Cultivar Variation in Pollination Deficit in BC Cranberries

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2021 update

Pollination in Cranberry

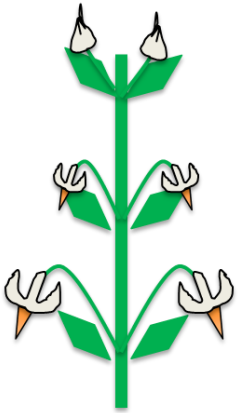
- Cranberry production relies on pollinators
  - typically honeybees
- Honeybees may be less attracted to cranberry flowers due to lack of nectar
- Cranberry flowers are buzz-pollinated – a behavior that honeybees do not do

Pollination in Cranberry

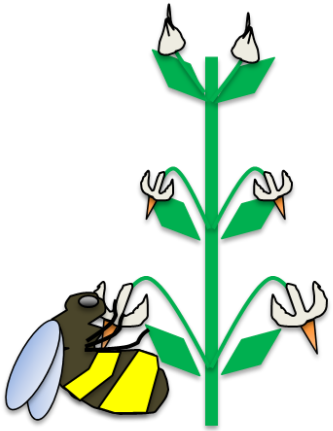
- Bumblebees buzz pollinate – potentially
- More efficient than honeybees in some crops
- i.e: In blueberry certain cultivars benefit from the presence of wild bees

Will increasing pollination matter?

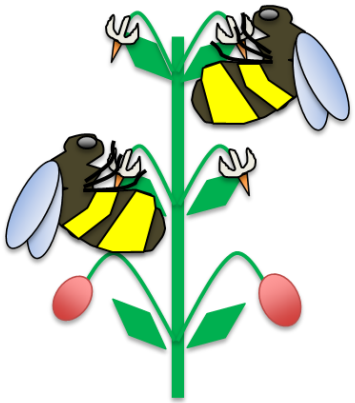
- Fruit set in cranberry is not known to be limited by pollination – extra fruit are aborted



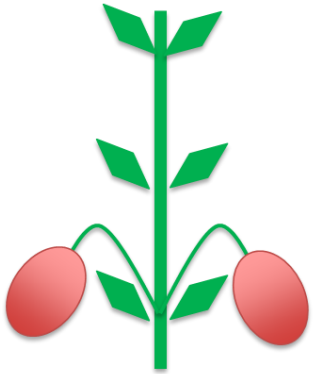
An upright might make 6 flowers



If bees pollinate the first two



And the rest…

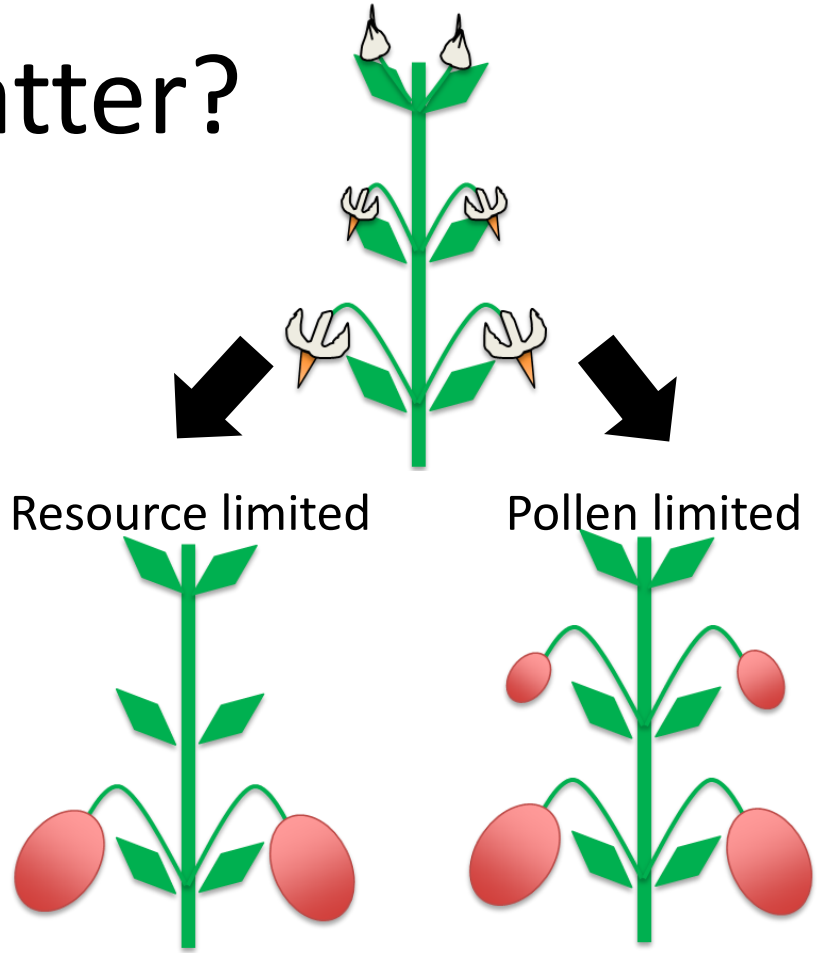


But plant only invests resources in the first two

Will pollination matter?

- However, studies of fruit abortion were done on one cultivars – Stevens

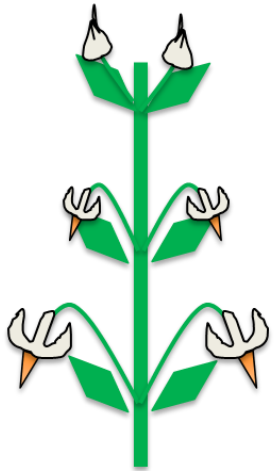
- Cultivars may vary in their respond to increased pollination

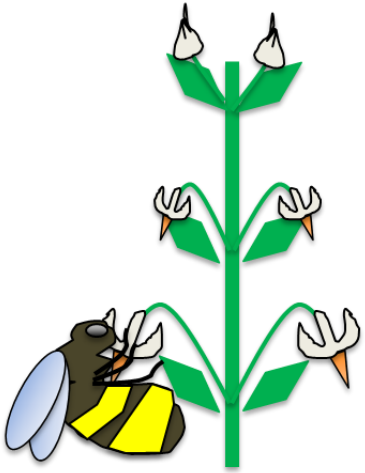


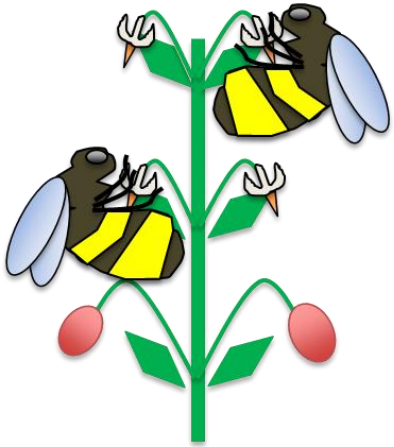
Will pollination matter?

- Different cultivars may also interact with pollinators in different ways

- i.e. Variation in flower number or nectar production







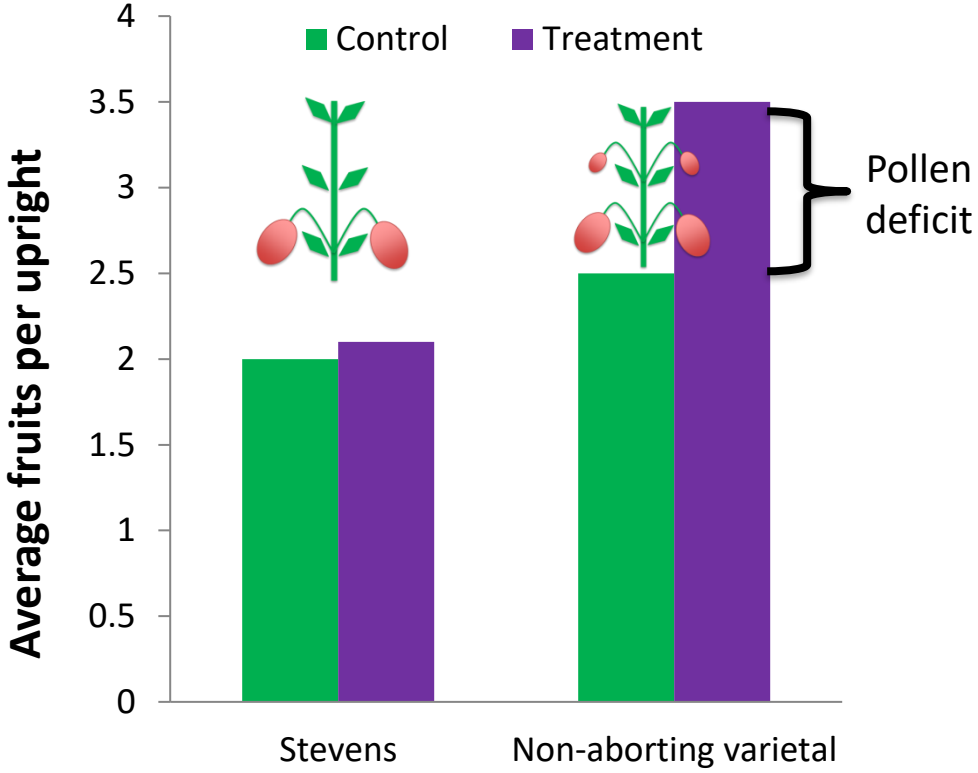
Study objectives

1. Measure cultivar variation in pollination deficit to determine which types might benefit from increased pollination.

2. Examine the role of honeybees vs. wild pollinators in mitigating this deficit across cultivars.

What is pollen deficit?

- The difference in fruit set between open pollinated and supplemented flowers
- Represents additional potential yield that could be achieved with more pollination



Methods: Field sites

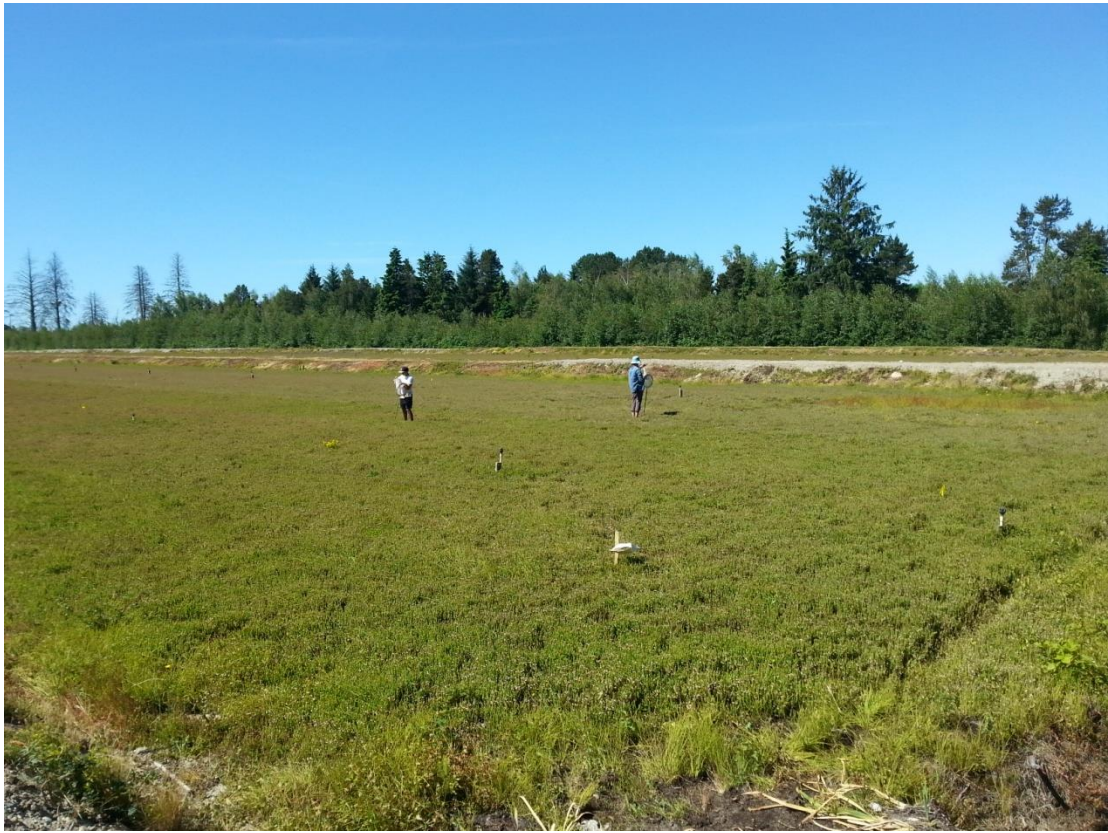
- **Cultivars:** Stevens, Demoranville, Mullica, Haines

Locations:

- Cranberry research station in Delta
- Commercial farm in Richmond, B.C.
- 2 Commercial farms in Chilliwack
  - No Demoranville

Methods: Quantifying pollinators

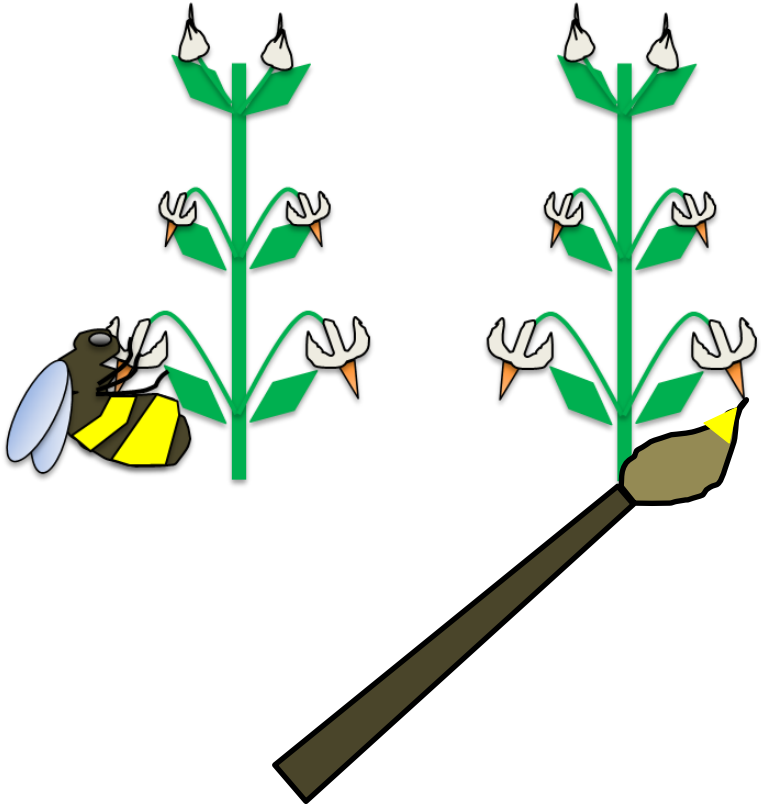
- Netted visiting pollinators for 2x 15 minutes per varietal at least 3 times during bloom.
- Honeybees were counted but not captured during collections.
- Estimated crop characteristics such as bloom density.



Methods: measuring pollen deficit

- Selected 50 pairs of cranberry uprights per varietal per farm
  - Reduced to 40 uprights in 2020

- Assigned to one of two treatments:
  - Controls: receive ambient pollen
  - Treatment: supplemental pollination added by hand



Methods: fruit data

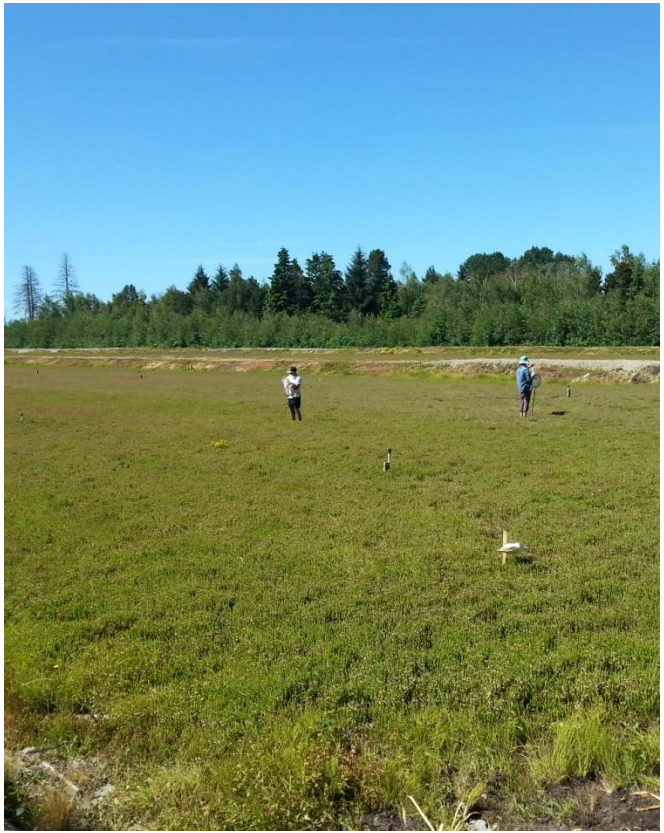
- Treatment and control uprights were collected prior to harvest

- For each upright:
  1. Counted the number of fruits
  2. Weighed each fruit
  3. Cut open the fruit and counted the seeds

Results: Data collected

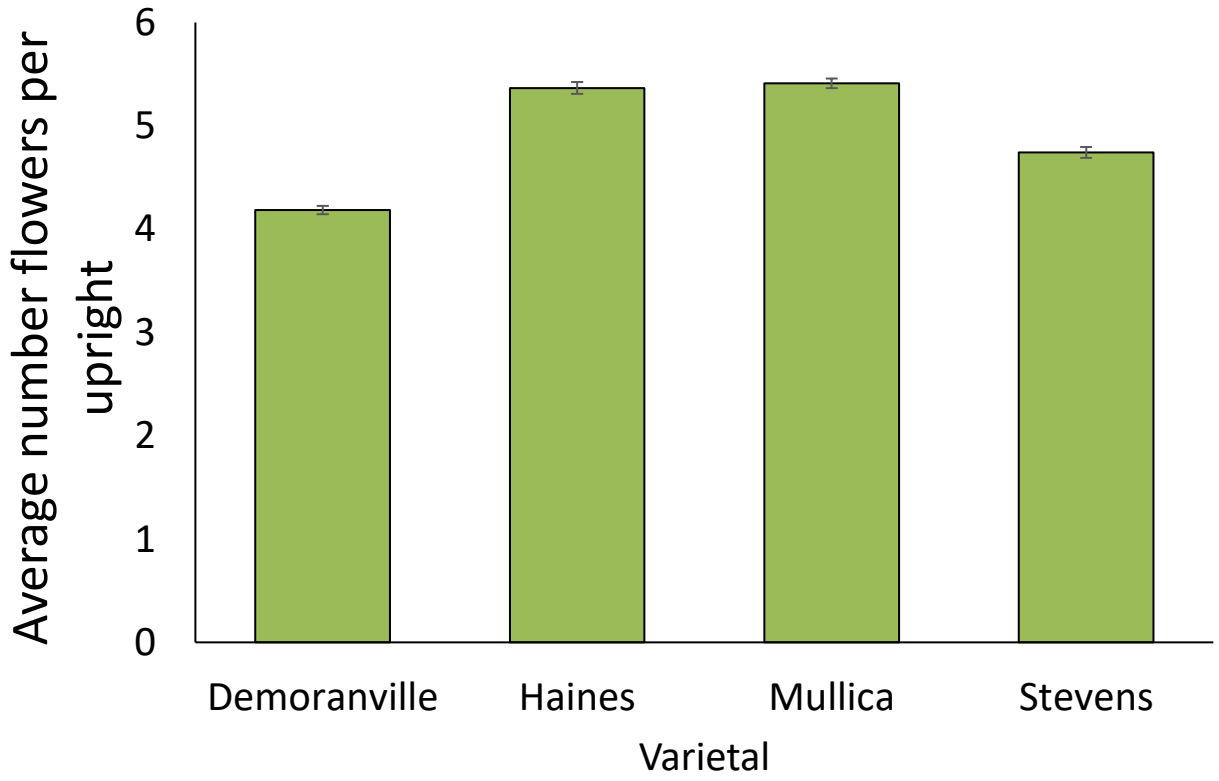
- Bees data collected 2-4 times per varietal:

- Hand pollinations:
  - Each varietal was pollinated at least six times in 2019
  - Between 4 and 6 times in 2019



Results: Flowers per stem

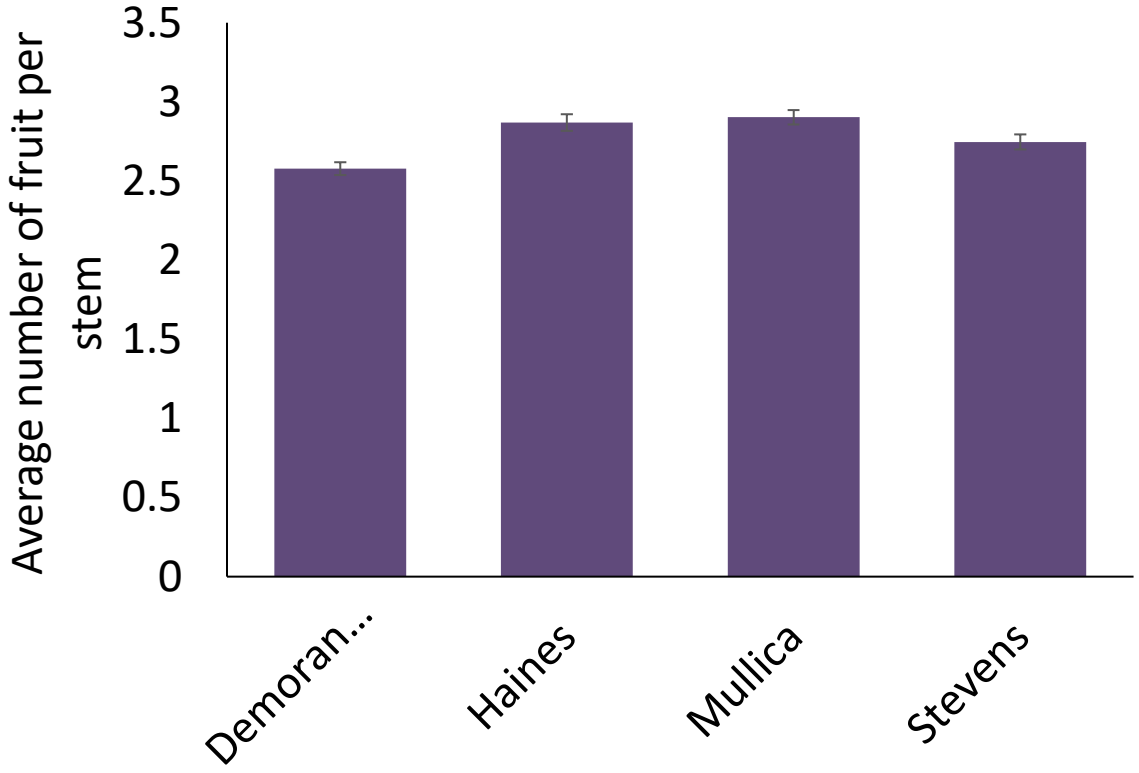
- Cultivars varied significantly in the number of flowers produced
- All varietals produced between 3 and 5 flowers per stem
  - Mullica produced the most
  - Demoranville the least



$p < 0.01$

Results: Fruits per stem

- Cultivars also varied significantly in the number of fruits set
- But the range was much lower
  - Between 2 and 3 fruits
- Mullica and Haines set the most, Demoranville the least
  - Note: This is fruit per upright. A higher density of uprights would mean equivalent fruit per area



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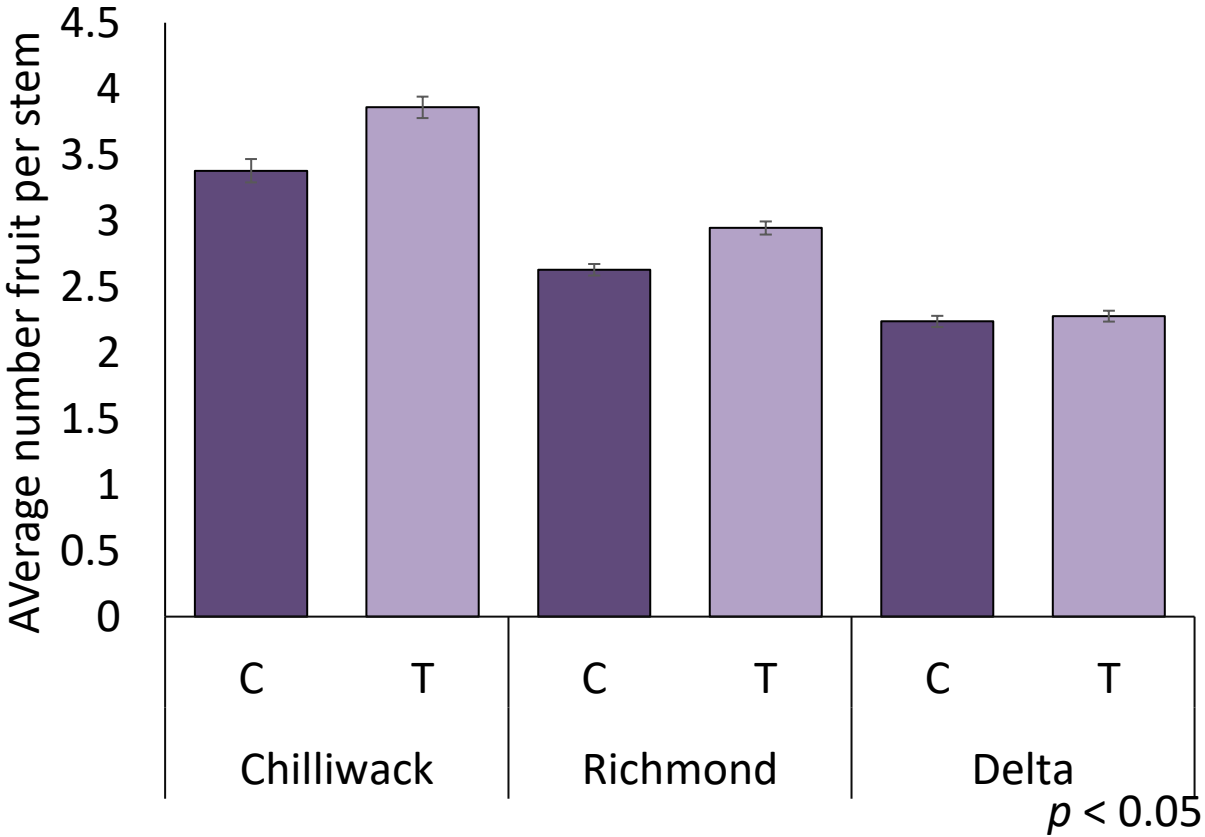
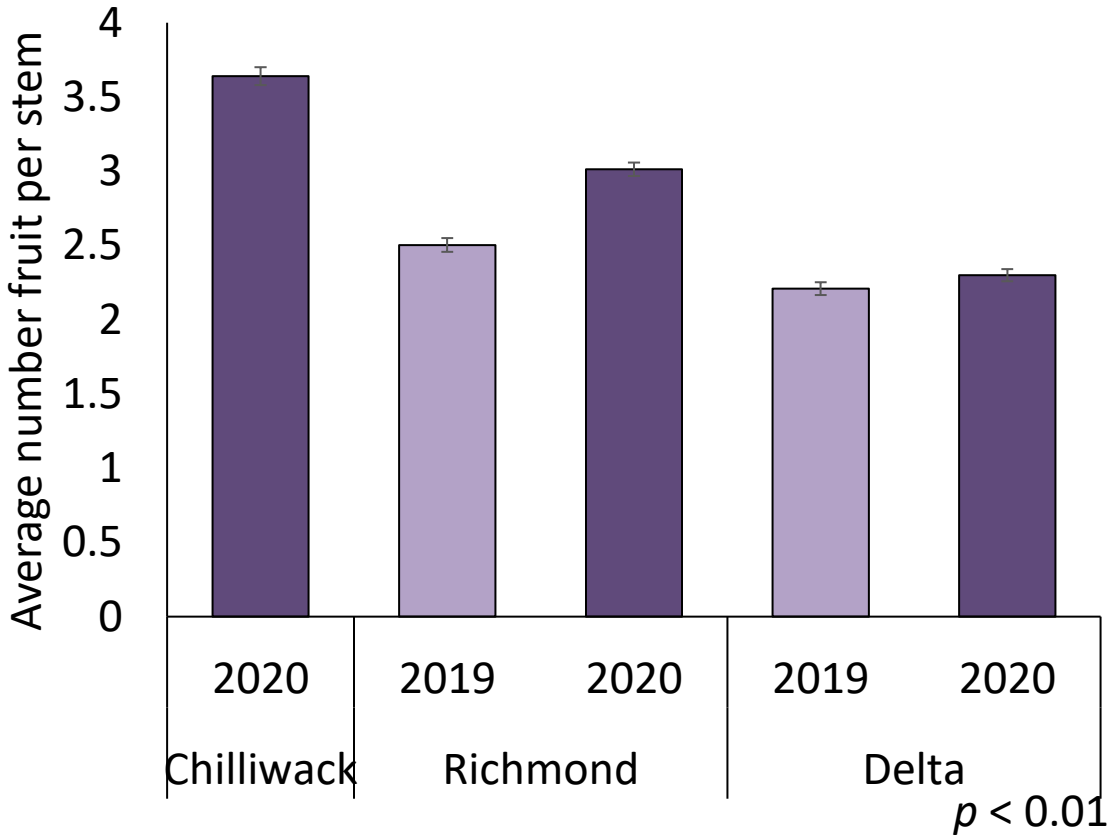
Results: Fruit per stem

- There was a significant site x treatment interaction affecting fruit number
- Treatments had higher fruit set across all cultivars
- But this pattern was weaker at the Delta field station



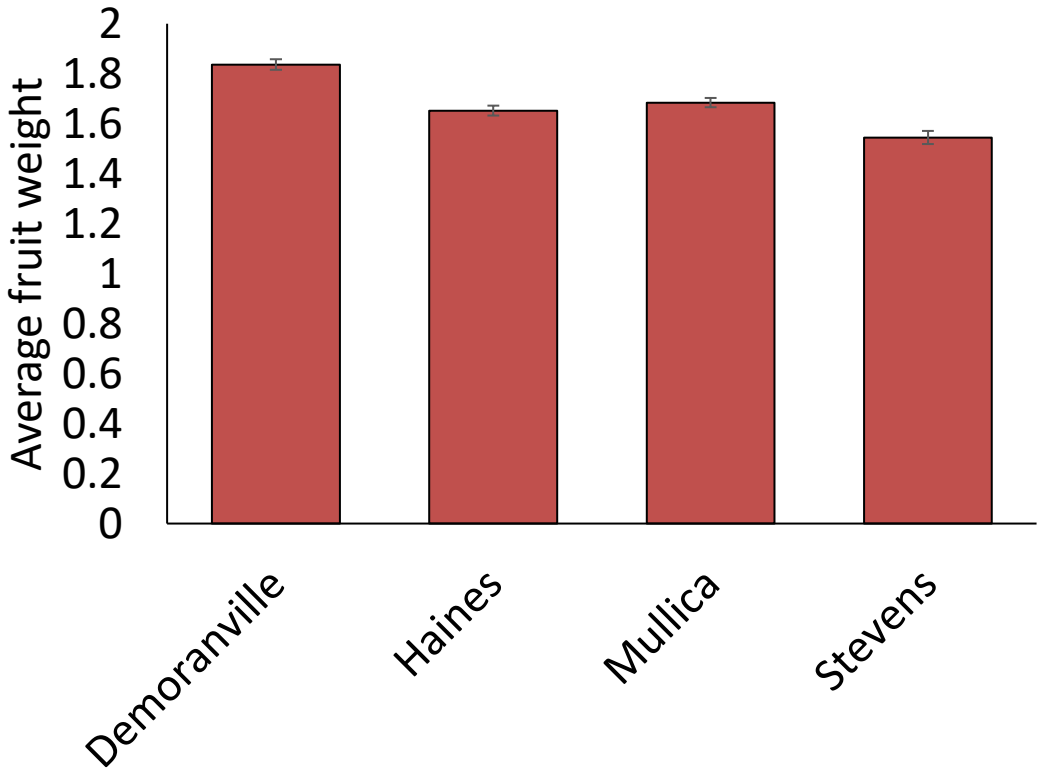
Results: Year-to-year variation

- Year did matter
  - Fruit set was overall higher in 2020
  - Regardless of varietal
  - And regardless of site



Results: Fruit weight and seeds

- Fruit weight and seed number varied by varietal
  - **Demoranville** had the heaviest fruit



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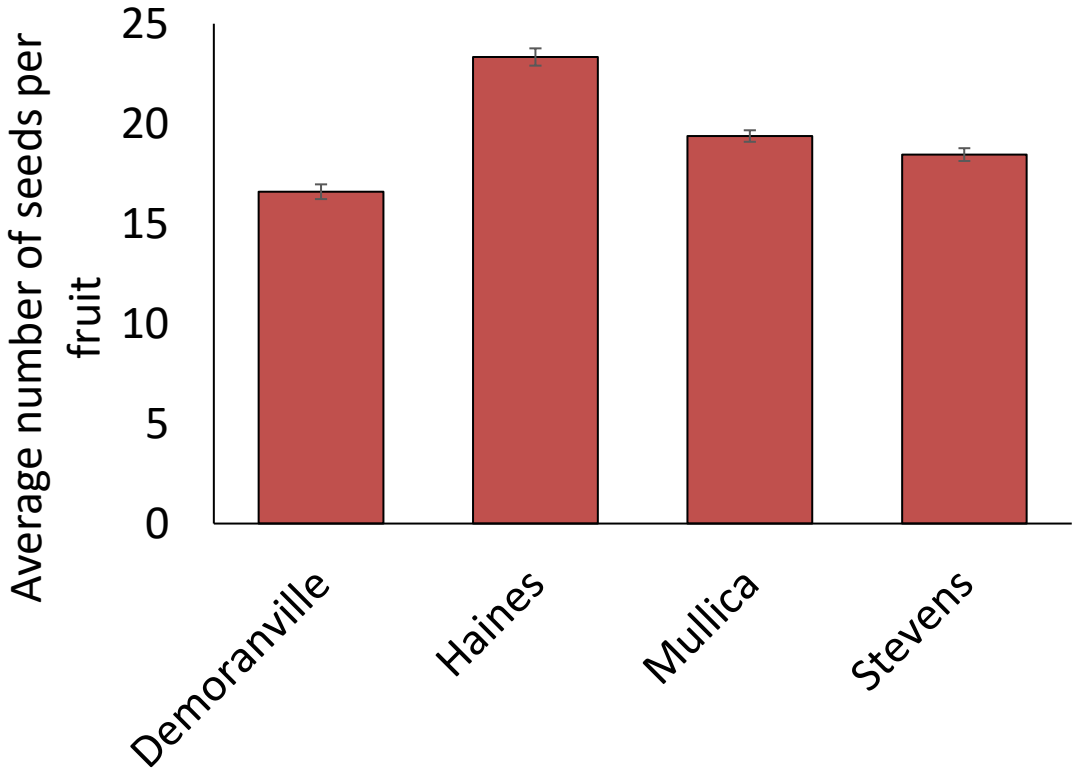
Results: Fruit weight and seeds

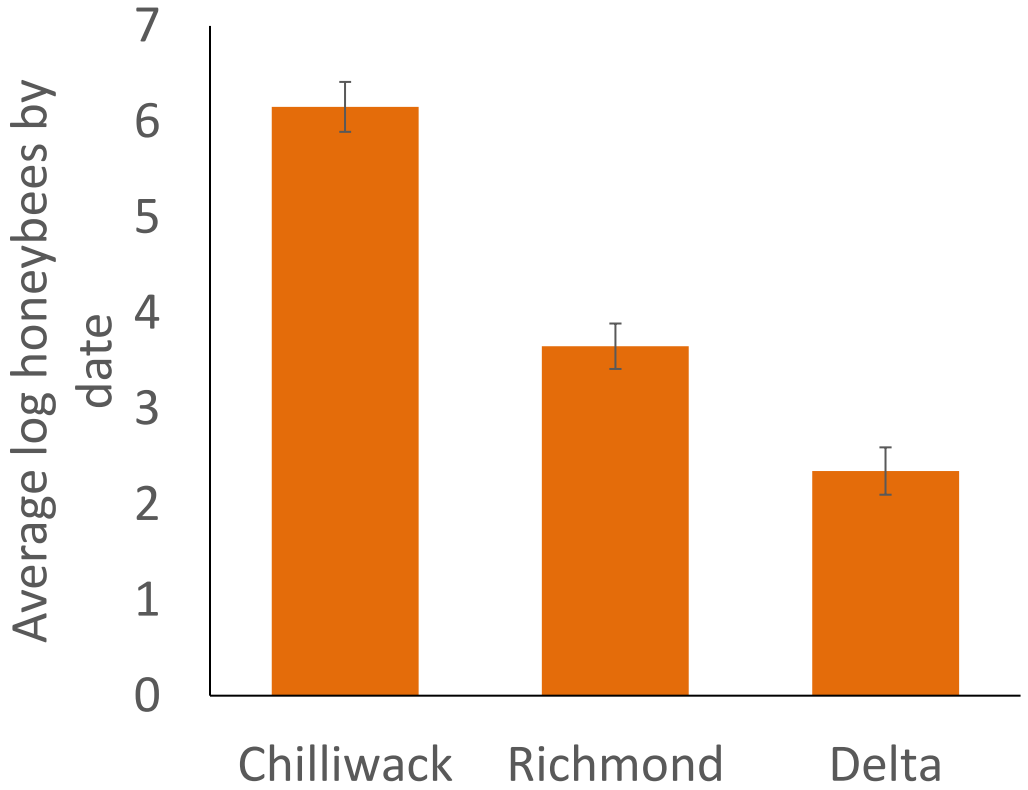
- Fruit weight and seed number varied by varietal
  - **Demoranville** had the heaviest fruit
  - **Haines** had the most seeds
  - **Treatment fruit** set on average more seed than controls



$p < 0.01$

Results: What about bees?

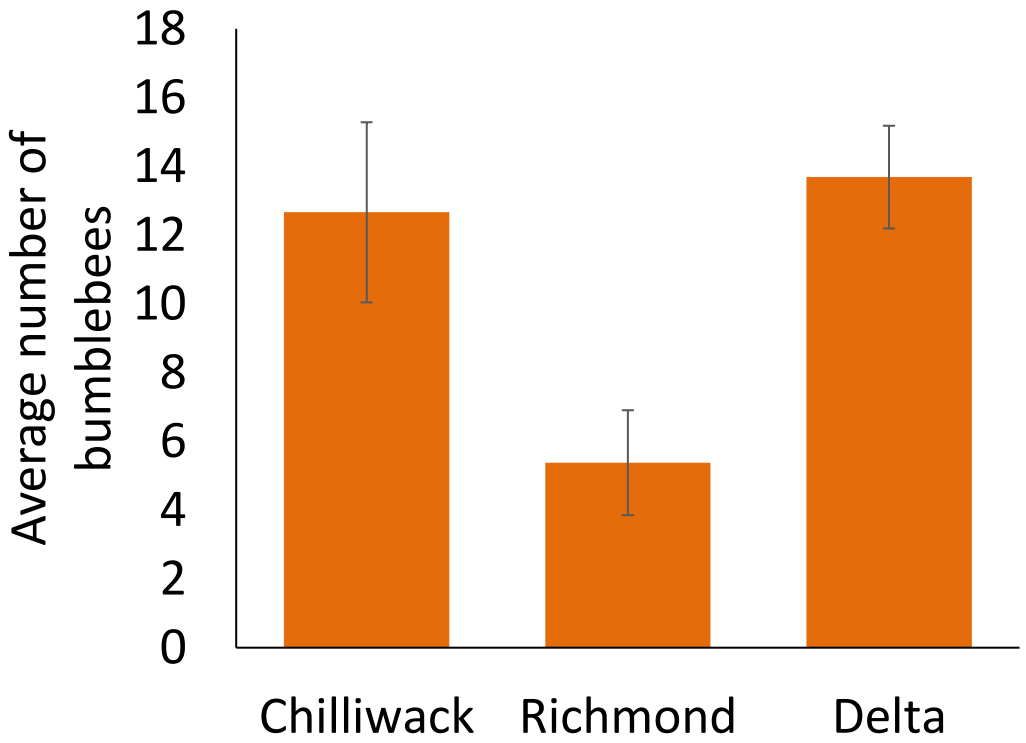
- The strongest factor affecting both honeybee and bumblebee abundance was location
  - Chilliwack had the highest abundance of honeybees
  - Two of our transects were very near the hives



$p < 0.01$

Results: What about bees?

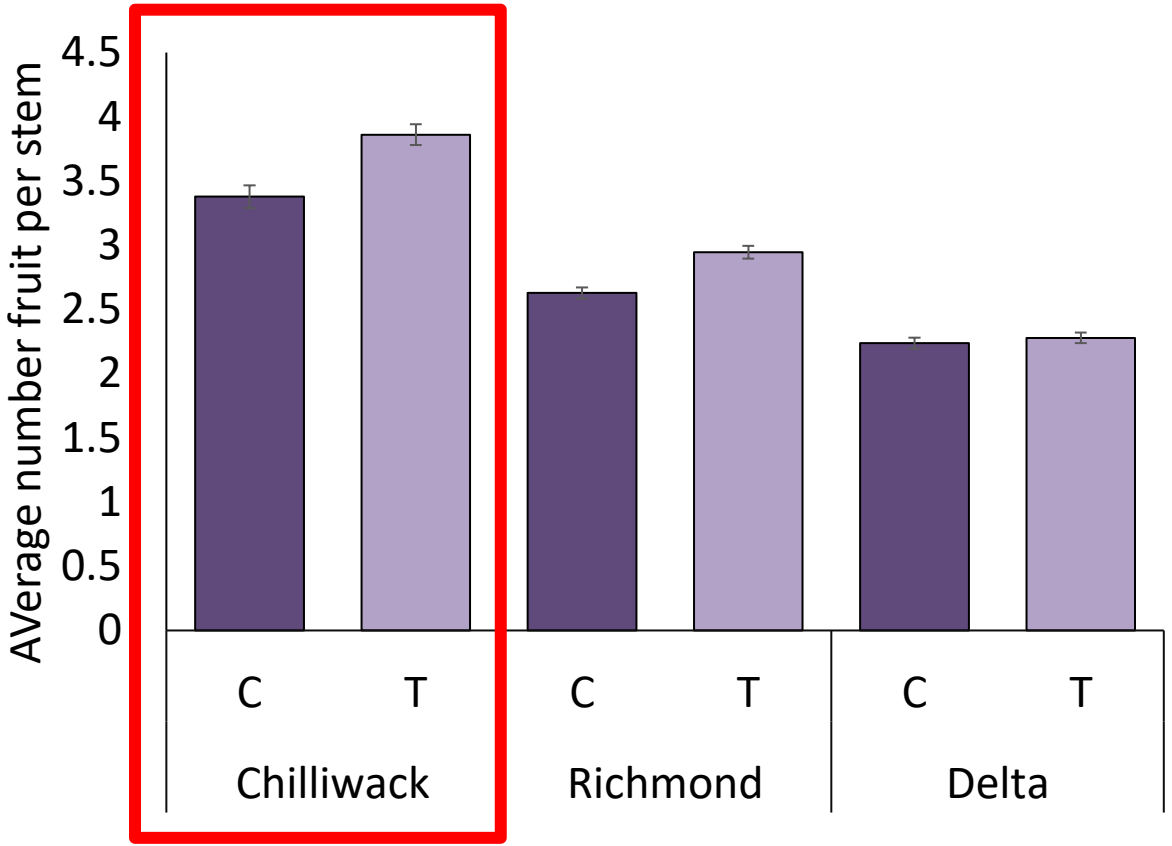
- The strongest factor affecting both honeybee and bumblebee abundance was location
  - Delta and Chilliwack both also had high numbers of bumblebees



$p < 0.01$

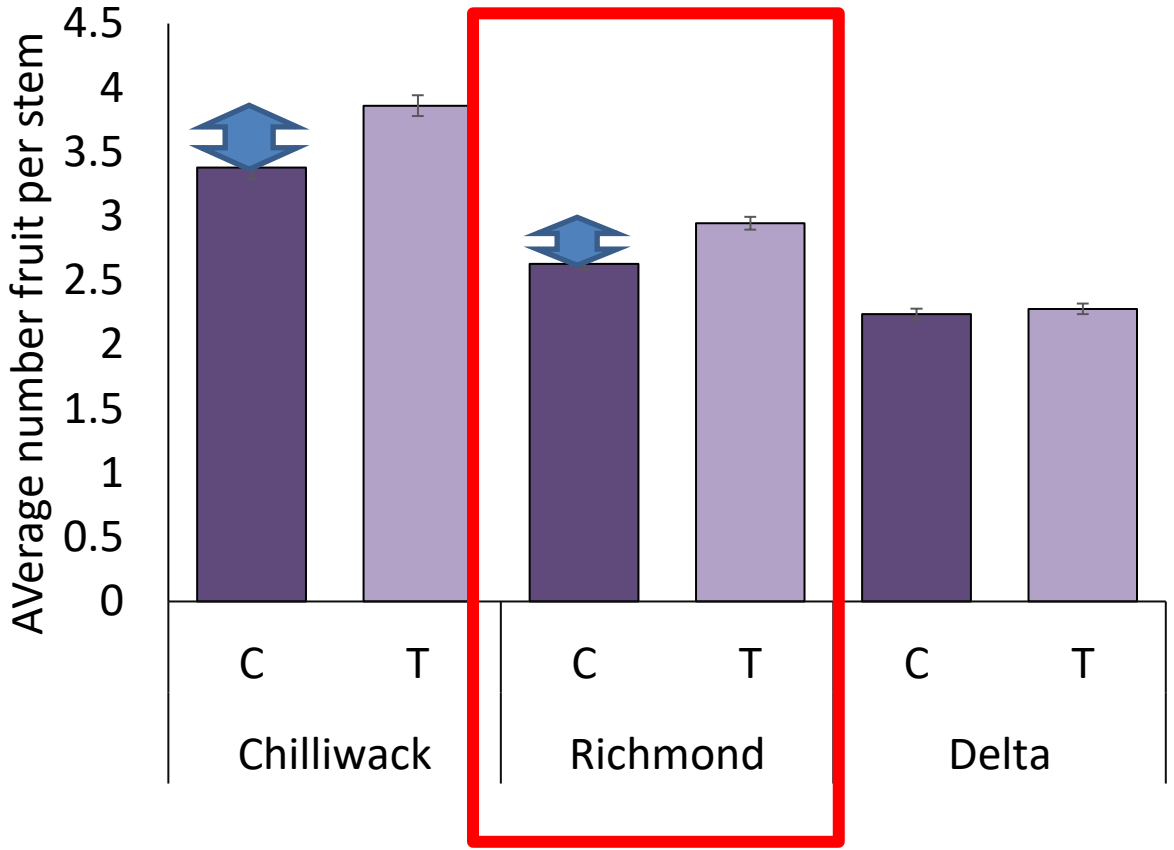
Putting it together

- Chilliwack had high numbers of bumblebees and honeybees
  - Highest number of fruits per stem
  - But still showed pollination deficit
  - Also lacked Demoranville – which had the fewest fruits per stem



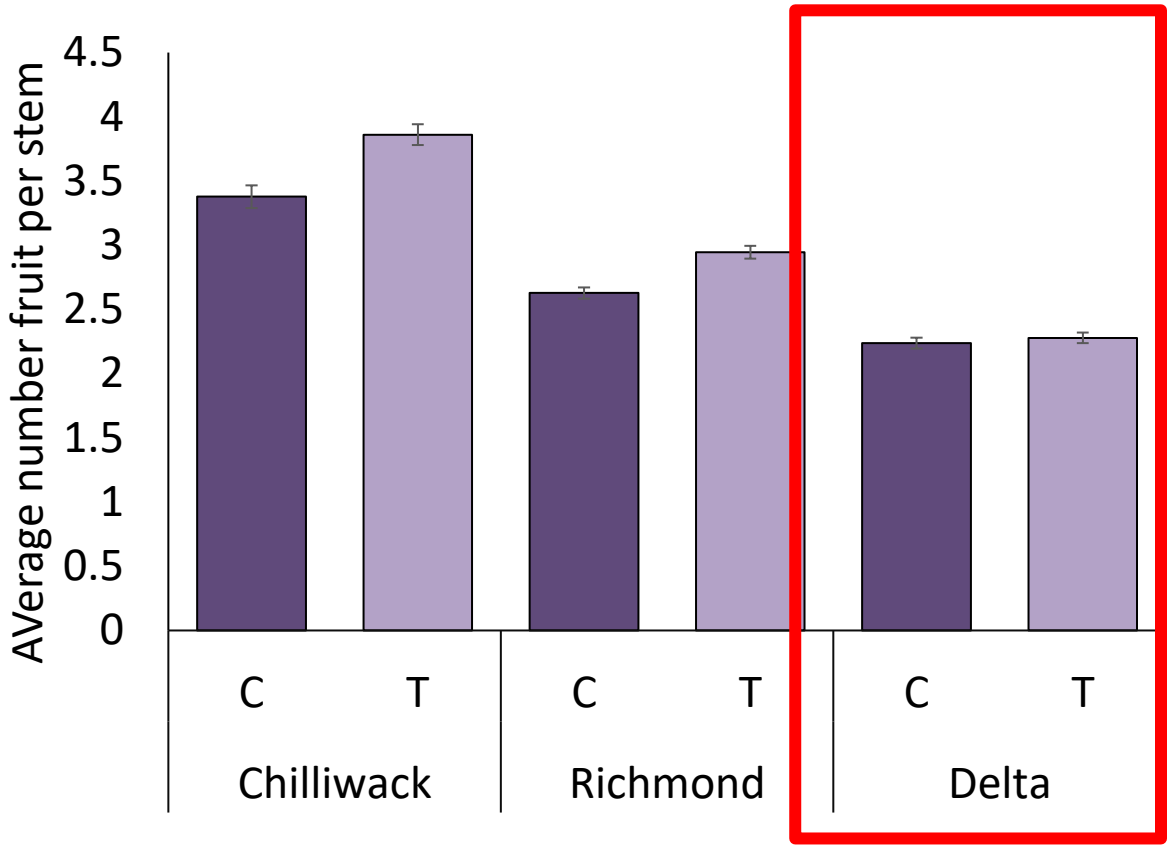
Putting it together

- Richmond had moderate numbers of honeybees and bumblebees
- Lower fruits per stem
  - But includes Demoranville
- Similar pollination deficits to Chilliwack
  - So difference in fruit set likely not due to pollinator differences



Putting it together

- Field station in Delta had lowest fruits per stem
  - Includes low productivity ‘Stevens’
  - Had highest numbers of bumblebees
  - Very low pollination deficits

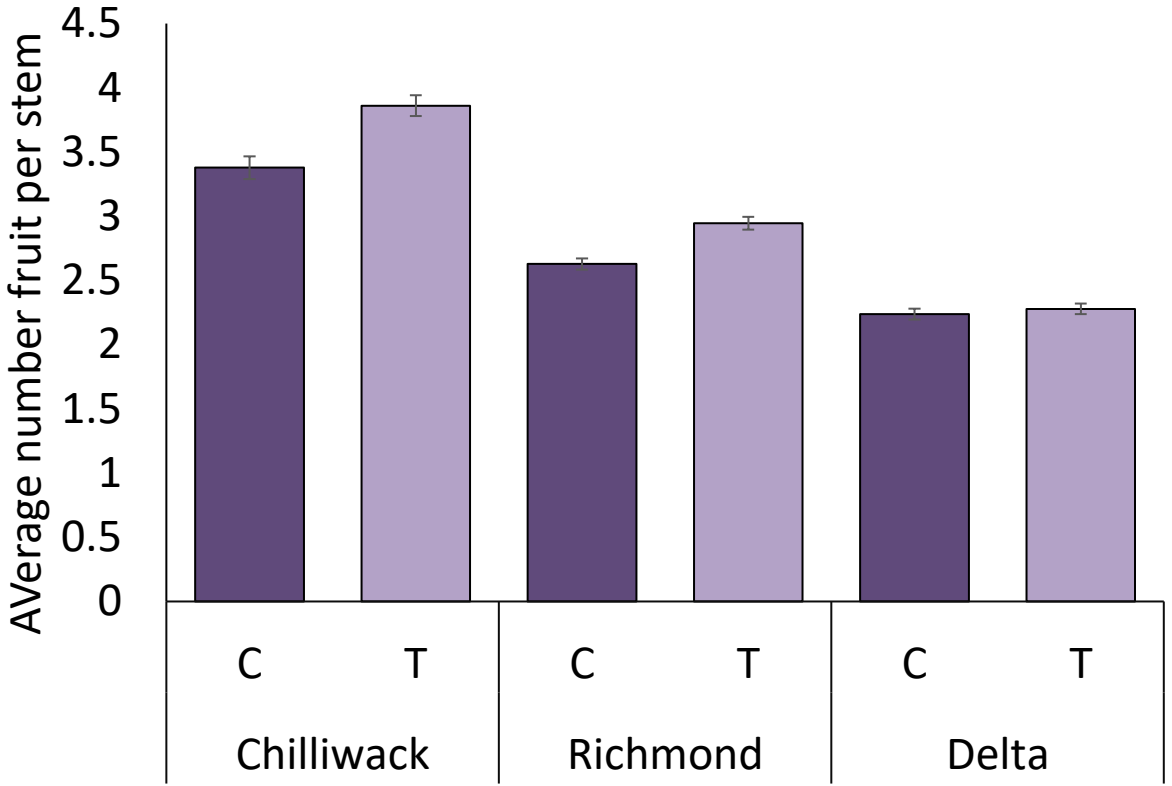


Study objectives

1. **Determine cultivar variation in pollination deficit**

- With both years of data combined, we find no evidence that some cultivars are more susceptible to pollen deficit than others

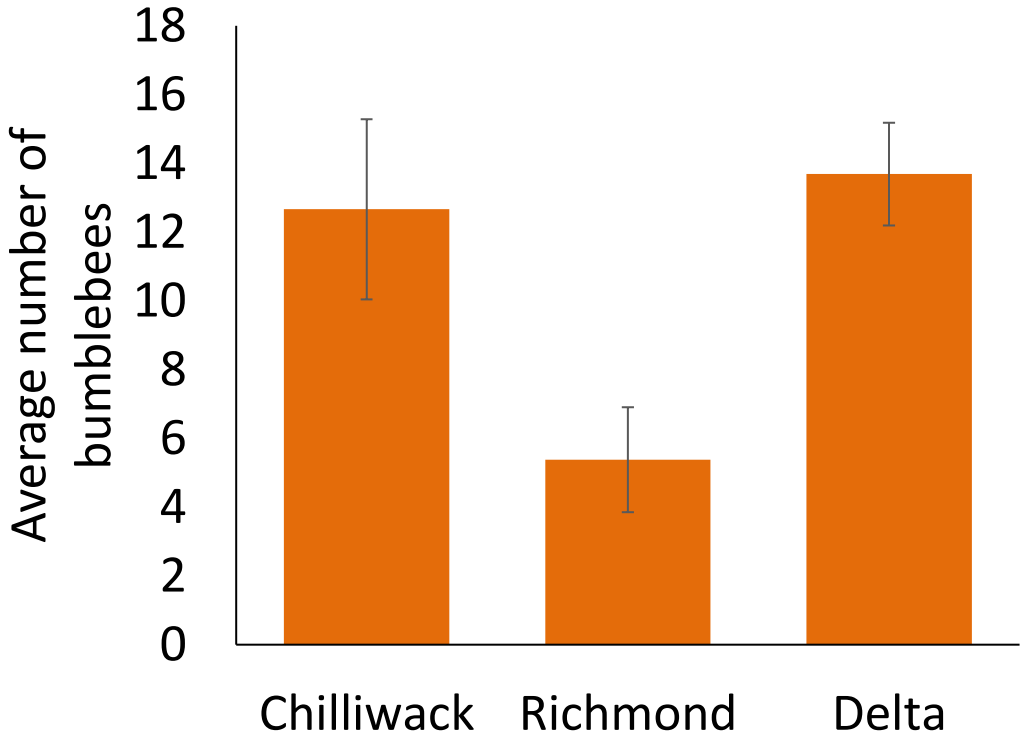
- **Rather we see variation between locations**

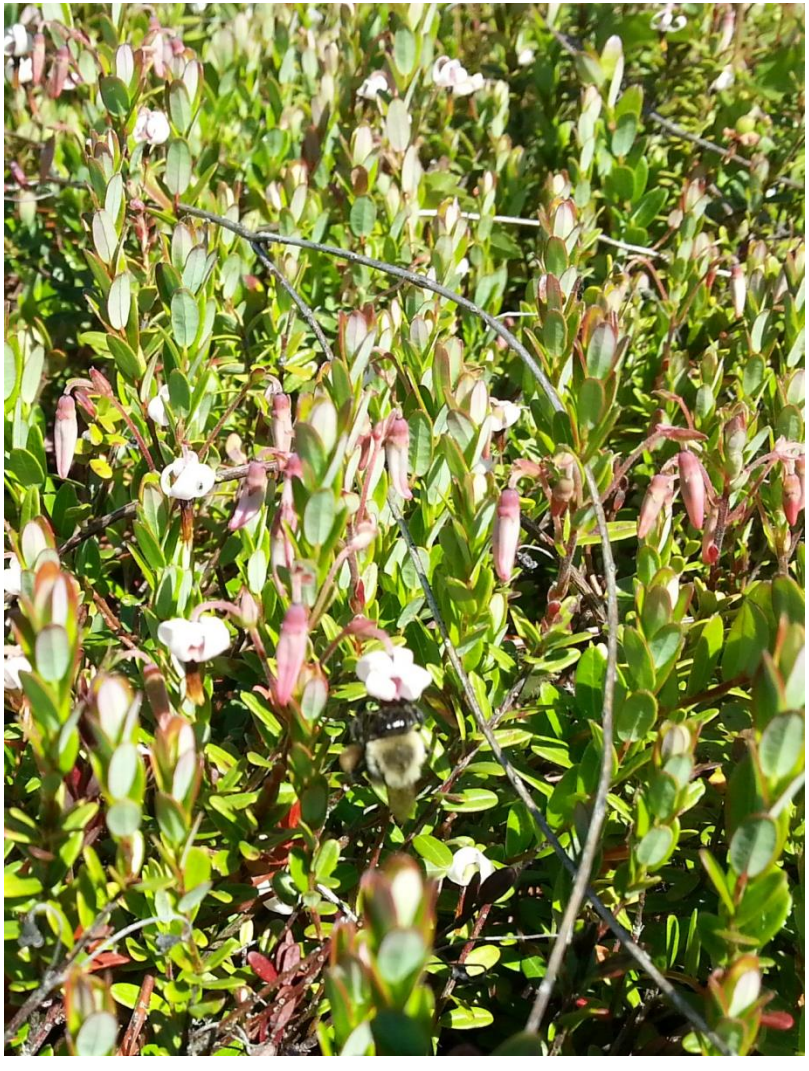


Study objectives

2. **Examine the role of honeybees vs. wild pollinators in mitigating this deficit across cultivars.**

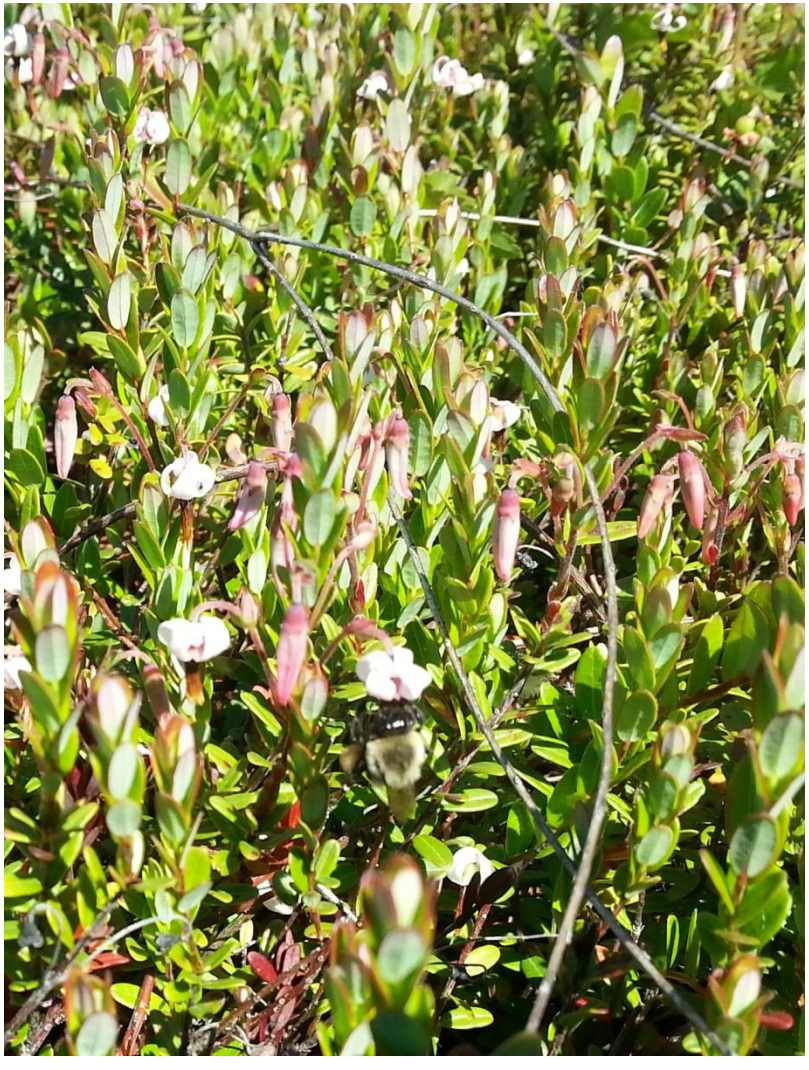
- Variation in pollinator abundance across sites does not appear to be associated with variation in pollination deficits
  - However, this needs further analysis





Still to do

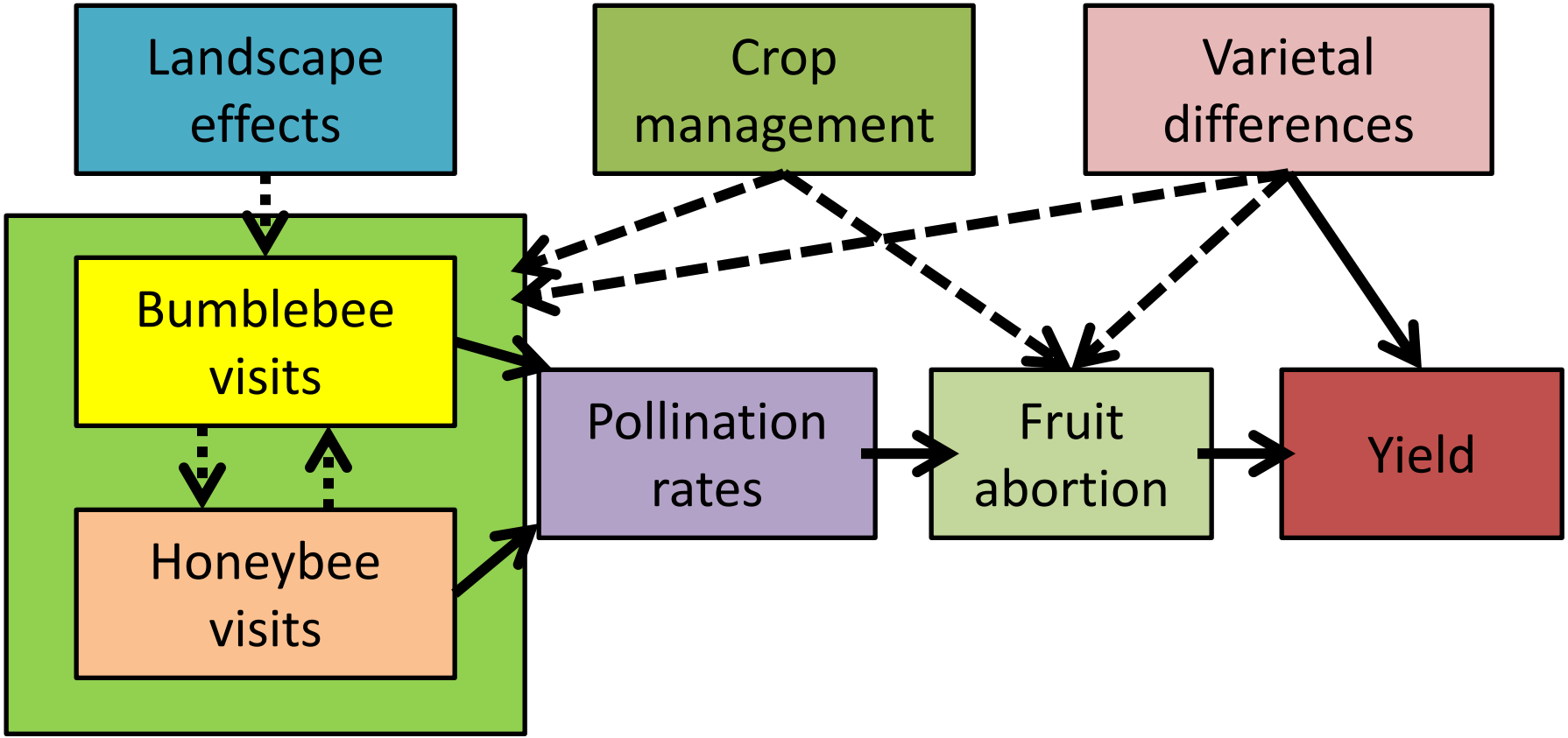
- Integrating bee data into fruit data analysis
- Putting together final analysis, report and publication



General conclusions

- None of the varietals tested stood out as being particularly susceptible to pollen limitation
  - Good news – suggests you can manage pollinators generally for all your fields
- Preliminary data does not conclusively indicate whether wild pollinators reduce pollination deficits
  - Further analysis will dig into this

A flowchart illustrating potential links affecting pollination and ultimately yield in cranberry. Dashed lines represent potential knowledge gaps.



Acknowledgements

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- Farmers and the field station for allowing us to work in their fields.
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