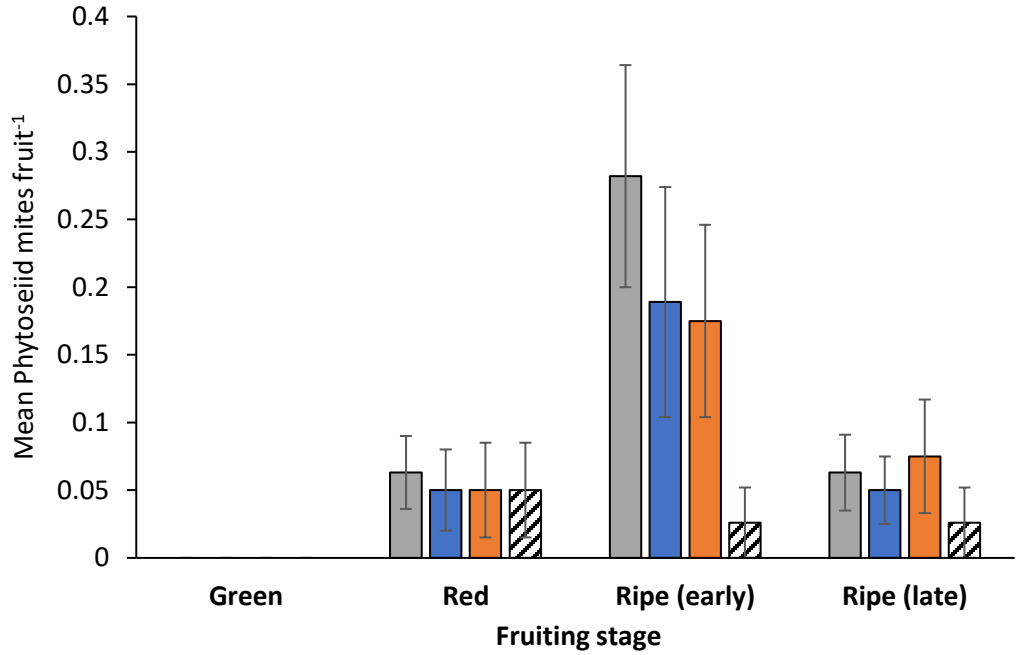
- Conducted at Costa's (Bengeo Rd)
- Full program versus no mancozeb or Abermectin at 10 % bloom
- Predatory mites released in rows with mod. program

Results

- Best control with full program
  - Lowest RBM
  - But predator numbers heavily impacted
- Doreen 2nd

No difference in damage between treatments!!!



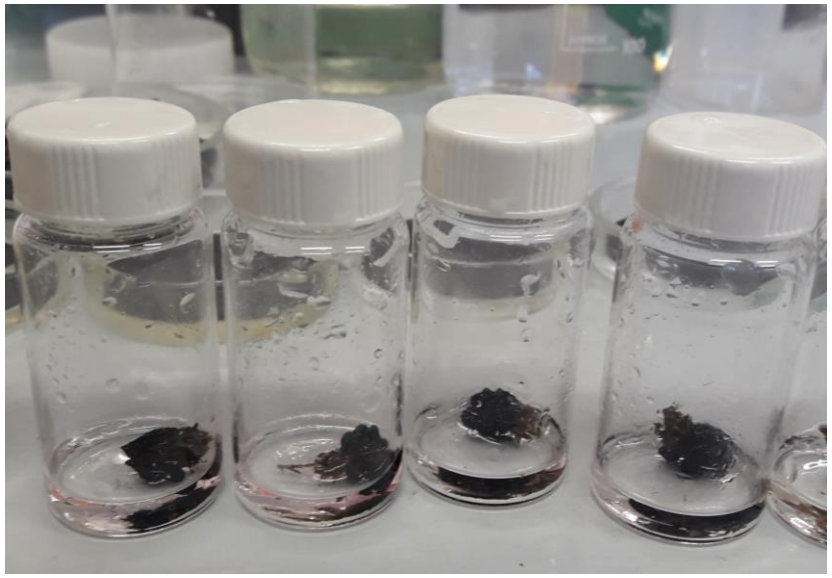


Mite extraction

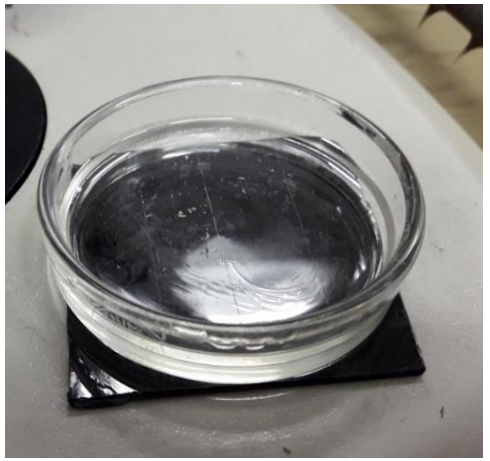
New extraction method

‘Shake and wash’ method

- 20 fruit per block recommended with calyx
  - We do 40 to make sure
- Vial containing 2 ml of either:
  - 70% ethanol
  - methylated spirits (metho)
  - dilute bleach & water
  - detergent & water
- Shake for 1 minute.
- Liquid poured on a petri dish with black car underneath for better visual contrast
- Count and/or ID the mites (20x magnification dissecting microscope).



Individual dried fruit in a cap vial containing 2ml ethanol

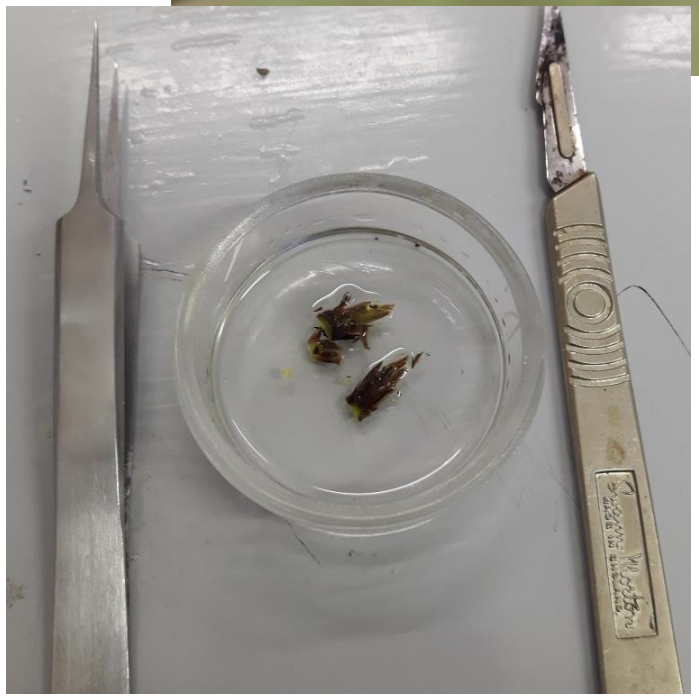


Petri dish with a gridded black Perspex card underneath

Bud sampling

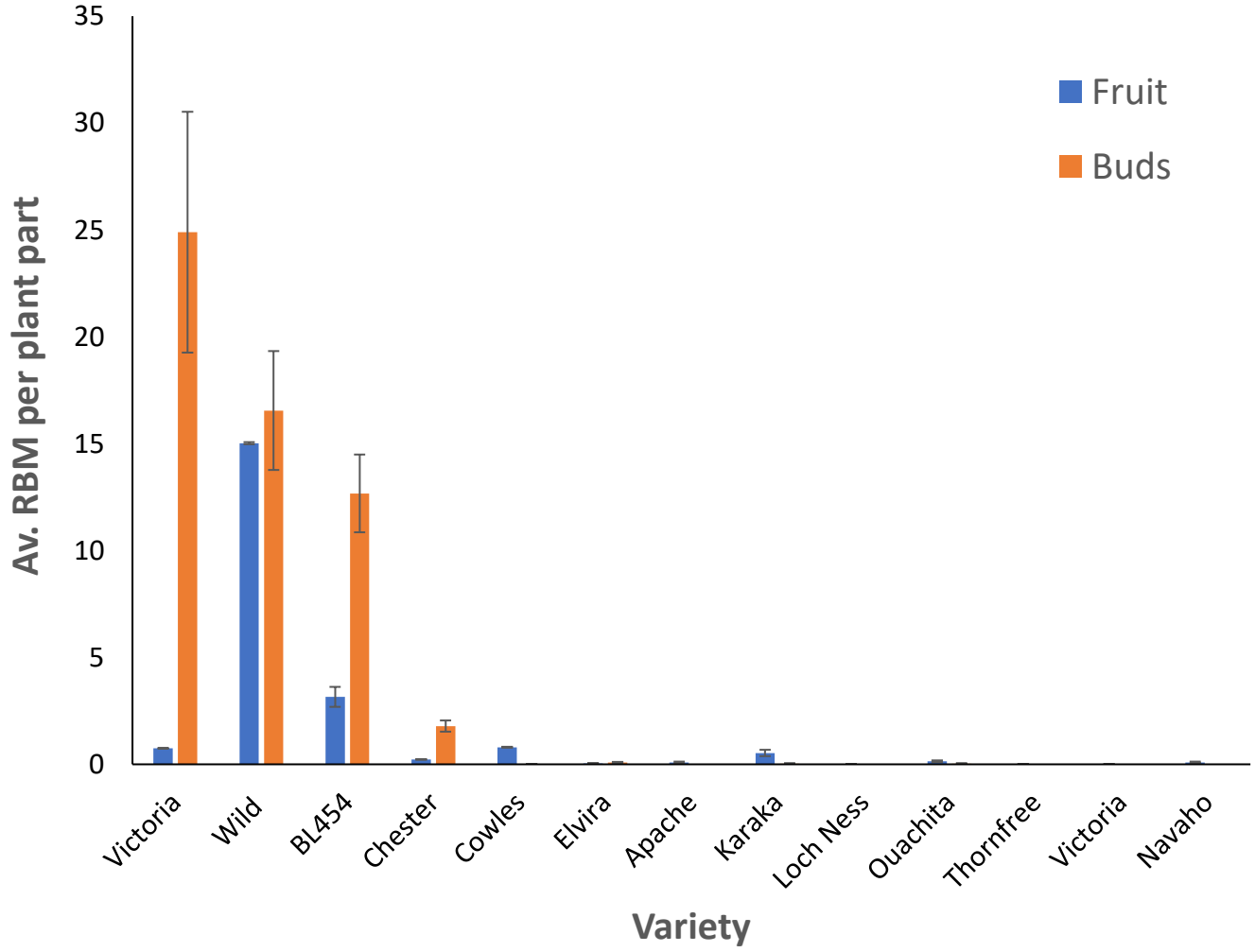
Why?

- RBM mite dispersed throughout the canopy
- Performed out of season (predictive)
- Enables early development of management strategies
- Buds dissected and then washed/agitated in ethanol or…. as per fruit
- Minimum of 7 buds per block recommended
    - We do 20 to make sure

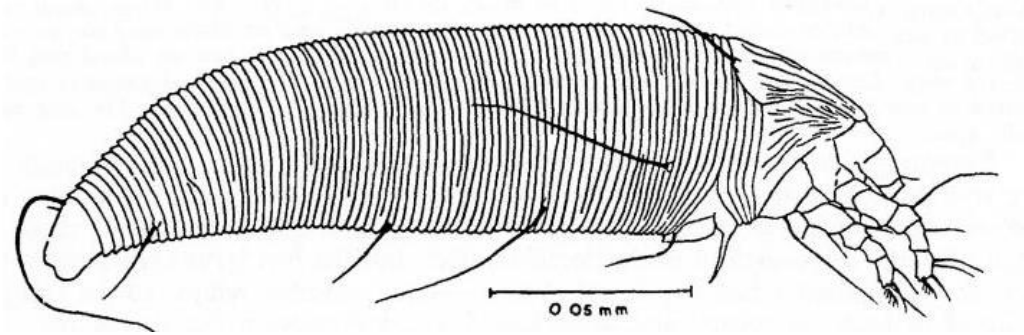


Fruit versus Bud sampling

- Far greater chance of detecting RBM in buds
- Probability of **50%** detection of RBM, **winter bud sample size needed is 7**
- Probability of 50% and 80% detection for predatory mite are **15 and 57 winter buds respectively**

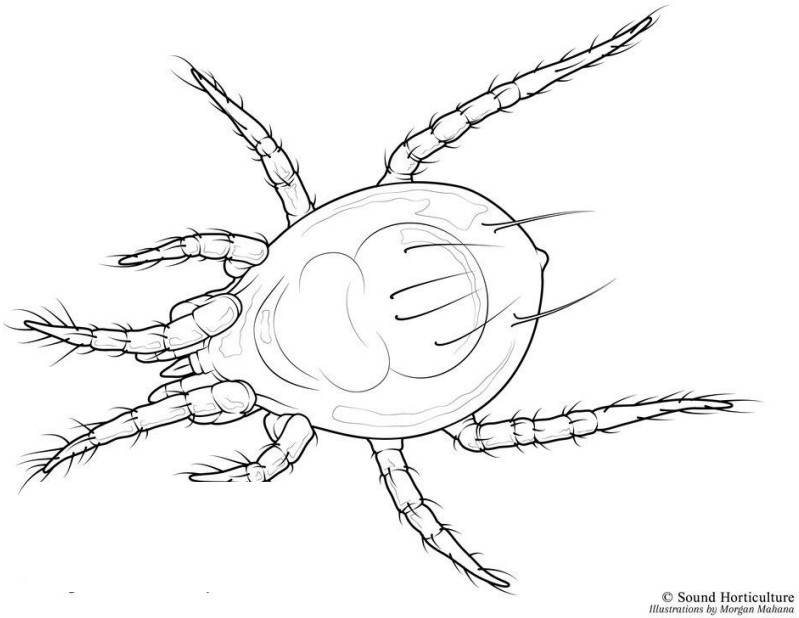


What mite is that?



Eriophyid mites

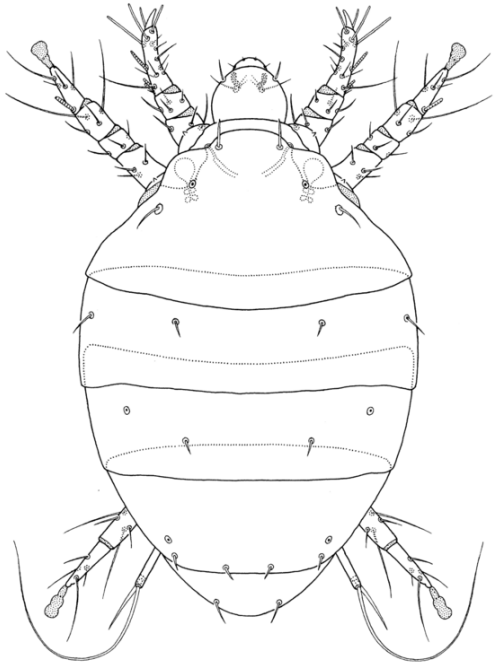
- Pests (RBM…)
- Long, worm-like
- Legs at one end



Phtyoseiid mites

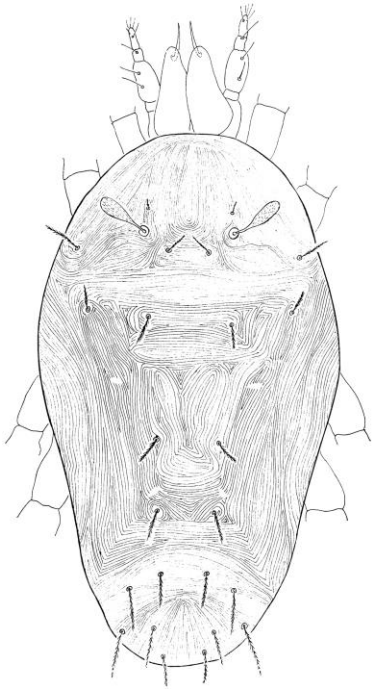
- Predatory
- Rounded body
- Enlarged mouth parts

What mite is that?



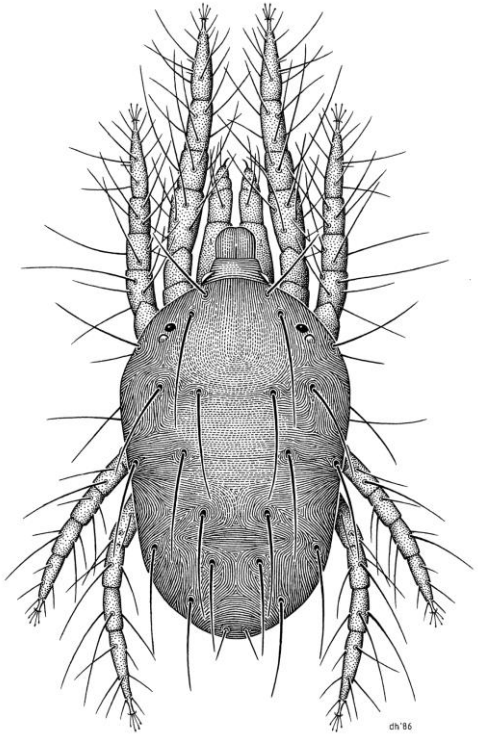
Tarsonemid mites

- Broad mites
- Round, hairy
- Small mouth parts



Tydeid mites

- Predators, fungivores…
- Oval shaped



Tetranychid mites

- TSM…
- Larger, spherical
- Large stylets (mouth parts)
- Web spinning