# Cherry fruit set – what do we know and what can we do about it?

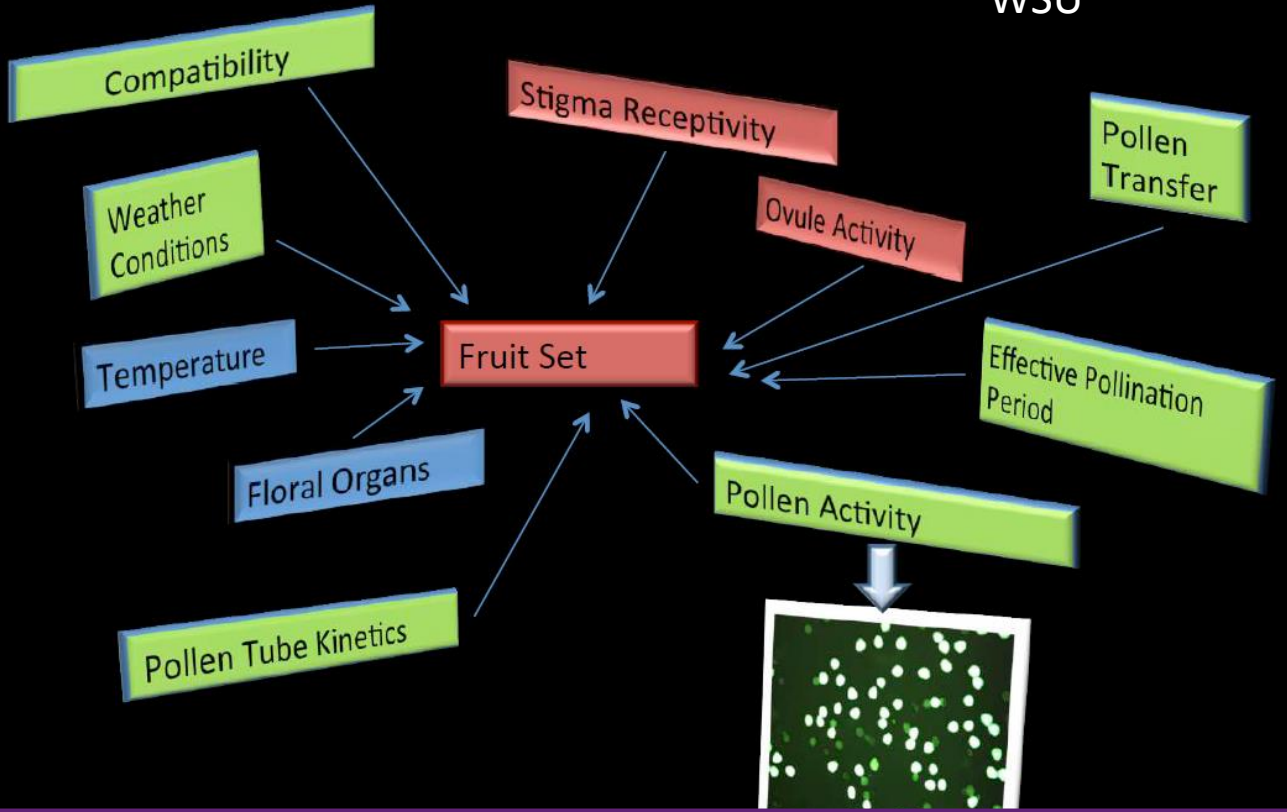
**Dugald Close**

Matt Whiting (and WSU team), Jo Jones, Sally Bound

TIA is a joint venture of the University of Tasmania and the Tasmanian Government

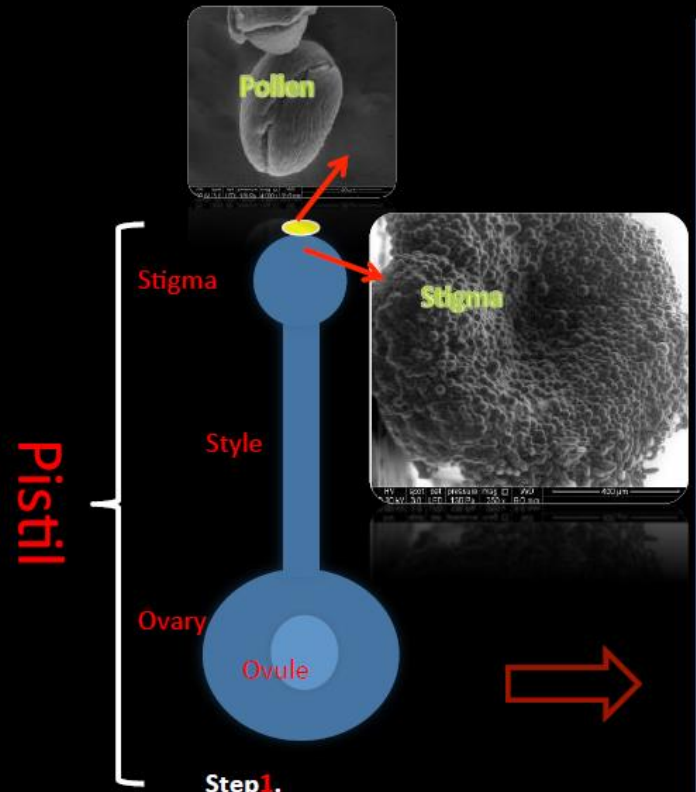
# Factors Influence Fruit Set

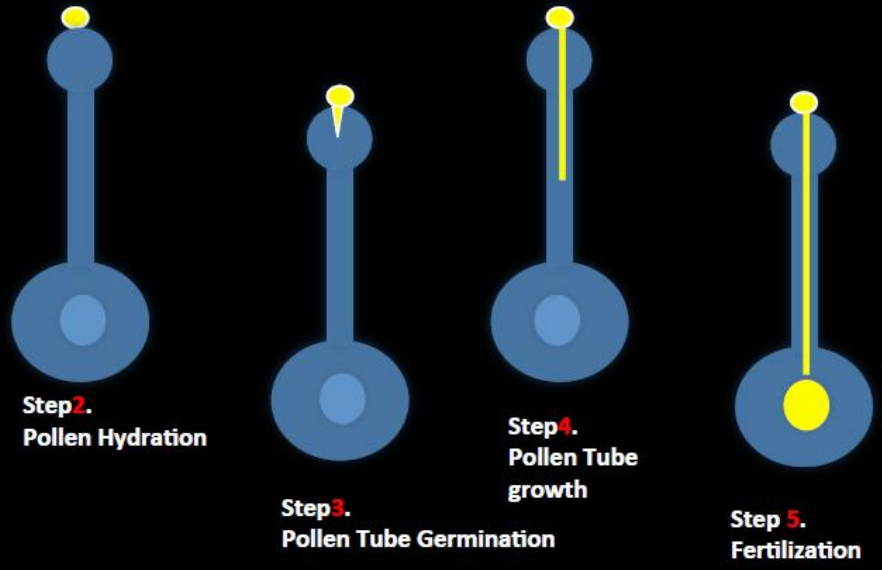
Thanks to A/Prof Matt Whiting of WSU



# Stigma Receptivity & Ovule Activity

Thanks to A/Prof Matt Whiting of WSU



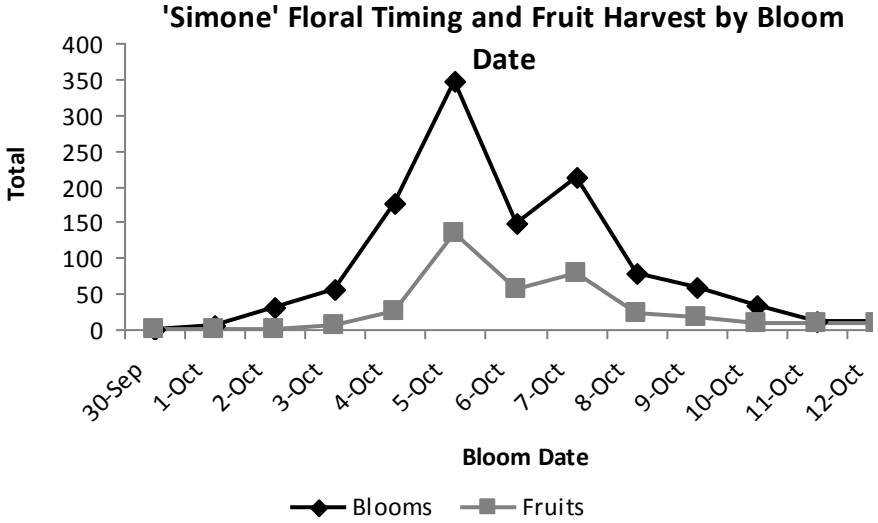



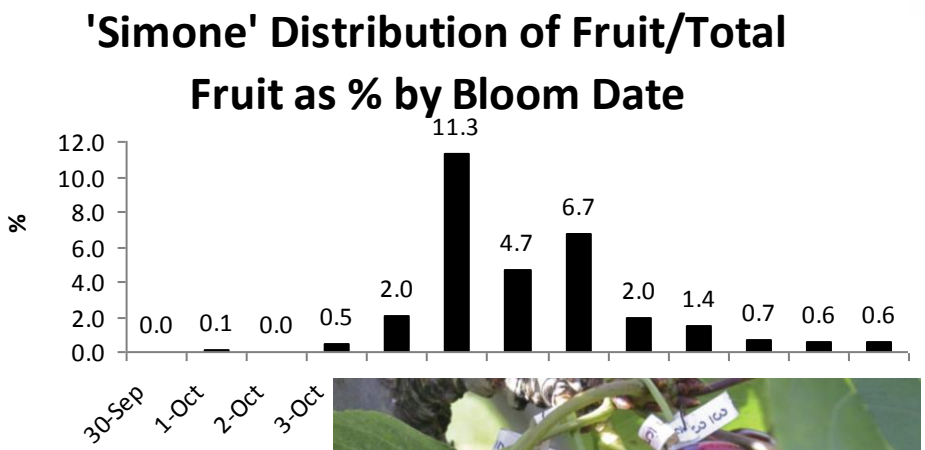
# Pollen Compatability and Availability

Granger 1997, 2004

- Pollinisers reached full bloom (3-7days) before the other cultivars as pollen dispersal occurs after flowers open,
- Pollen needs to be available just as Kordia etc flowers open (when stigma most receptive)
- Majority of pollinisers were within 20m (but not necessarily closest ‘pollinisers’) of trees setting fruit
- Strong impact of mesoclimate on bloom dates eg. Crystal Creek 3-7 days behind Yark – winter chill and heat unit differences
- Pollen does not come in from outside bird netted areas

# Flower timing – stigma receptivity and ovule longevity



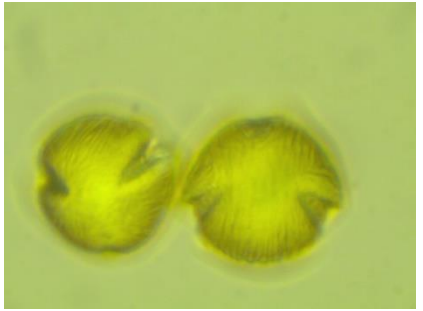

- Key points – 3-4 day window only!
- And similarity in timing between varieties (Van and Sweetheart) and sites

# Floral biology project

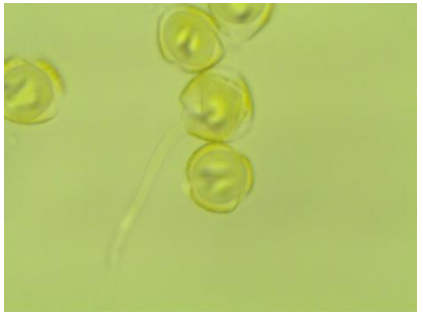
- 2014/15 season
- No CHO limitation impacting on shedding in Kordia or Regina prompted floral biology study
- *In vitro* investigations
  - Pollen viability
  - Pollen germination
  - Presence of pollen on stigma
  - Stigma receptivity

# Results

- Pollen grains healthy
- In some orchards, bloom synchronisation between compatible pollinator cultivars was not ideal



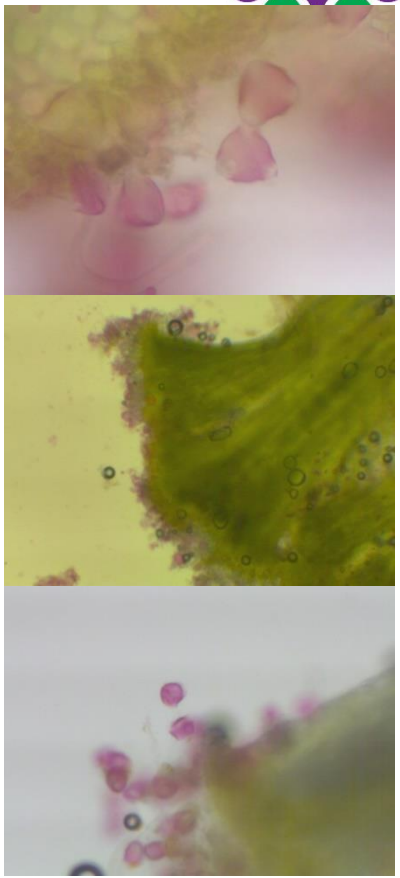
Kordia pollen grains



Sylvia pollen tubes

# Rain negatively impacts pollen

- Pollen dispersal and germination appeared to be negatively impacted by rain events
- Possible that stigma receptivity also negatively impacted by rain events
- No published research on rain and pollen health or stigma receptivity



- In Midwestern US 2013 rainfall corresponded to fine pollen particles attributed to osmotic rupture of pollen grains (Rathnayake et al Atmospheric Chemistry and Physics 2017)

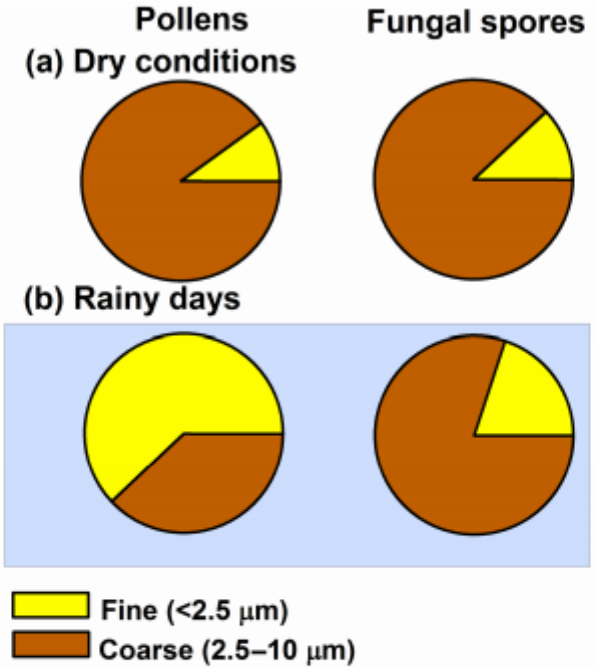


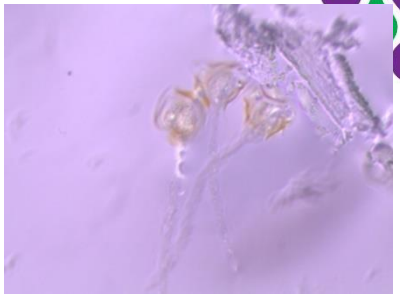

**Figure 6.** Distribution of pollen and fungal spore mass (apportioned by the CMB model) across fine and coarse PM during dry and rainy conditions. The fine- and coarse-mode distributions of pollens and fungal spores shifted towards fine particles during rain, with a more pronounced effect for pollens compared to fungal spores.

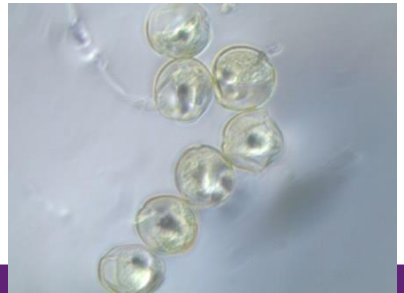
# Temperature and light effects – note these data are for Pinot noir

| | Outside | 20-25˚ C glasshouse | 30-35˚ C glasshouse | Shade house |
|---|---|---|---|---|
| **Stigma Receptivity** | No affect | No affect | No affect | No affect |
| **Pollen Viability (%)** | 62 | 59 | 51 | 47 |
| **Pollen tube length (µm)** | 800 | 720 | 100 | 50 |
| **Fruit set (%)** | 84.8 | 67.8 | 48.3 | 41.7 |

**Table 1**: Stigma receptivity, pollen viability, pollen tube length and percent fruit set for potted Pinot Noir grapevines under varying environmental conditions.

- Lapins had high pollen germination percentages and very long tubes when grown in nutrient liquid agar
- Regina and Sylvia pollen tubes were long (top and centre images), except at one site which was impacted by rain events throughout bloom (bottom image)





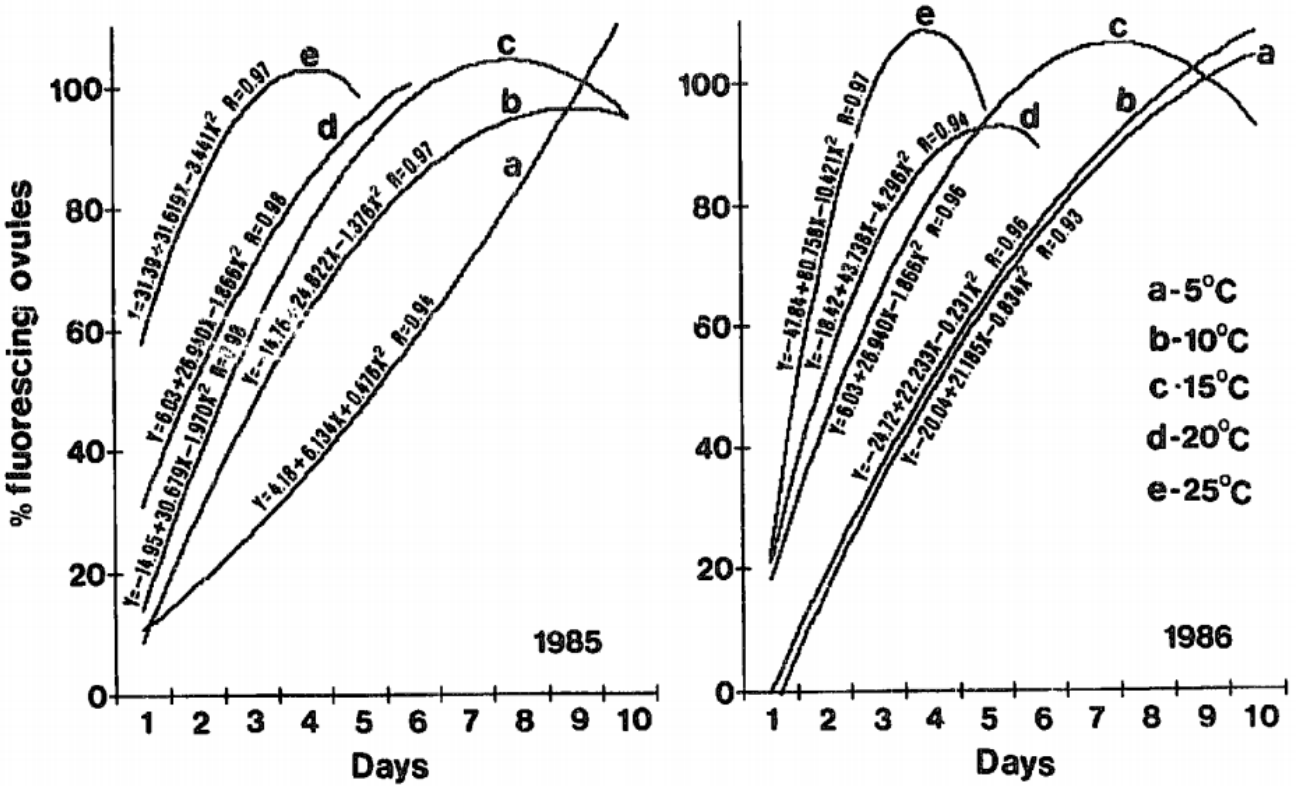
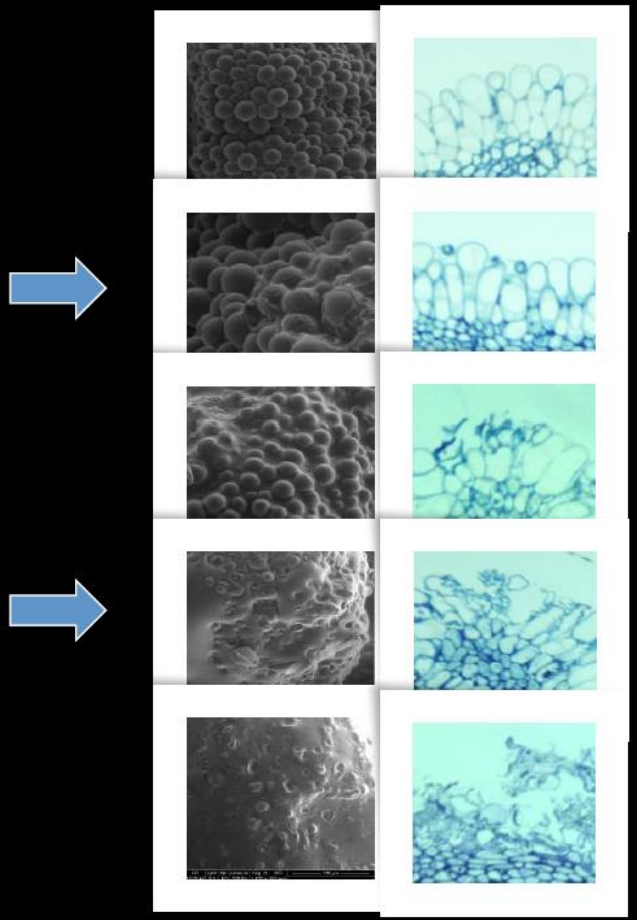



Fig. 1. Relationship between percent fluorescing ovules in 'Čačanski Rubin' and days after anthesis at different temperatures in 1985 (left) and 1986 (right). All $R$ (multiple correlation coefficient) values are significant at $P<0.01$.

- Cerovic and Ruzic Sci Hort 1992

# The Development of Stigma Surface



1 day

2 day

3 day

4 day

5 days

Days After Opening

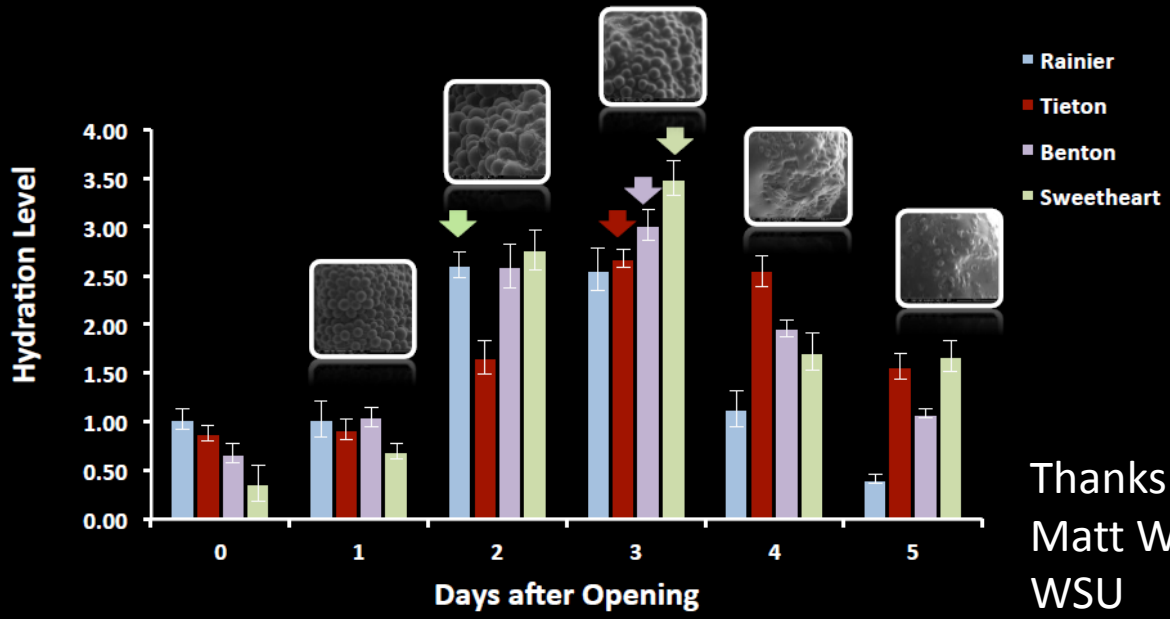
Thanks to A/Prof Matt Whiting of WSU

***Results***

No differences among genotypes

# Pollen Hydration

- Flowers pollinated at 1-day intervals post-anthesis
- Pollen collected from stigma 20 mins post-pollination



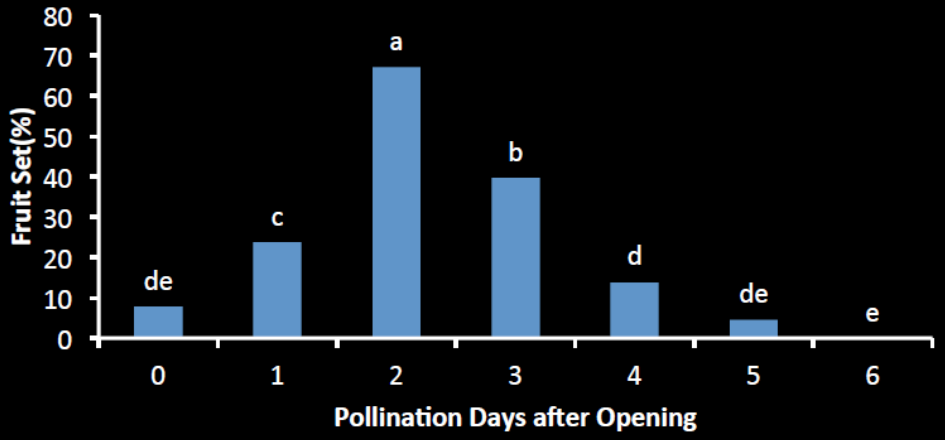

Thanks to A/Prof Matt Whiting of WSU

***Results***

No differences among genotypes

# Fruit Set

- Hand pollinations in field at 1-day intervals
- Fruit set assessed at harvest




Thanks to A/Prof Matt Whiting of WSU

*Results*

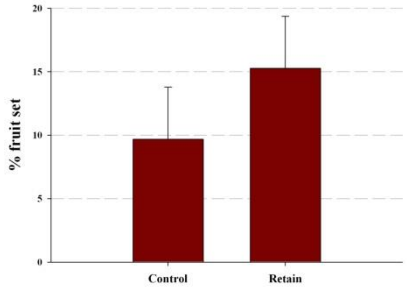
- Maximum fruit set when pollinated 2 days after anthesis

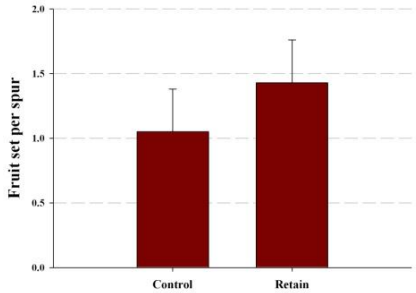
# ReTain® (AVG) – anti-ethylene plant growth regulator

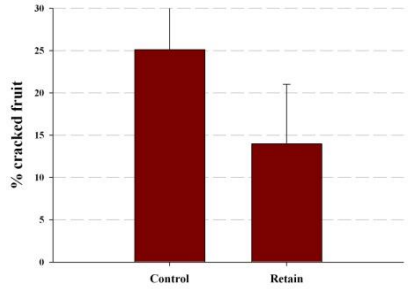
**Fruit set – 2011/12**

2011/12 season (Kordia):

**Treatments**:
1. untreated control
2. 4g Retain / 5L water @ 30% bloom (500g/ha)
3. 4g Retain / 5L water @ 80% bloom
4. 4g Retain / 5L water @ 30% & 80% bloom
5. 6g Retain / 5L water @ 30% bloom
6. 6g Retain / 5L water @ 80% bloom
7. 6g Retain / 5L water @ 30% & 80% bloom



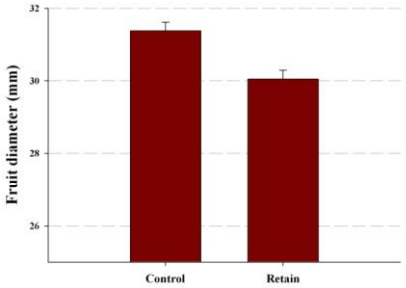




Higher fruit set, higher fruit set per spur (and less cracked fruit)!

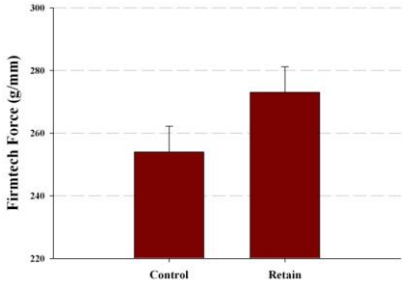
## Fruit set

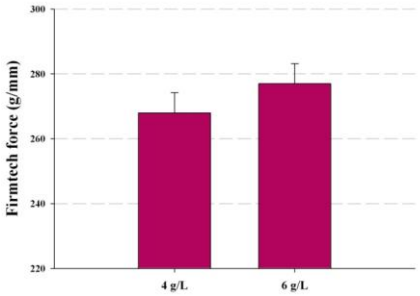
ii. Can we manipulate fruit set with PGRs?

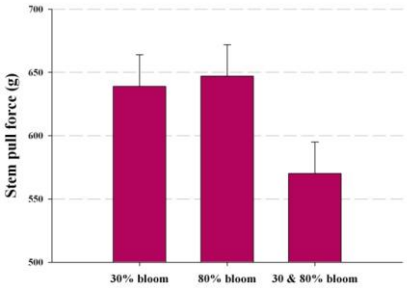
Yes but there are impacts on fruit quality associated with higher crop loads




- Higher set comes with smaller fruit



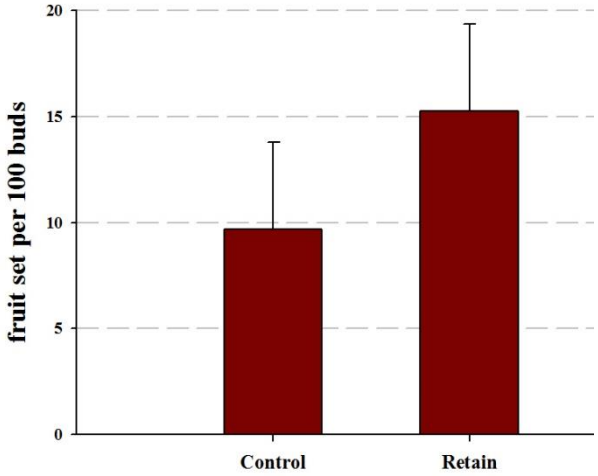



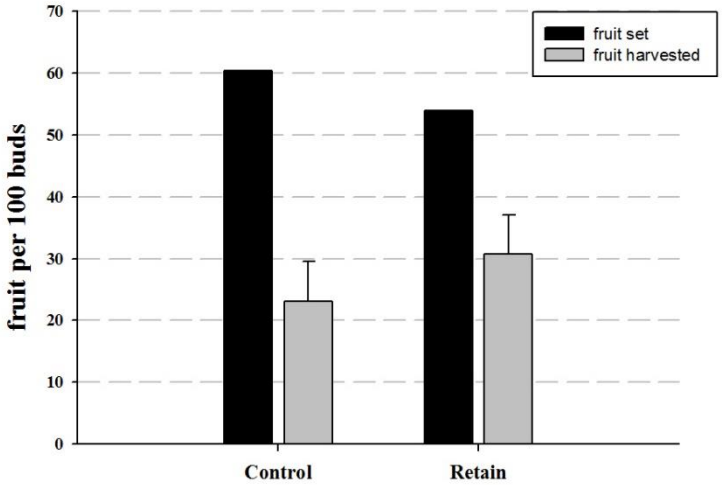

- Firmness greater with retain, with 6 g/L and stem pull force impacted by double application

# Results: Fruit set 2012/13

**Kordia** - 3 weeks before harvest




**Regina** - 10 weeks before harvest




No significant differences for

- Retain rate, or
- time of application (30% bloom, 80% bloom or 30 & 80% bloom

Interim summary

- No variety differences in time that flowers are open, stigma receptivity or pollen hydration
- Limiting factor compatable pollen availability when stigma and ovules receptive?
- Rain impacts on pollen availability and viability and/or stigma receptivity
- Temperature impacts on ovule longevity
- Retain indicates important role of ethylene in less stigma receptivity / ovule longevity

Bees and pollination

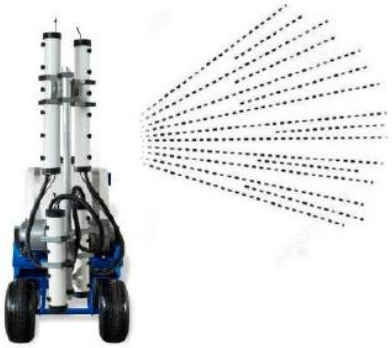
- Don’t like cool temperature, rain or wind
- Cost, availability, hive strength etc
- =RISK!!!

- (Bumble bees far more robust)

# Pollen application

## Spring 2014

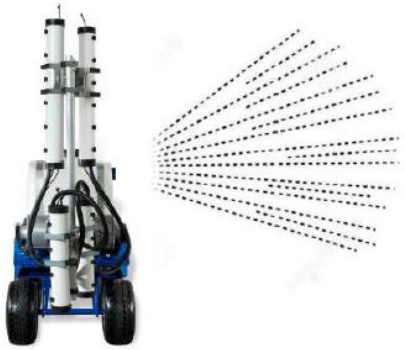
- Pollen
- Proprietary slurry



Viscous droplets

## Spring 2015

- Pollen
- WSU-developed slurry

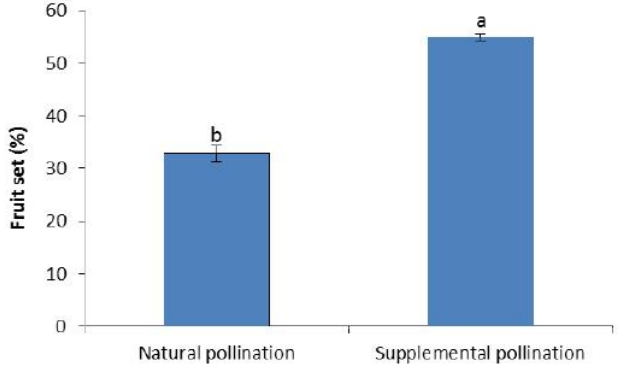


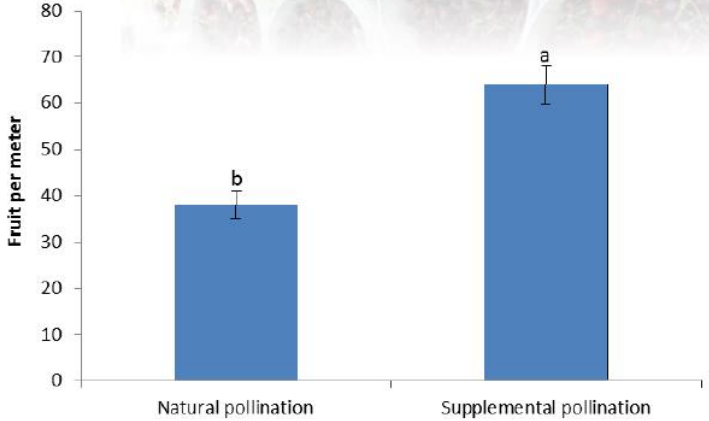
Non-viscous & fine droplets

Thanks to A/Prof Matt Whiting of WSU

# Results: Spring 2015

## Regina/Mazzard®

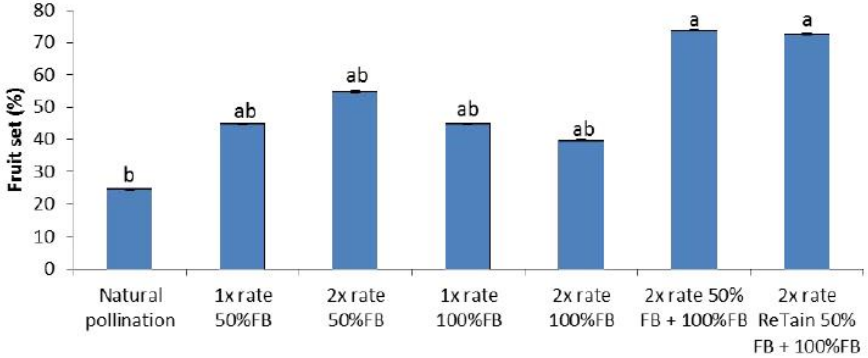


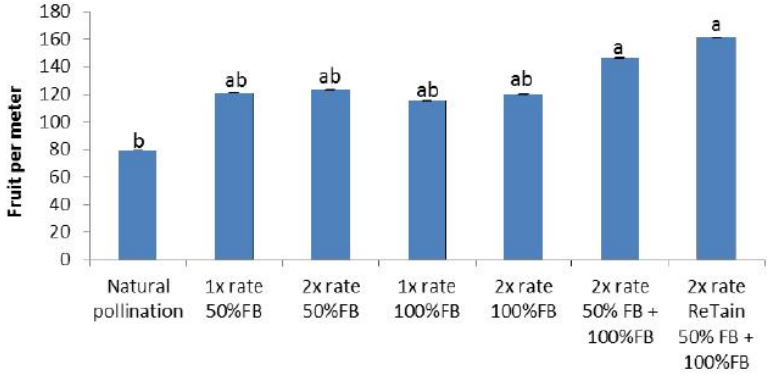




Thanks to A/Prof Matt Whiting of WSU

# Results: Spring 2015

## Early Robin/Gisela®12




Thanks to A/Prof Matt Whiting of WSU

# Nutrition and ‘flower quality’

- Different performance of flowers under identical environmental conditions – related to crop load
- Ovule viability correlated with N and B concentrations in flower tissues
- Autumn B application - increases pollen tube growth

# Conclusions

- Synchronisation of bloom time (i.e. 3-7 days before flowers open) of compatible cultivars is crucial
- Flowers are open and receptive for 4 days only
- Rain appears to have a negative impact on fertilisation. Bee activity, pollen dehiscence, pollen viability and stigma receptivity could all be involved.
- Temperature impacts: cool increases ovule longevity but decreases pollen tube growth and vice versa
- Temperature and light impacts on pollen tube growth of Pinot Noir
- Tree and flower B and N nutrition is important for flower health and pollen tube growth
- Matt Whiting's results indicate pollen availability is limiting in many rootstock/variety combinations – note dry, sunny growing environment
- Variability in fruit set = Rain? Temperature? On pollen and vectors? All factors depending on the site….
- (Precocious root stocks make fruit set impacts far less dramatic)

# Management considerations

- Pollen compatibility and availability: understanding flowering timing and growing systems that provide compatable pollen at the right time – use of dormex? Graft in pollinators?
- Use precocious rootstocks in new blocks – modern training systems?
- Pollen viability: do rain shelters prevent pollen explosion?!
- Pollination: healthy and abundant (3 per ha or 6+ per ha?) hives within netted areas
- Tree nutrition postharvest for adequate B and N

# Acknowledgements


- Thank you to Howard Hansen, Wayne Trengrove, Steve Chapman, Simon Rouget and Peter Morrison for discussions
- Optimising fruit set, crop load and fruit nutrition and size (Phase 1&2), CY10002 (flower timing, retain), CY12003 (floral biology) and the National Cherry development Program CY12023 (Matt Whiting presentation) projects were funded by Horticulture Innovation Australia Limited using the cherry levy with co-investment from TIA, Washington State University and funds from the Australian Government.