Do plants have internet? Interplant communication via common mycorrhizal networks

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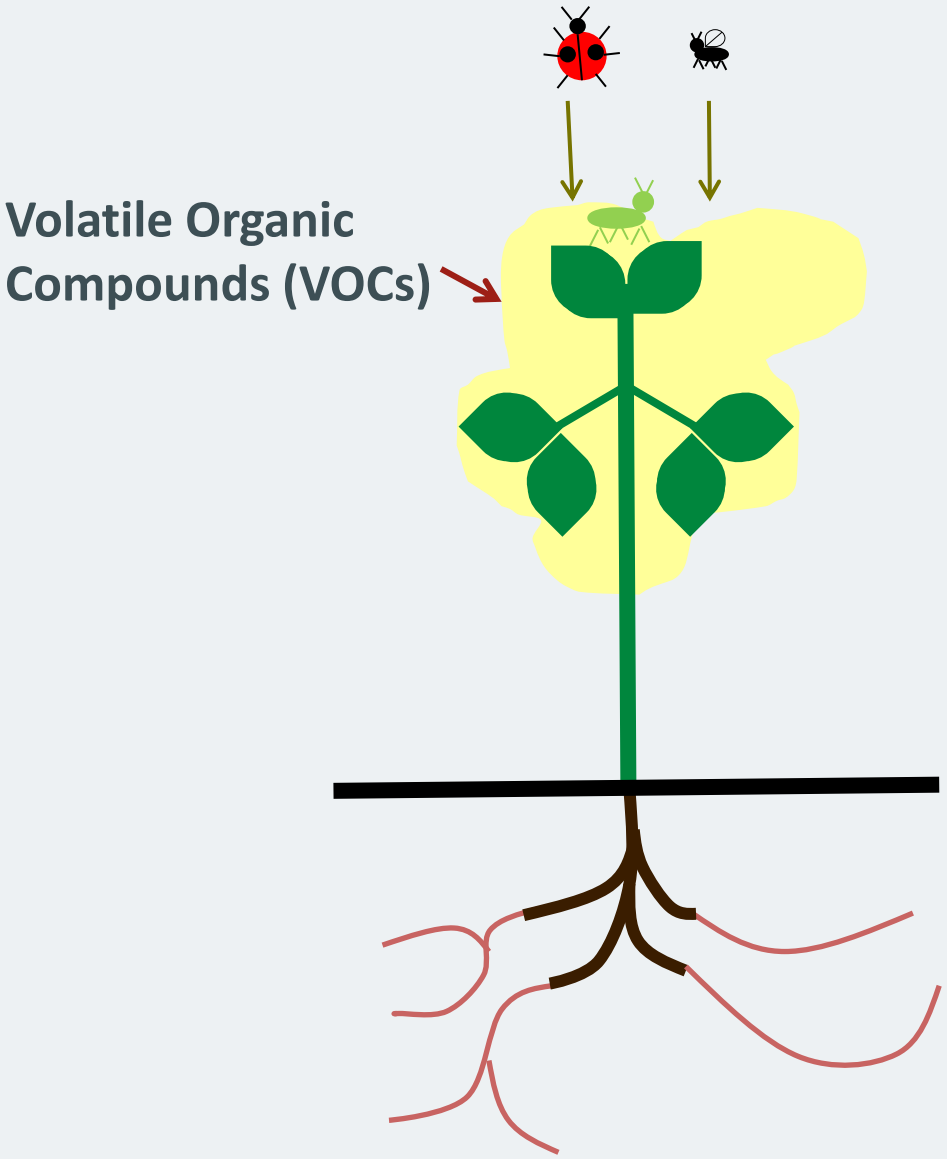
Rationale

- **Food Security**
- **9-21% of crop yield is lost due to pests globally**

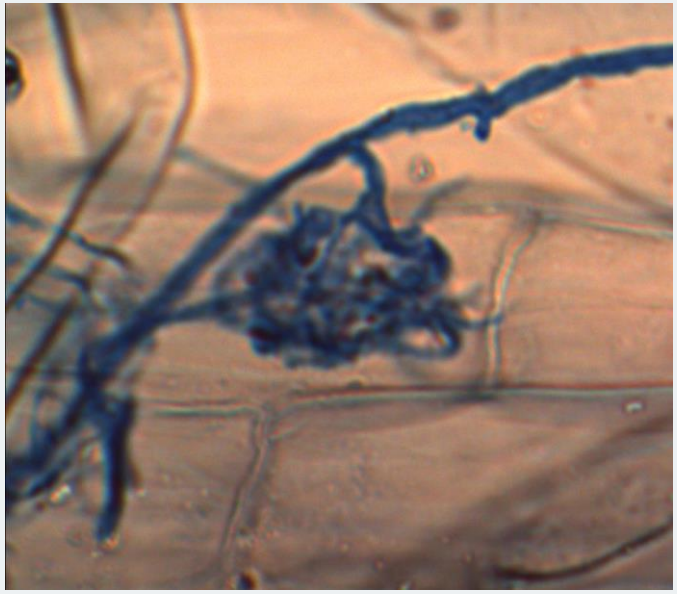
- **Pesticides in the UK**
  - Environmental problems
  - Legislation
  - Sustainable methods

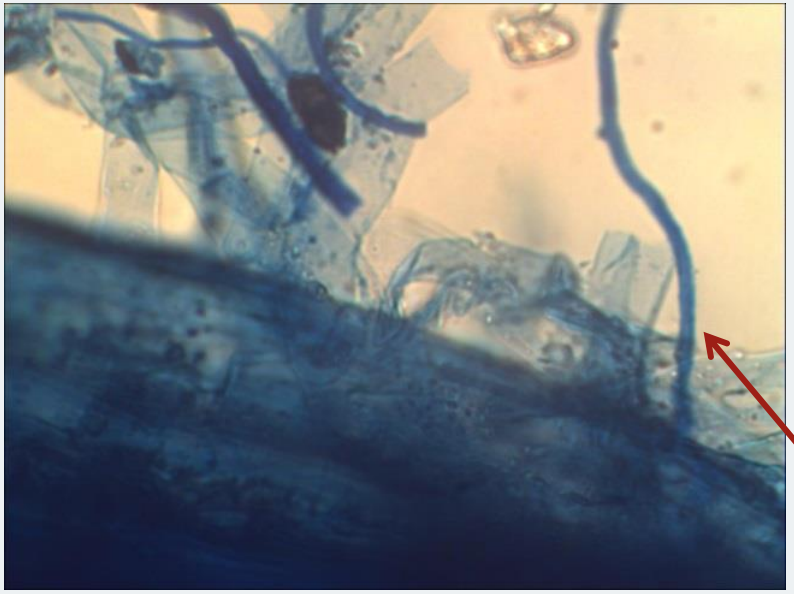
- **Alternative: using Plant Defence Mechanisms**

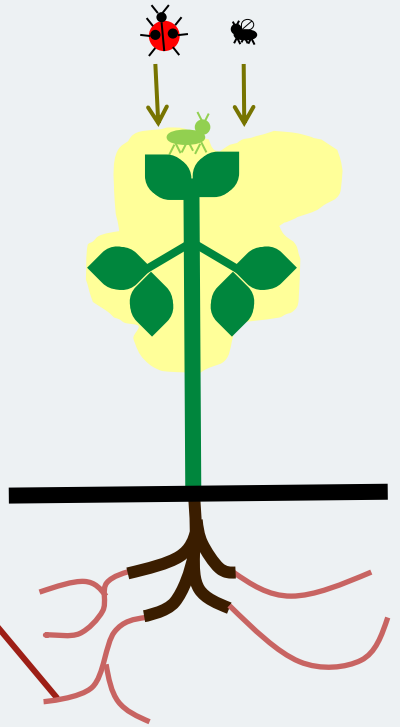
System



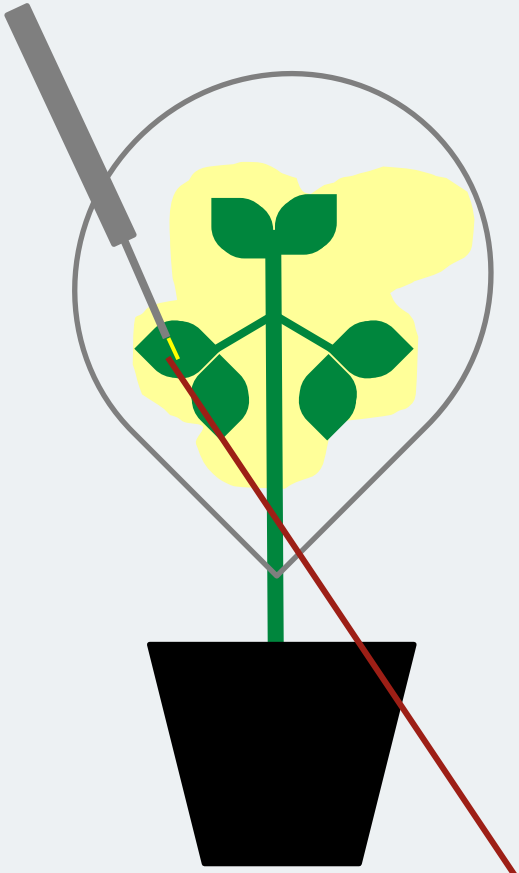
System: Arbuscular Mycorrhiza Fungi

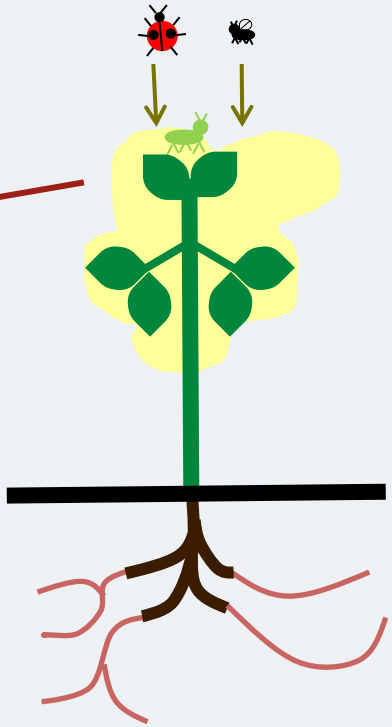




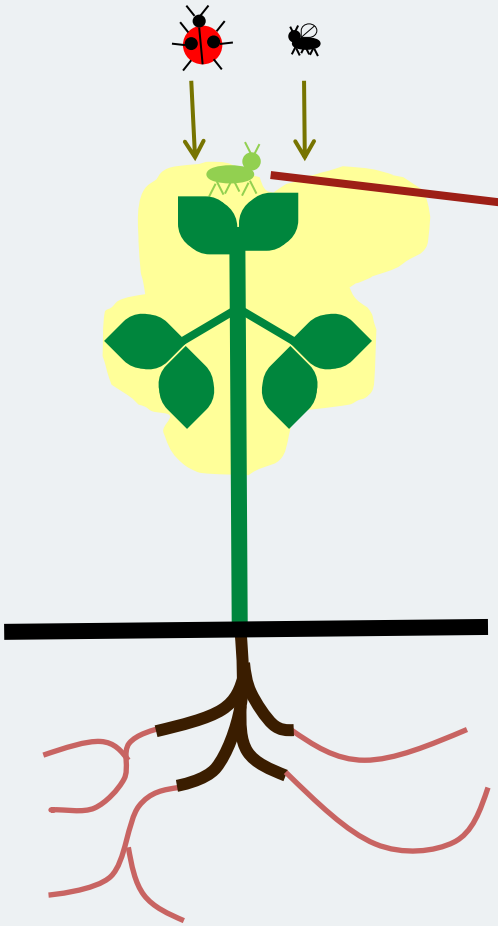


System: Bean (*Vicia faba*)



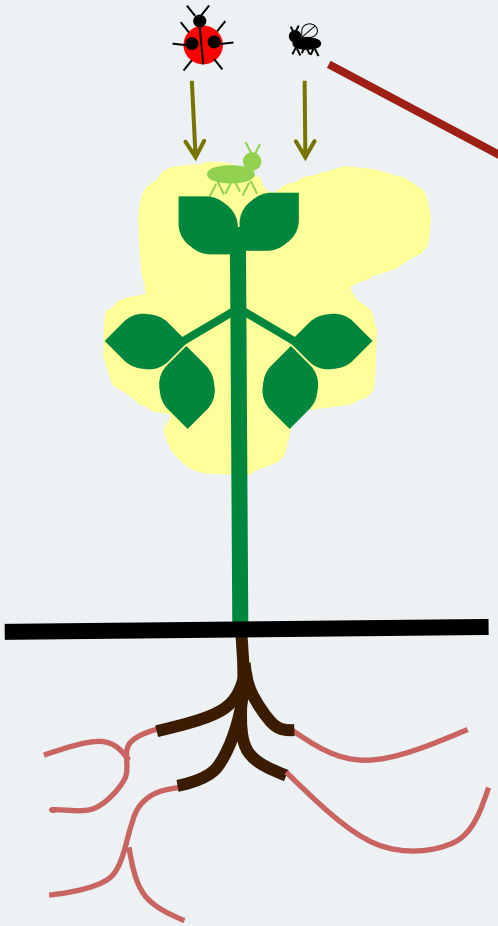


System: Pea Aphid



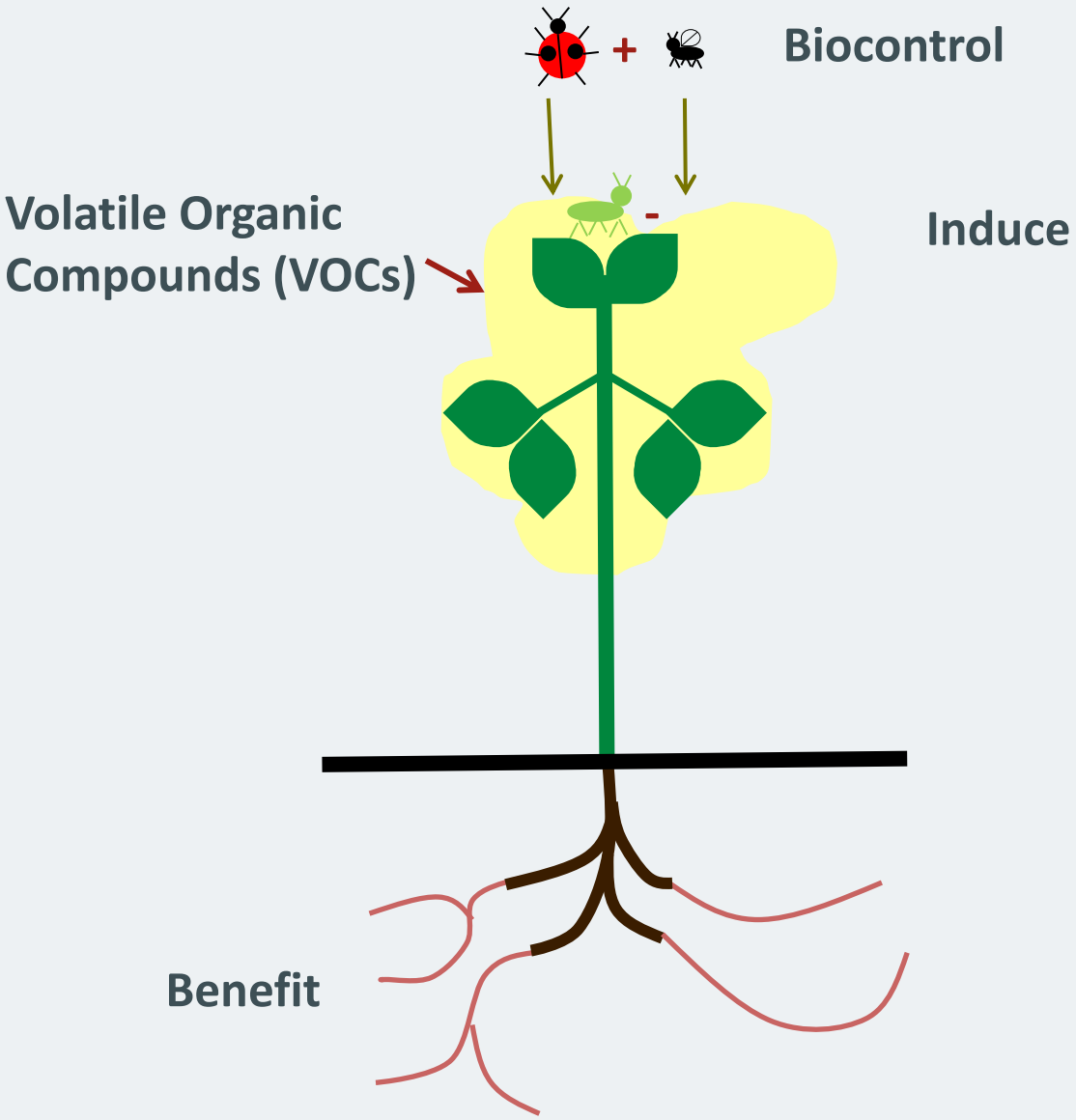
Acyrthosiphon pisum

System: Parasitoid Wasp

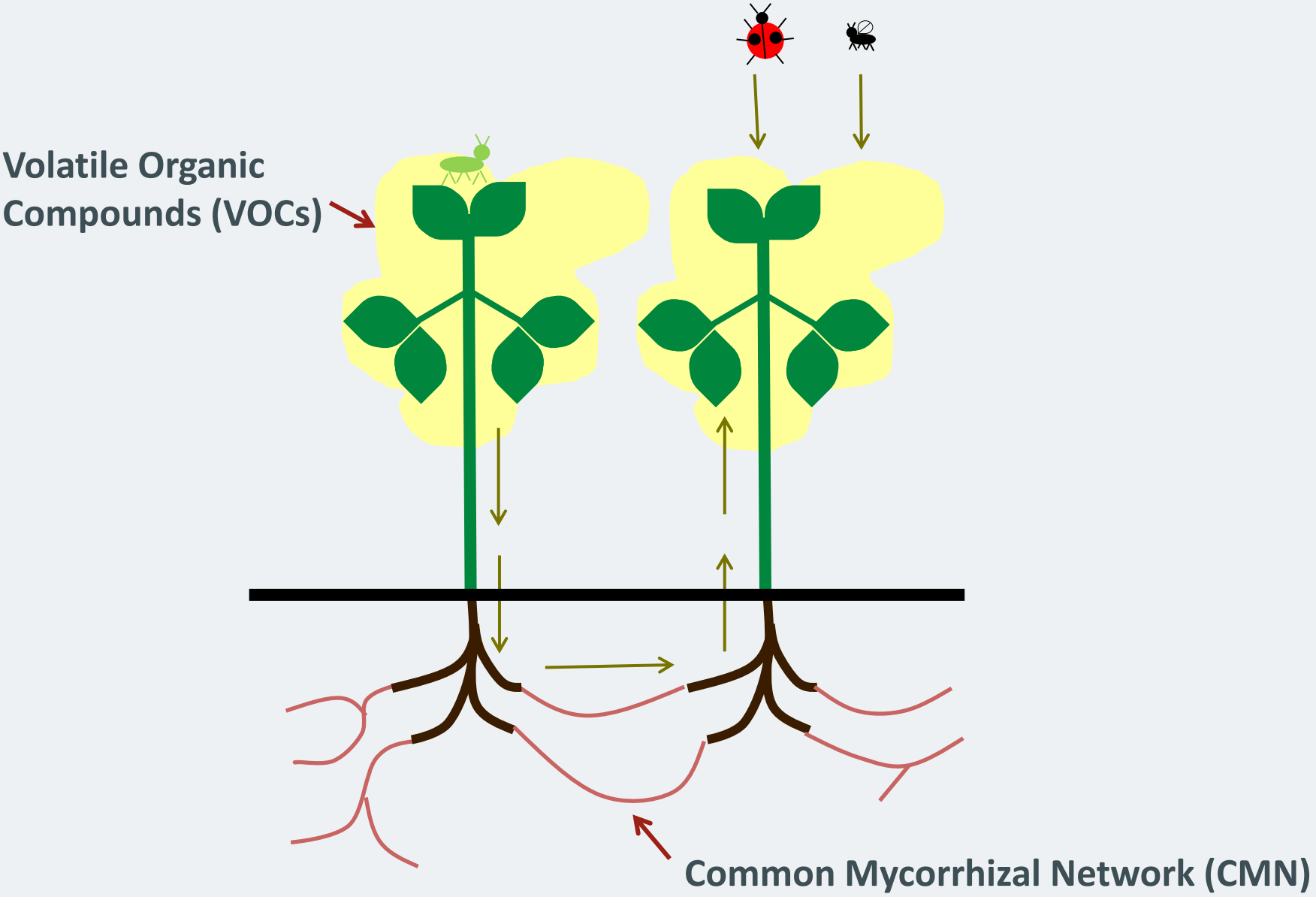


Aphidius ervi

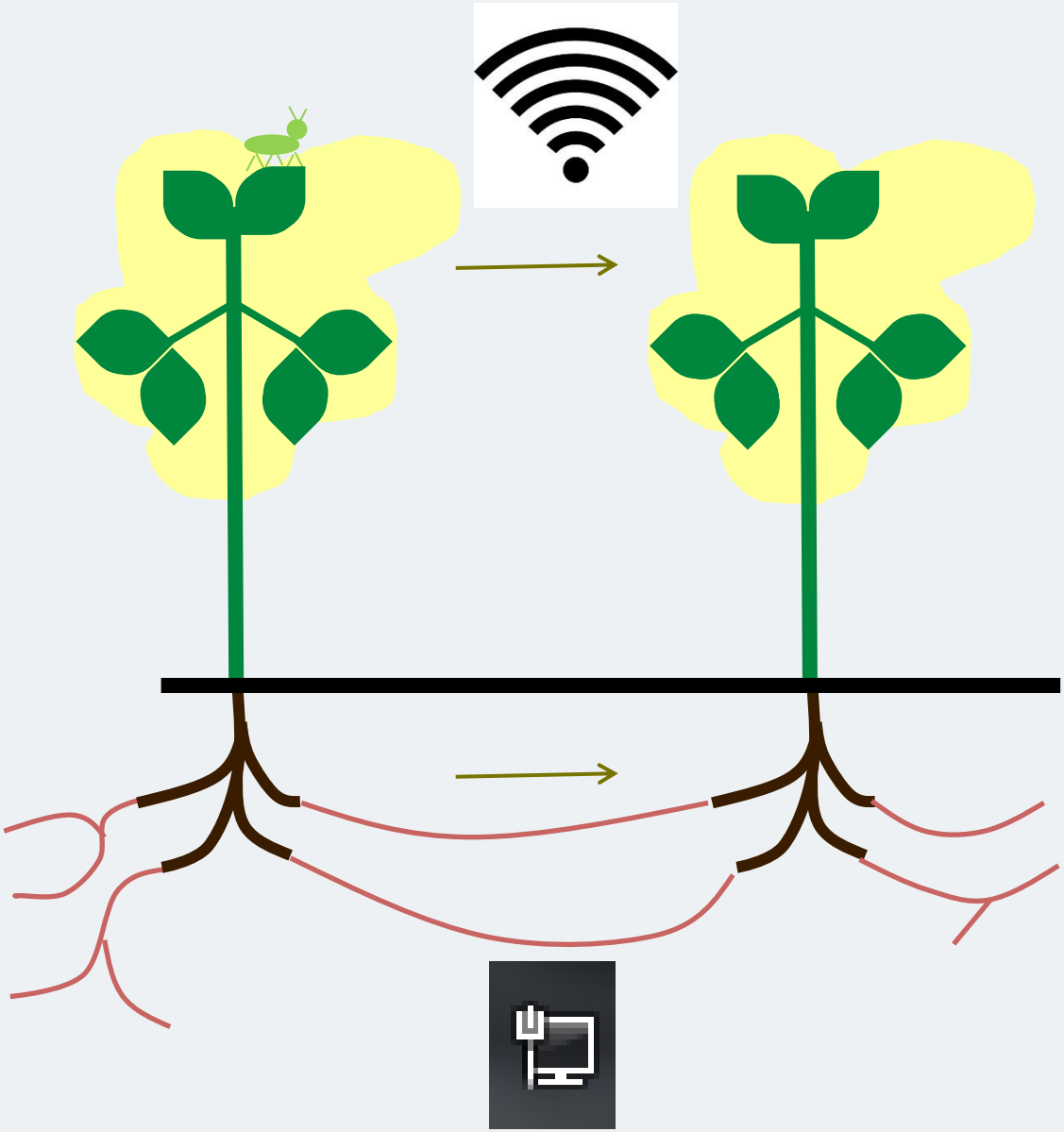
Indirect Induced Plant Defences

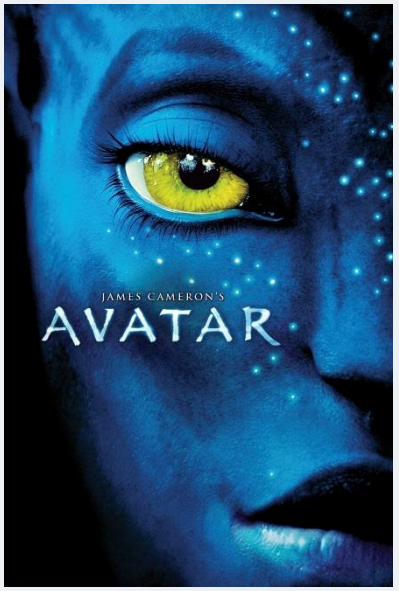


Defence Signal Transfer



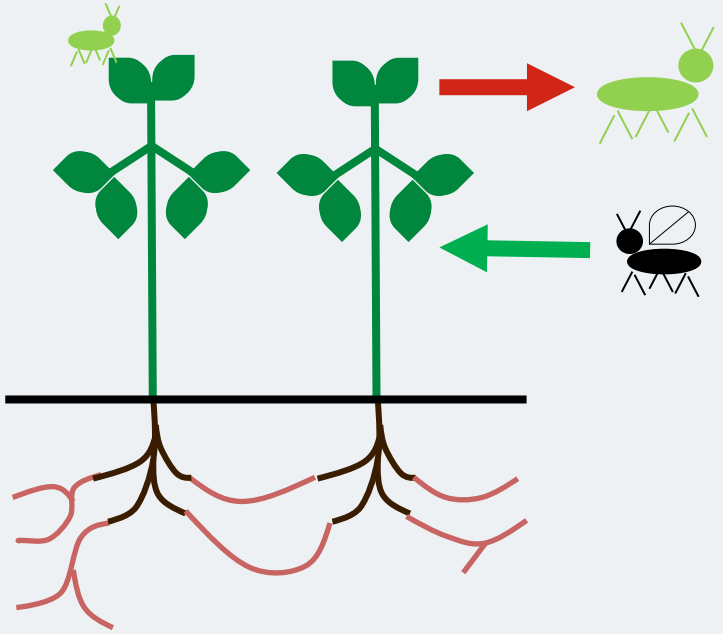
Defence Signal Transfer



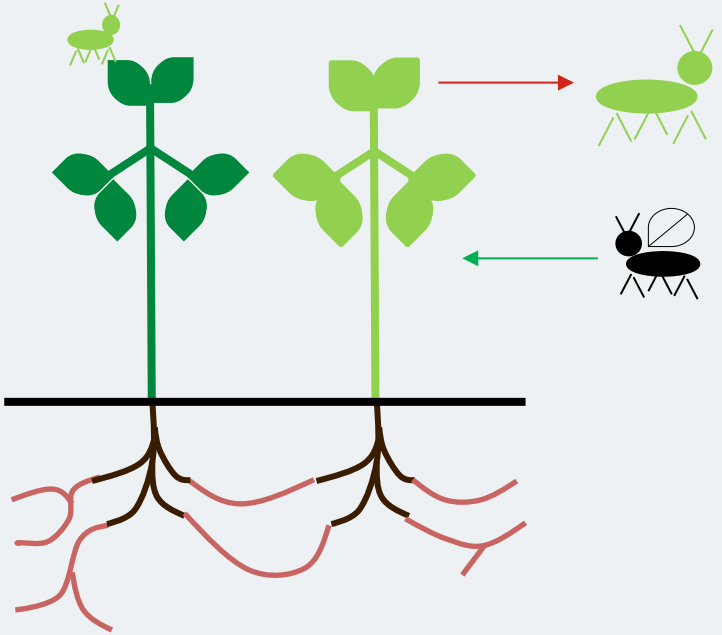


Question and Hypotheses

- **Can plant-plant signalling occur between different species of related plants that share the same insect pest?**

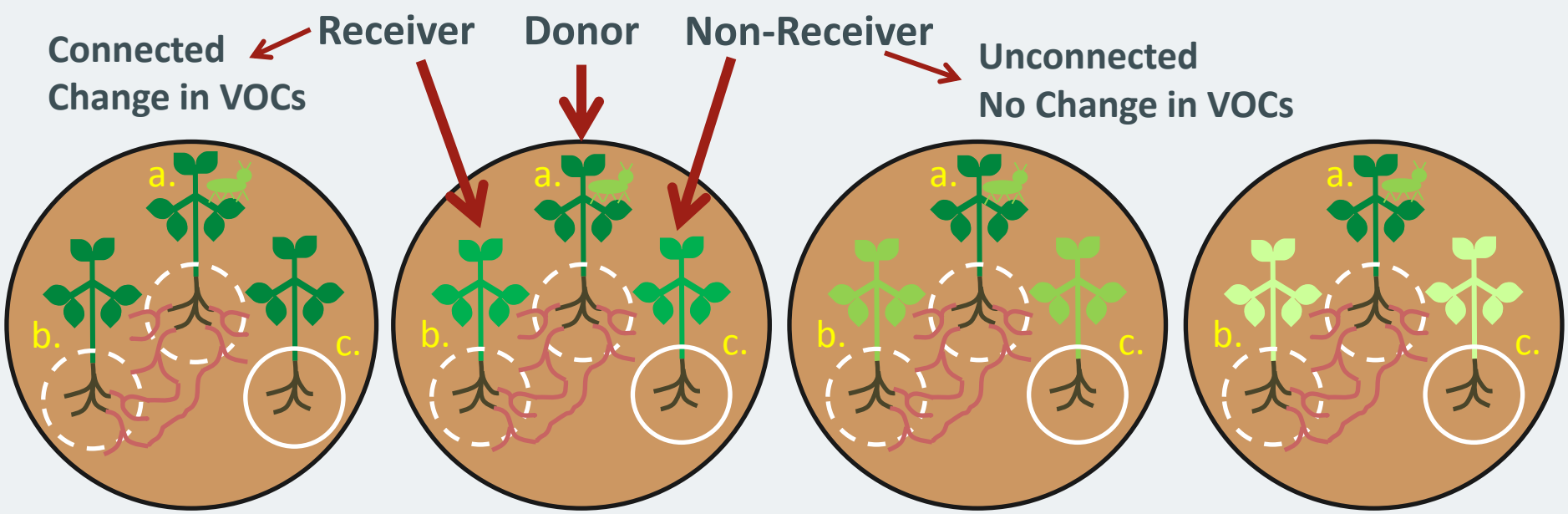


Same Species
More Pronounced Insect Responses



Different Species
Less Pronounced Insect Responses

Experimental Design



Same Cultivar Bean (Sutton Dwarf) (cultivar)

Different Cultivar Bean (Aquadulce) (species)

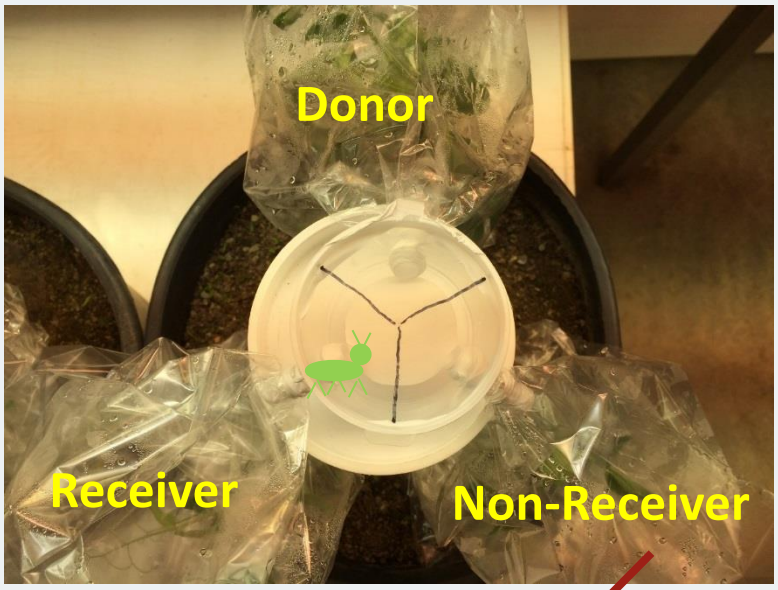
Vetch (genus)

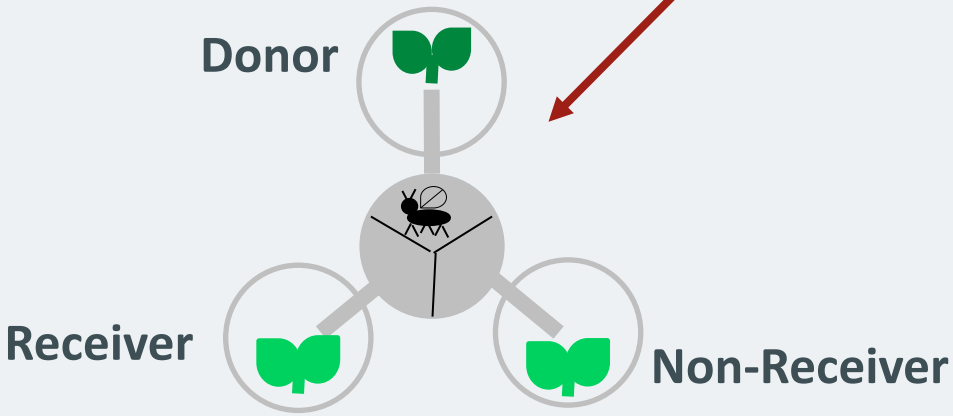
Pea (family)

More Related

Less Related

Olfactometer: Insect Choice Tests

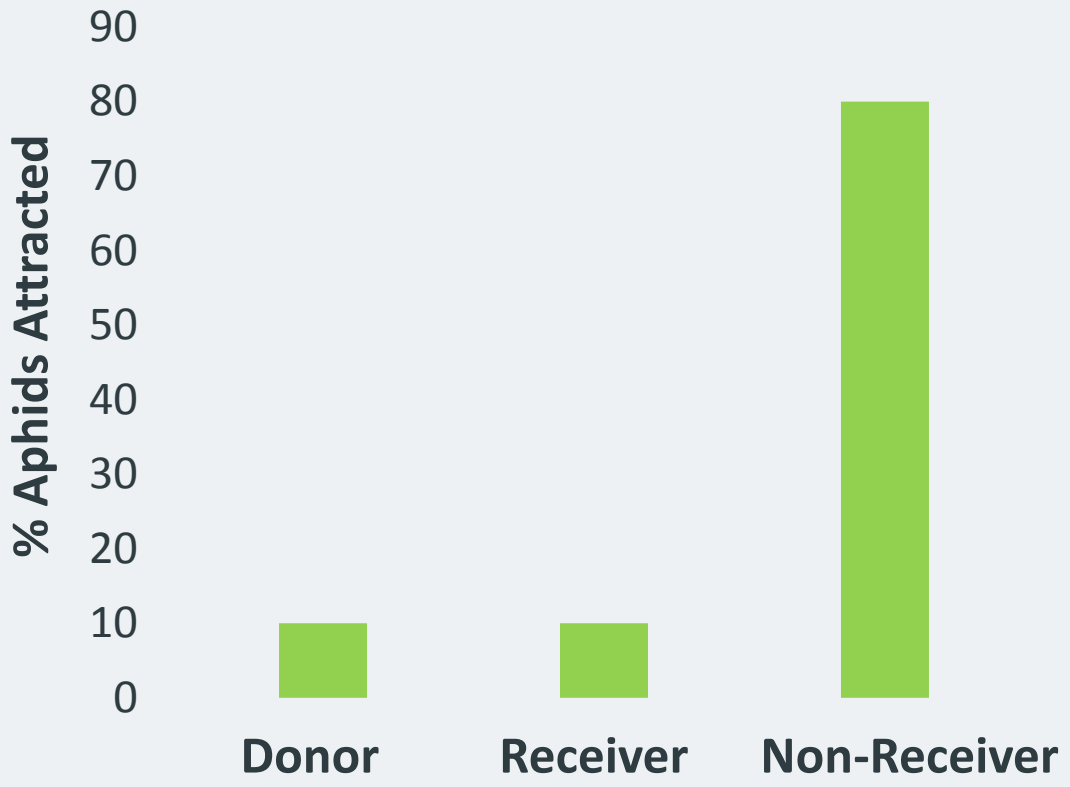




Results: Aphid Visitations

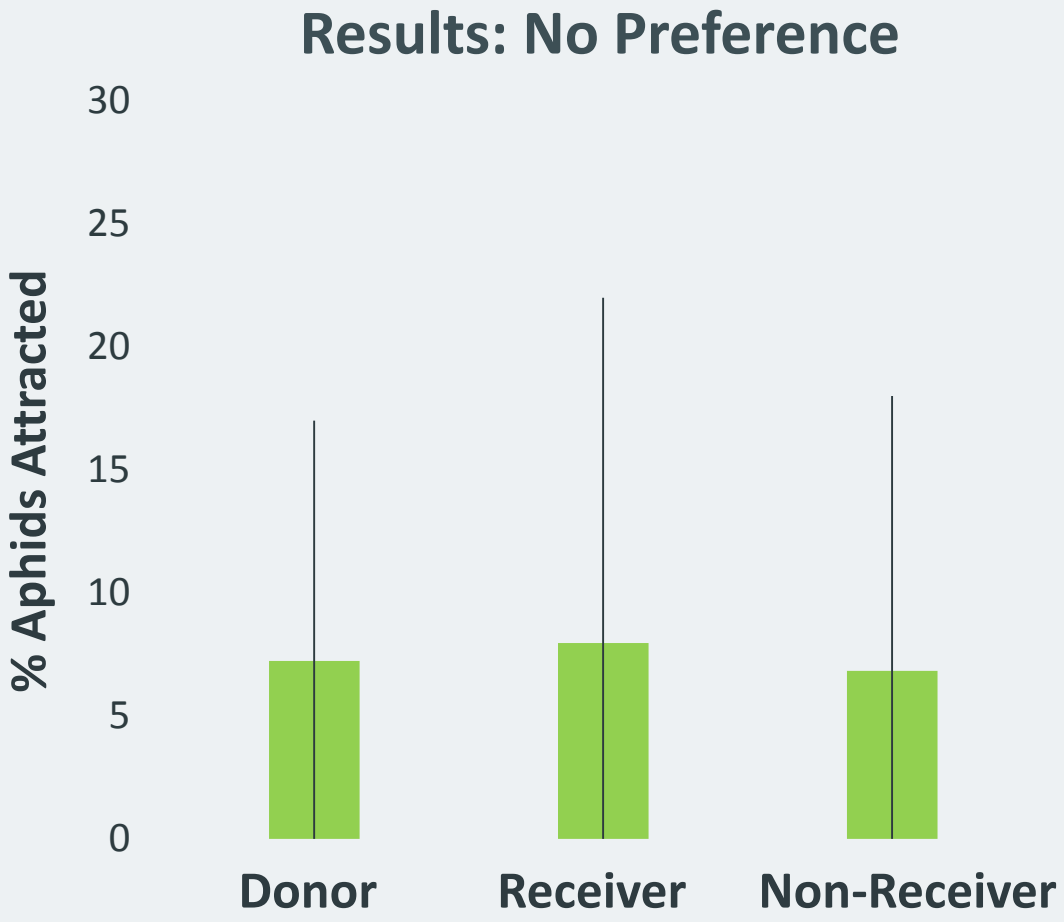
Error Bars signify Range

Predictions: Prefer Non-Receiver VOCs



Results: Aphid Visitations

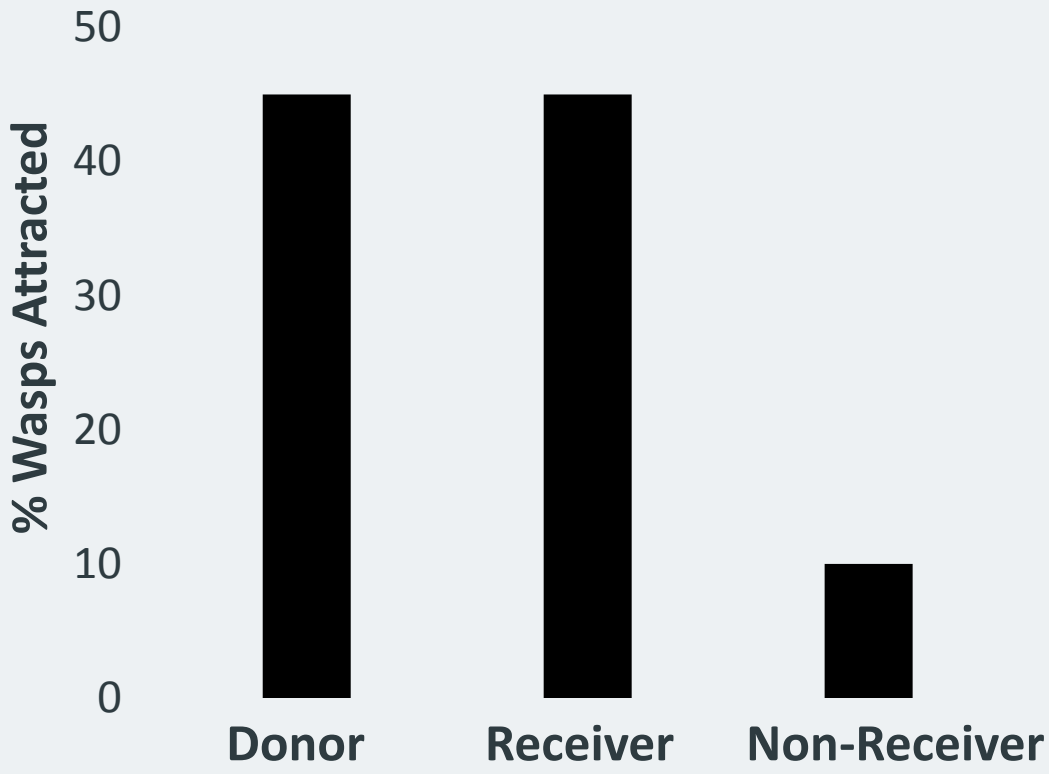
Error Bars signify Range



Results: Wasp Visitations

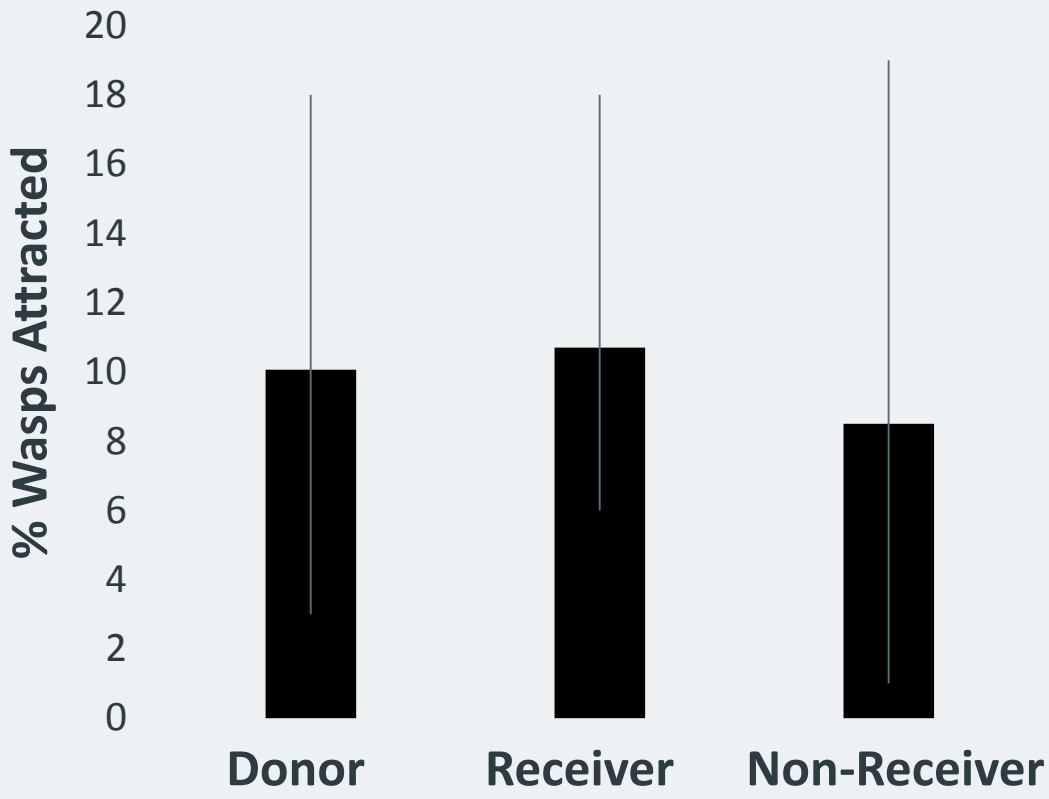
Error Bars signify Range

Predictions: Prefer Donor and Receiver VOCs



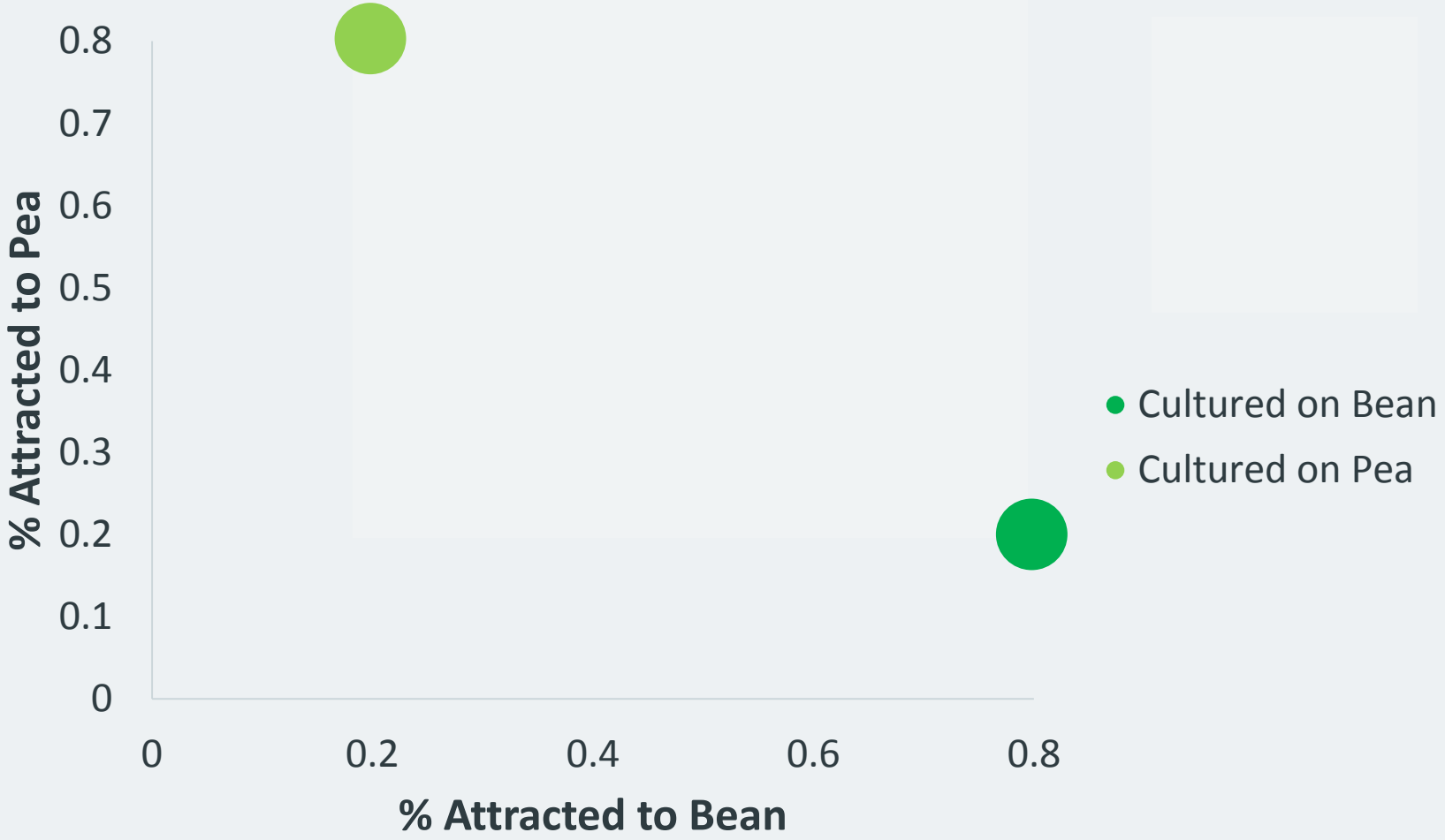
Results: Wasp Visitations

Error Bars signify Range

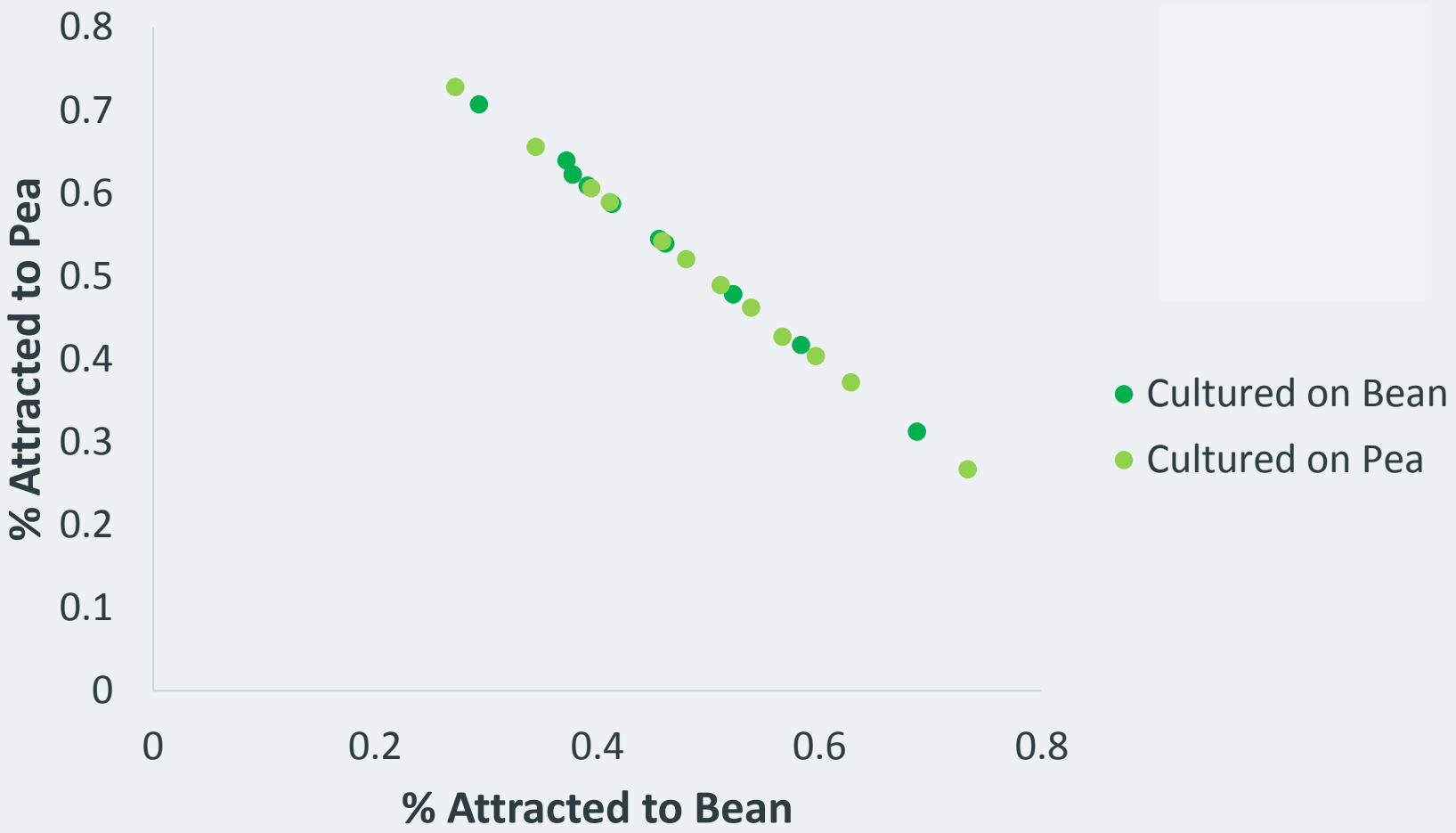


WHY ARE THEY NOT RESPONDING AS PREDICTED?

Results: No Maternal Effects

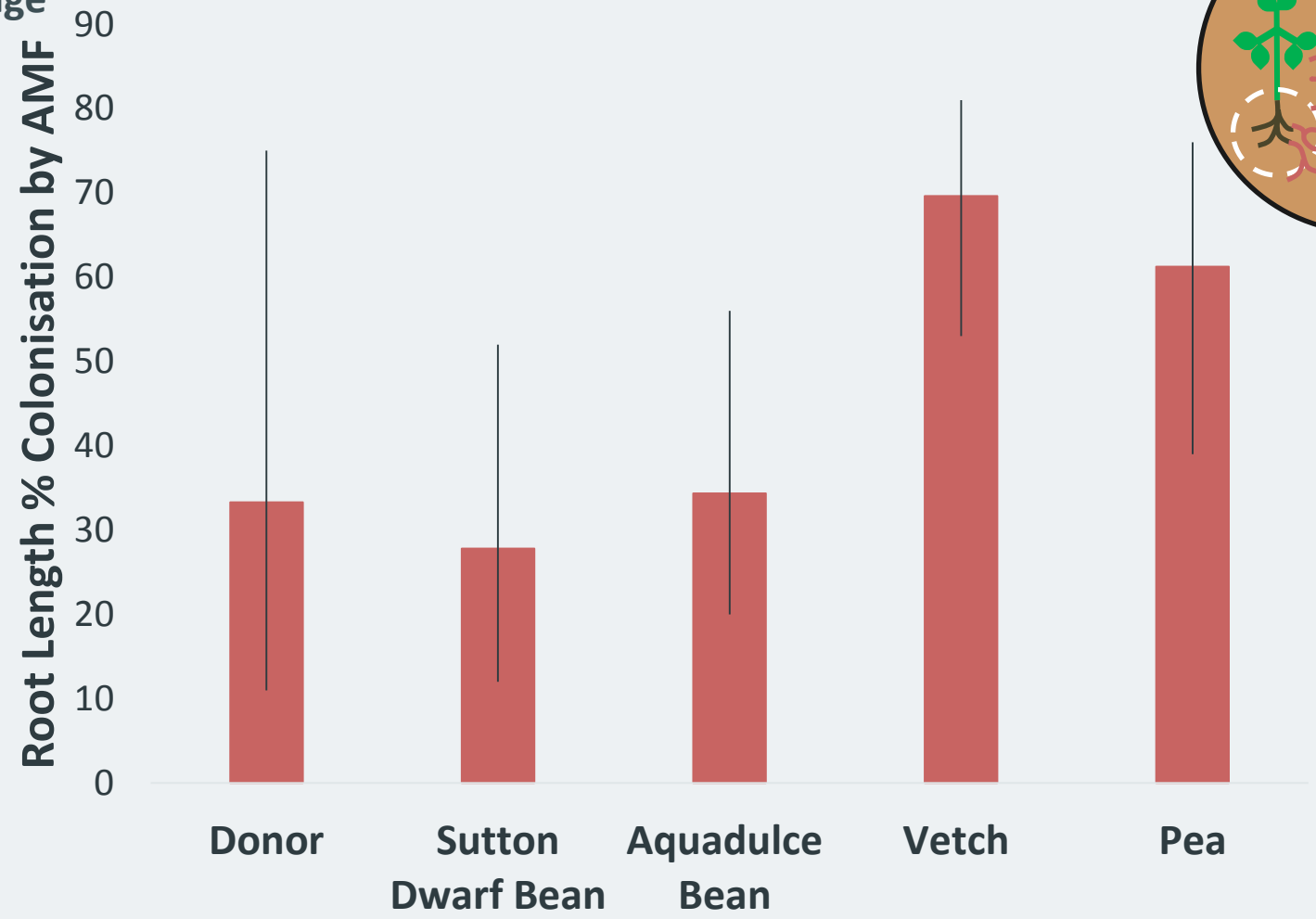


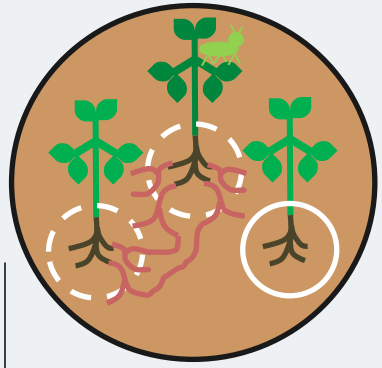
Results: No Maternal Effects



Results: AMF Colonisation

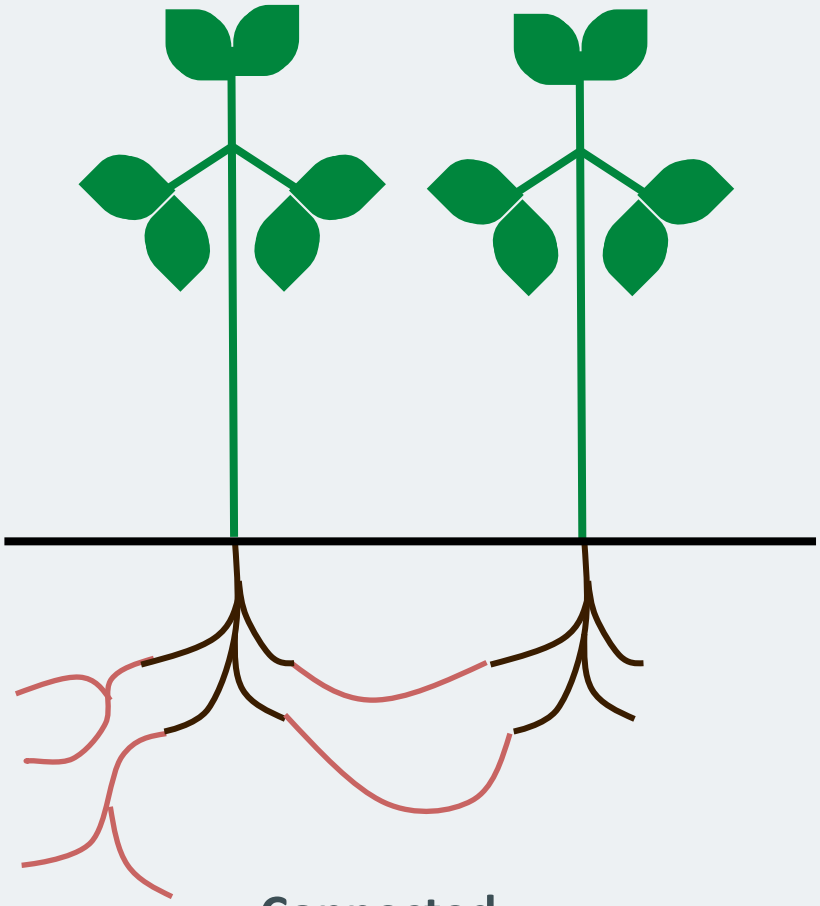
Error Bars signify Range



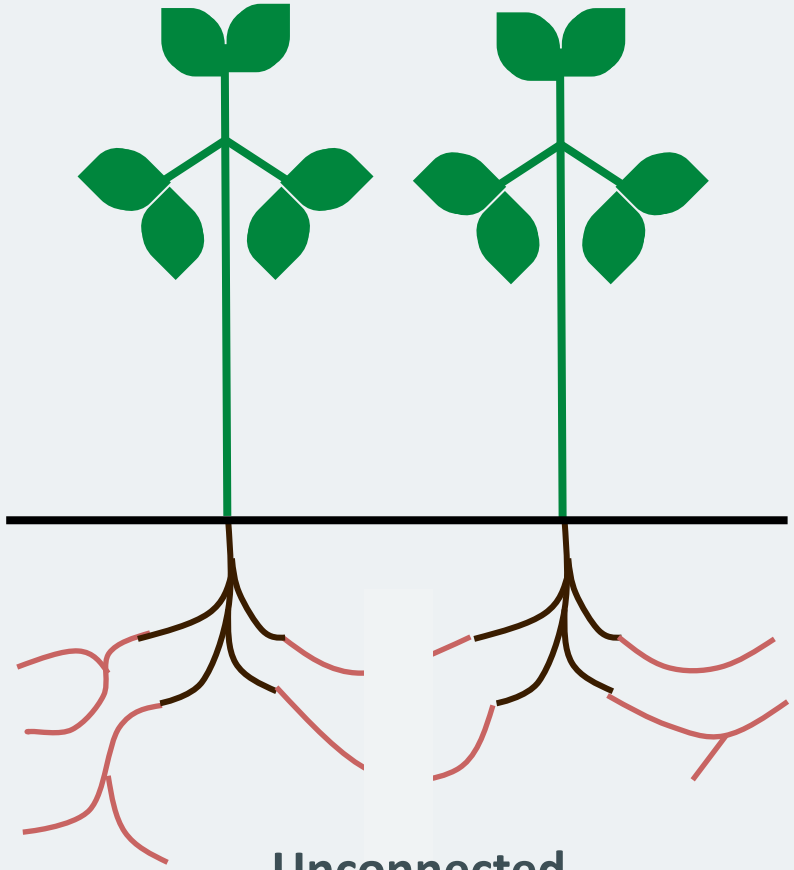


Root Architecture or Species Preference?

Connection Established?

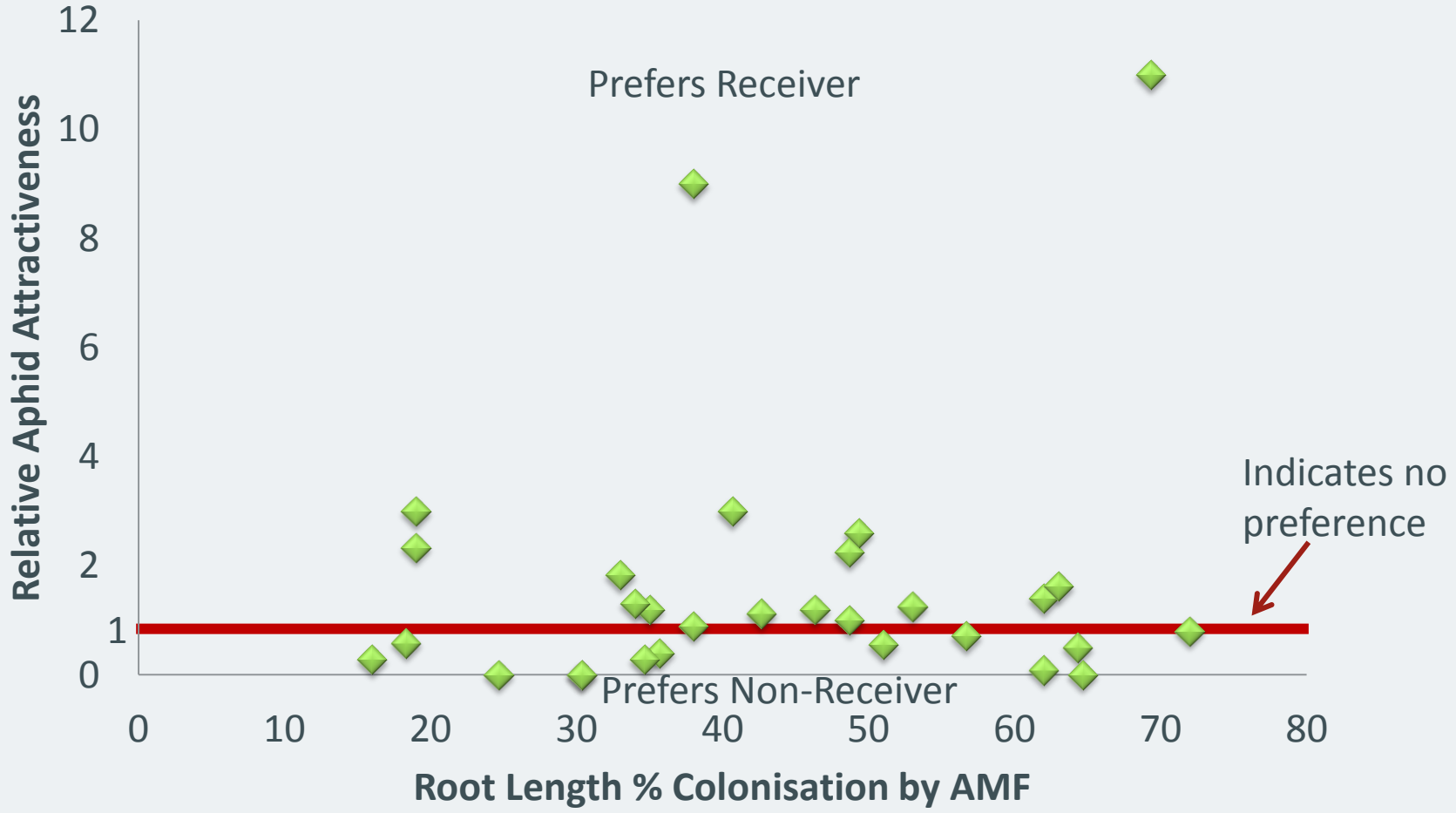


Connected



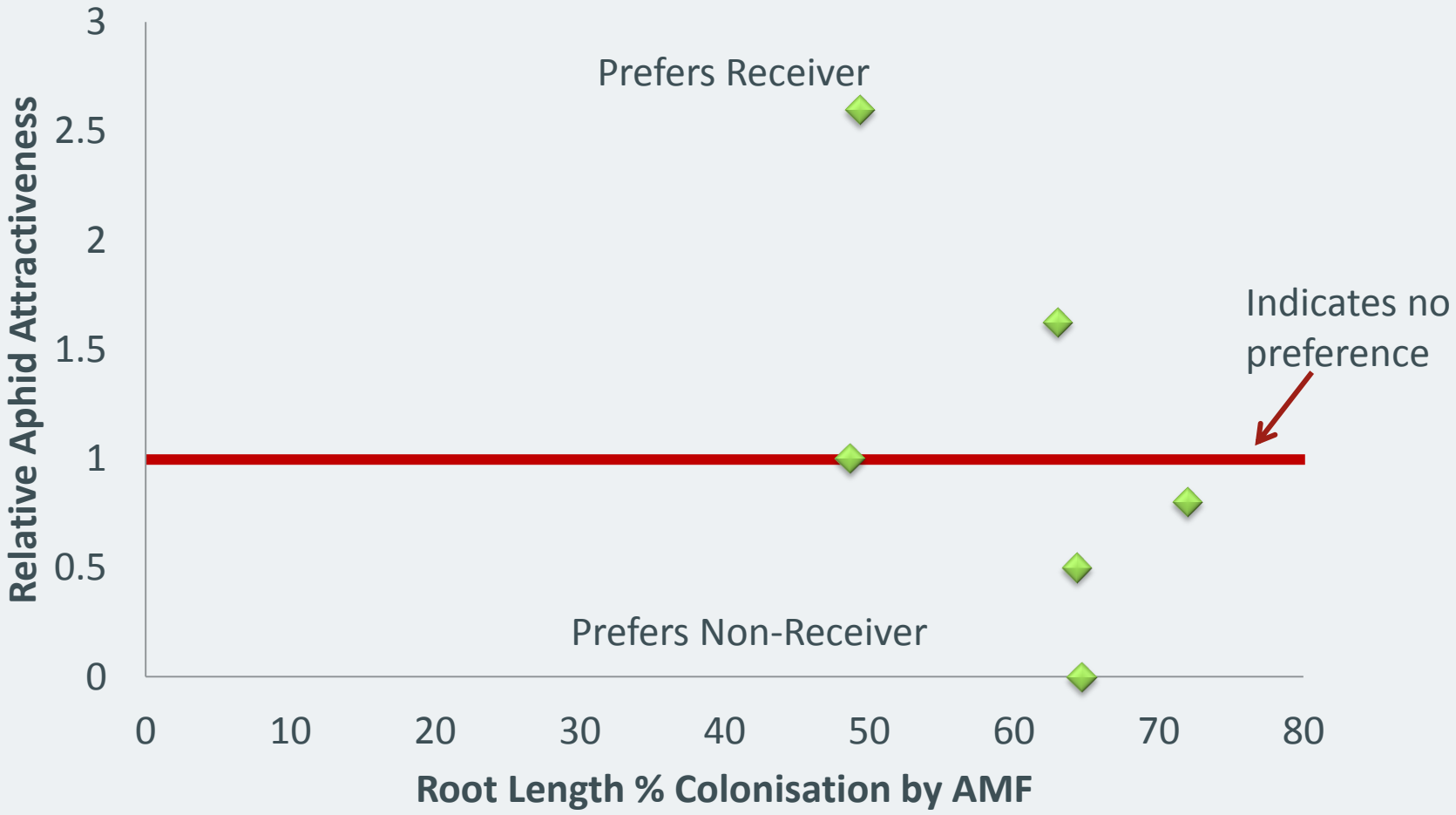
Unconnected

Results: Aphid & AMF Linked?

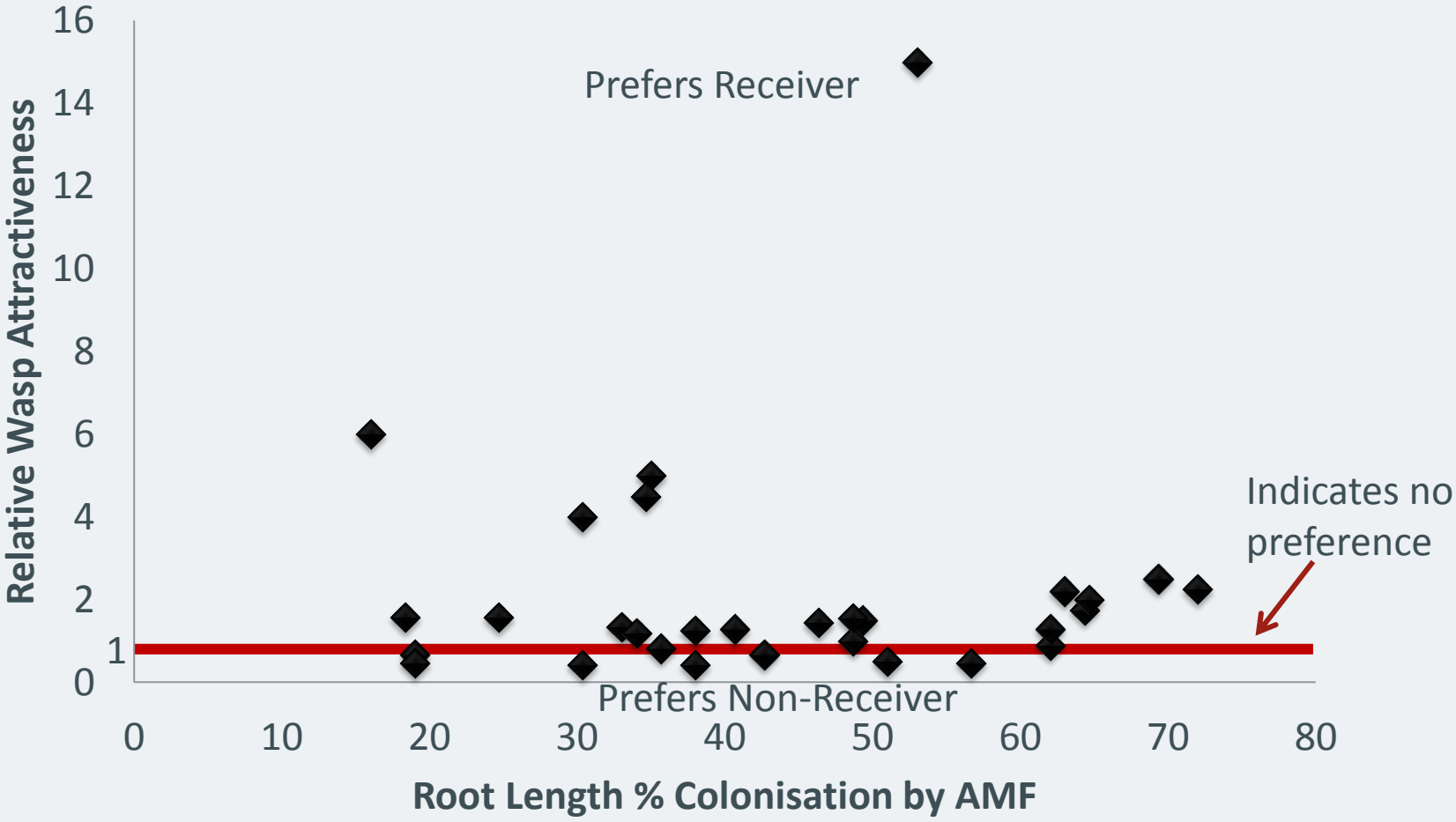


Results: Aphid & AMF Linked?

Plants with over 40% AMF Colonisation: Still no strong pattern

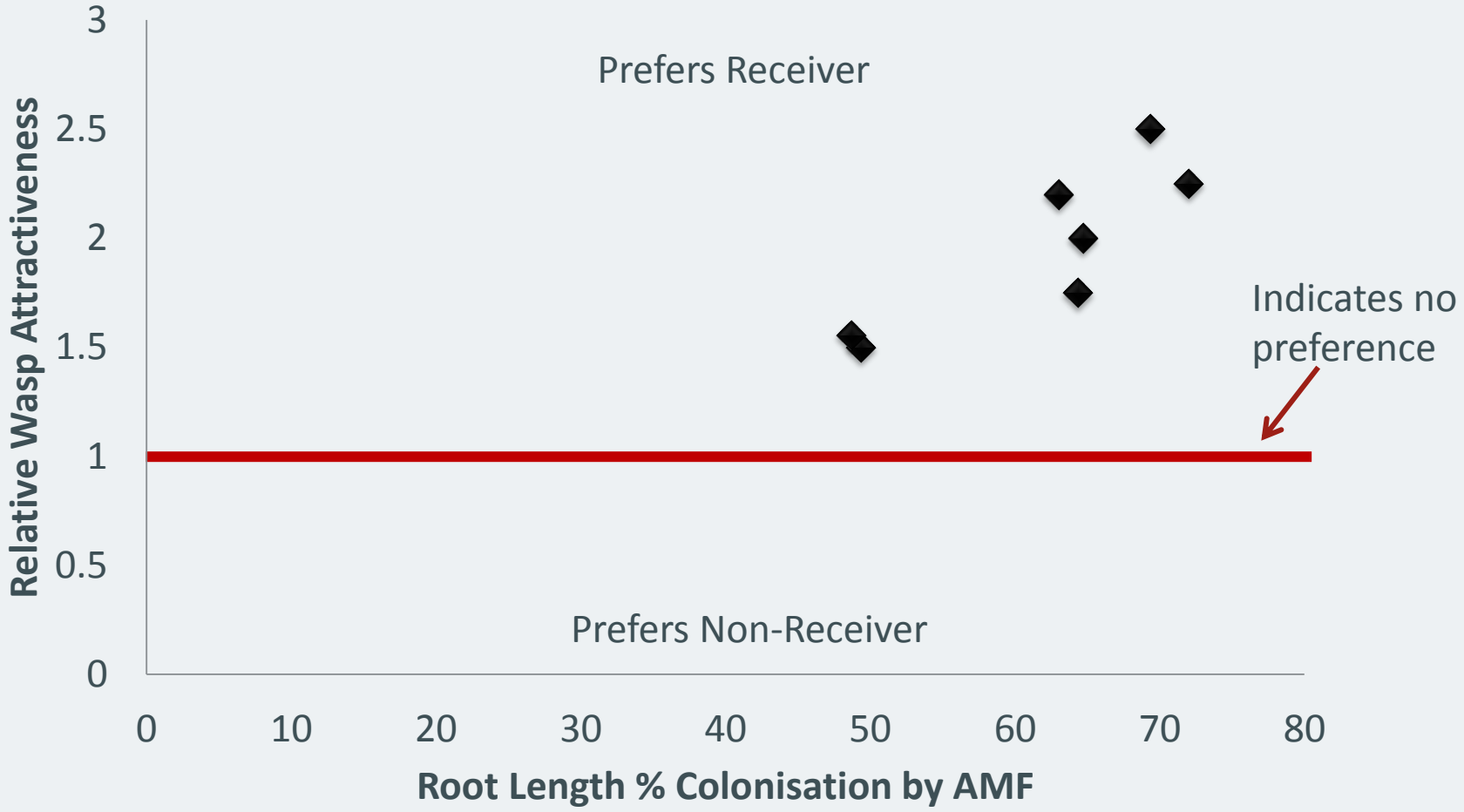


Results: Wasp & AMF Linked?

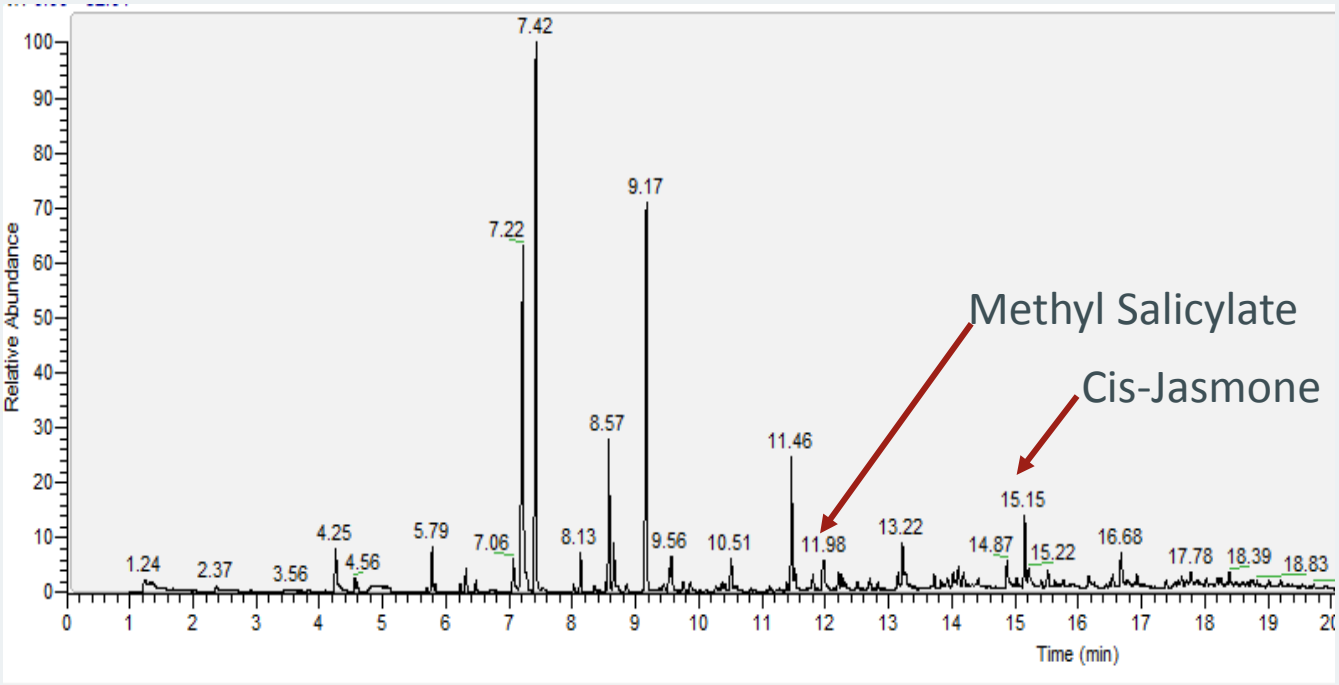


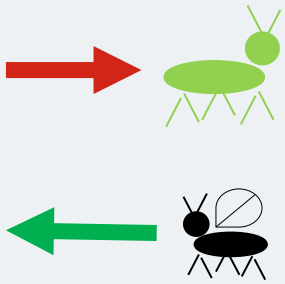
Results: Wasp & AMF Linked?

Plants with over 40% AMF Colonisation: Potential Pattern



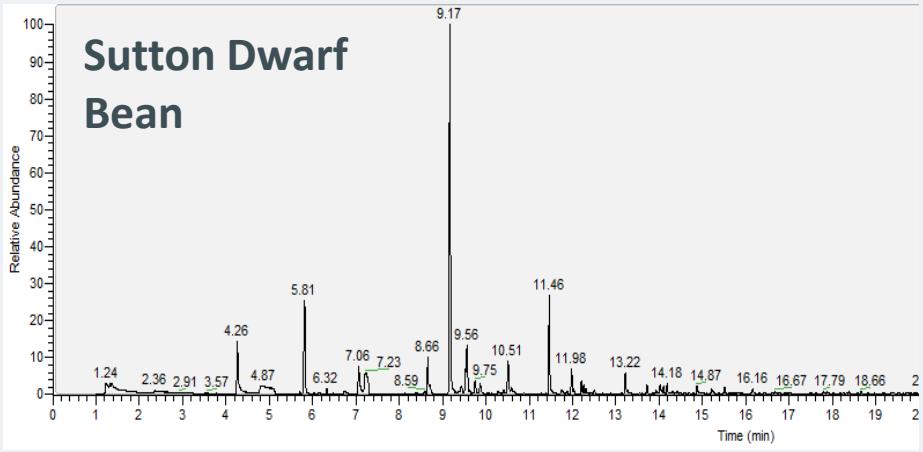
Mechanism: Plant VOCs?

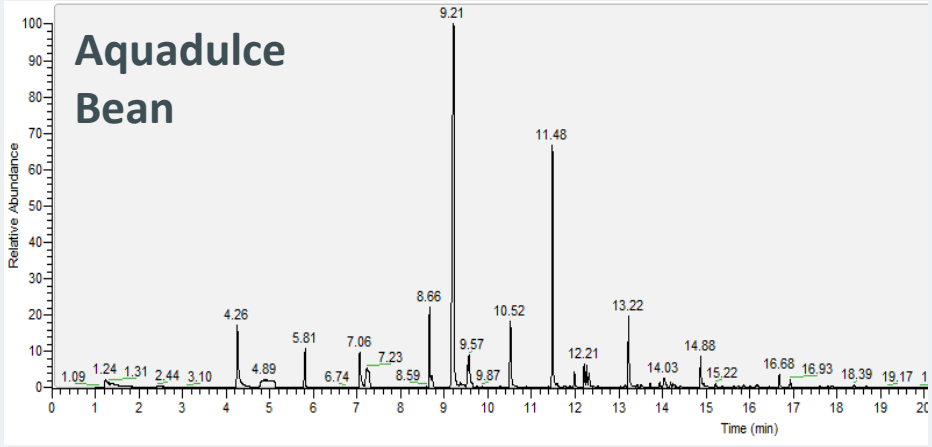


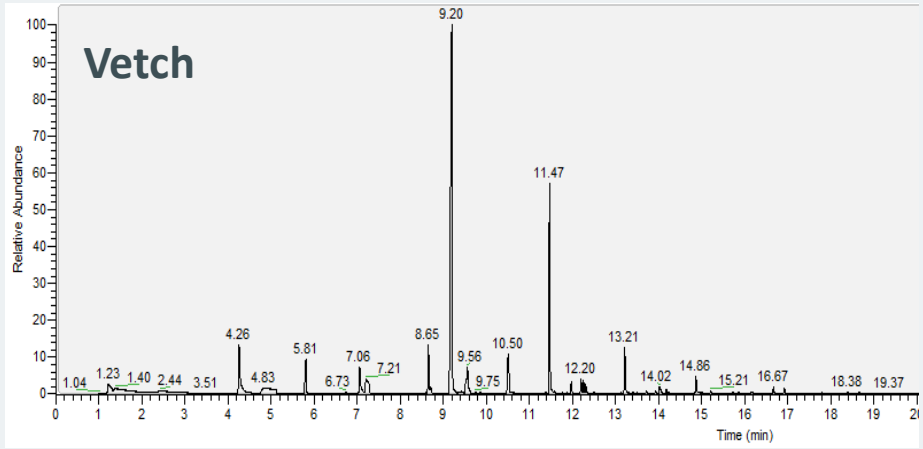


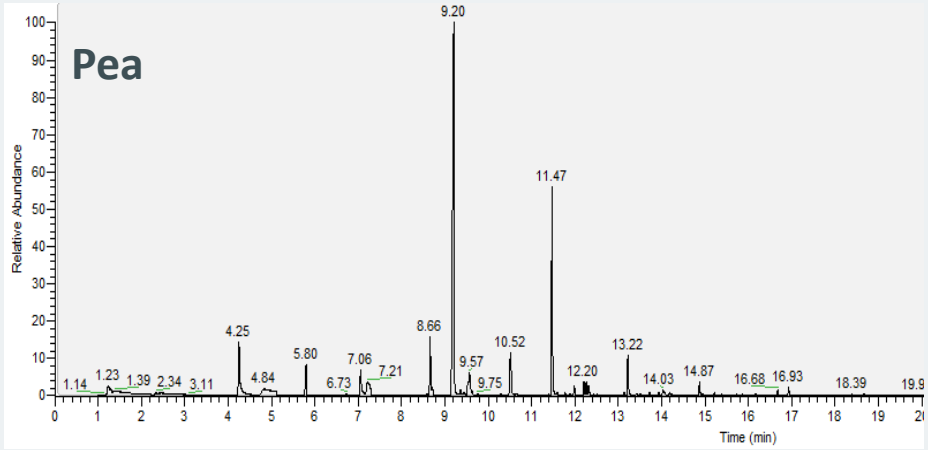
- α-Pinene
- b-Myrcene
- 4-Carene
- cis-β-Ocimene
- Limonene
- Eucalyptol
- cis-3-Hexen-ol-acetate
- trans-β-Ocimene
- Benzaldehyde
- Linalool
- Naphthalene
- Methyl Salicylate
- Cinnamaldehyde
- β-Caryophyllene
- α-Caryophyllene
- Indole
- cis-Jasmone

Plant VOCs Similar

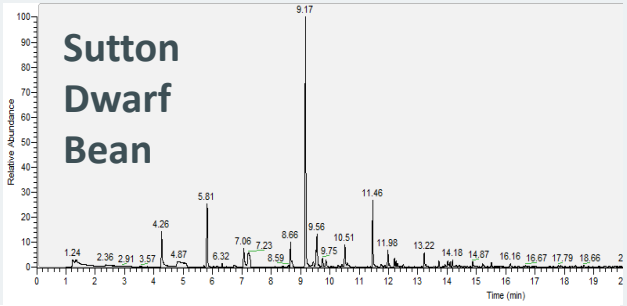


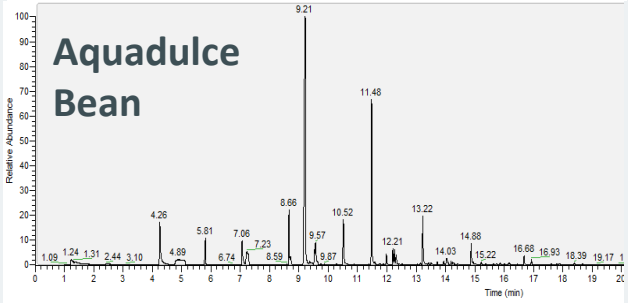


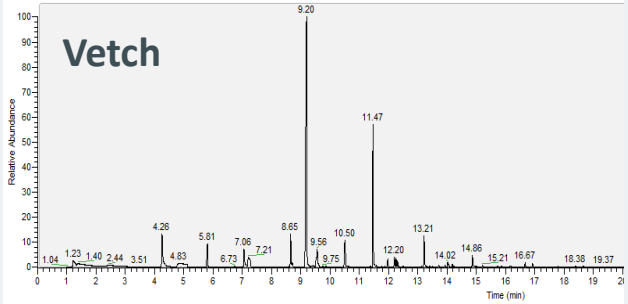


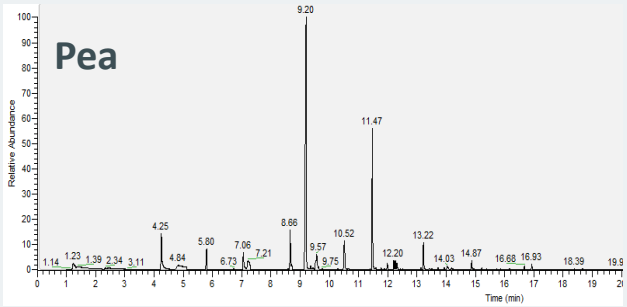


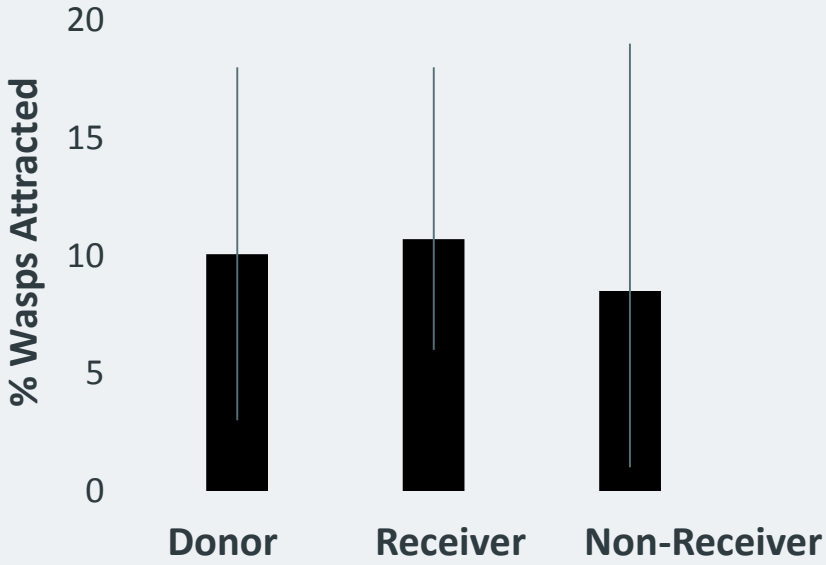
Mechanism: Plant VOCs?



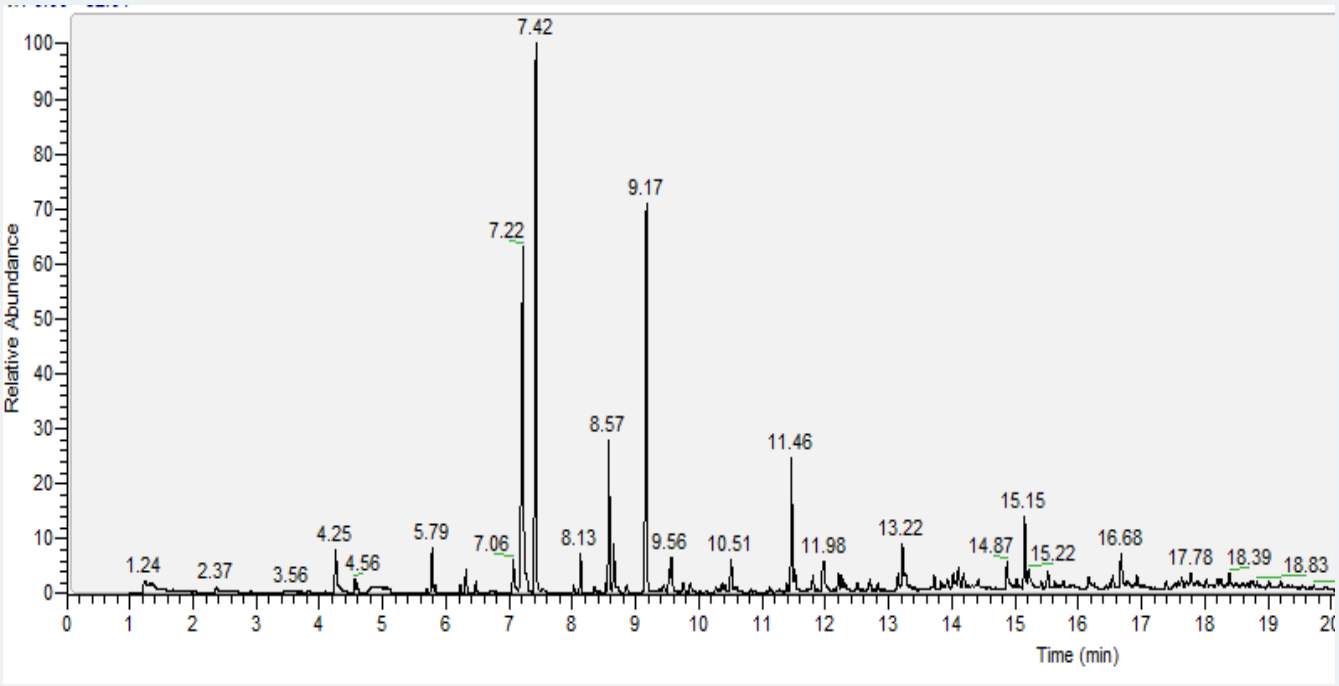








VOCs Associated with AMF



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- Naphthalene
- Methyl Salicylate
- Cinnamaldehyde
- β-Caryophyllene
- α-Caryophyllene
- Indole
- cis-Jasmone

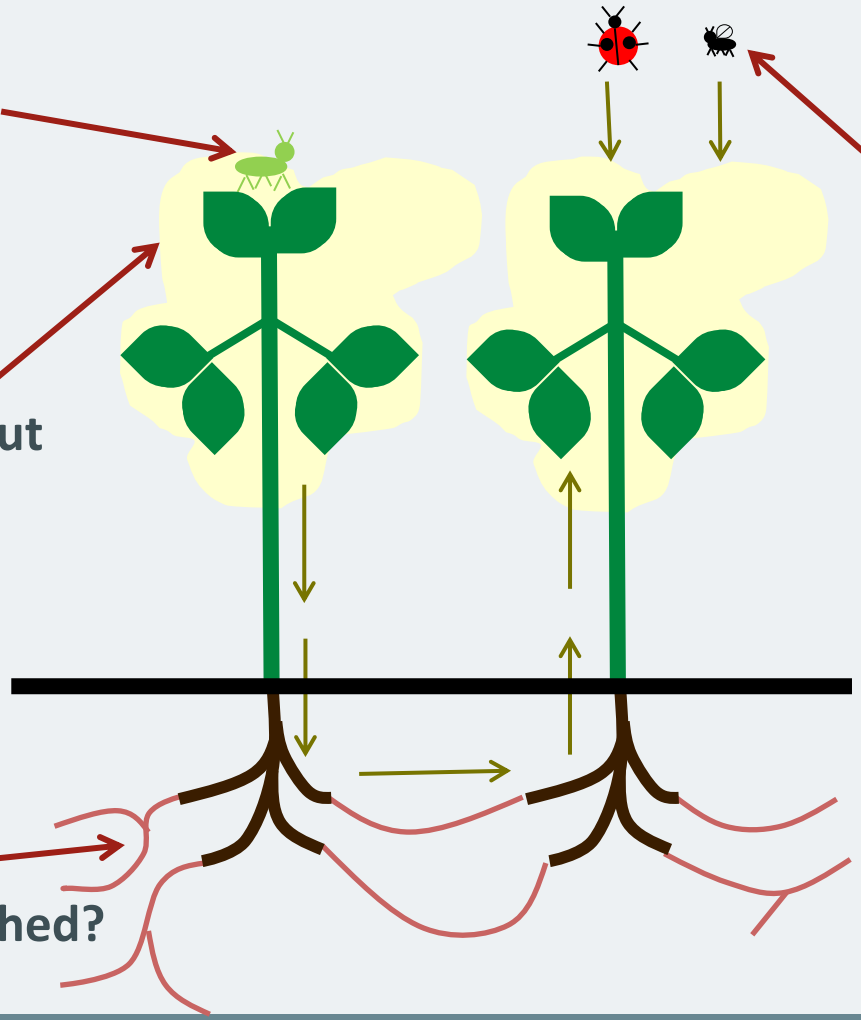
Not sure if VOCs due to

- **Infected with AMF**
- **Infected with Aphids**
- **Combination of AMF and Aphids**

RED = VOCs associated with AMF infected Plants

Conclusions

Can plant-plant signalling occur between different species of related plants that share the same insect pest?



3. No patterns or maternal effects

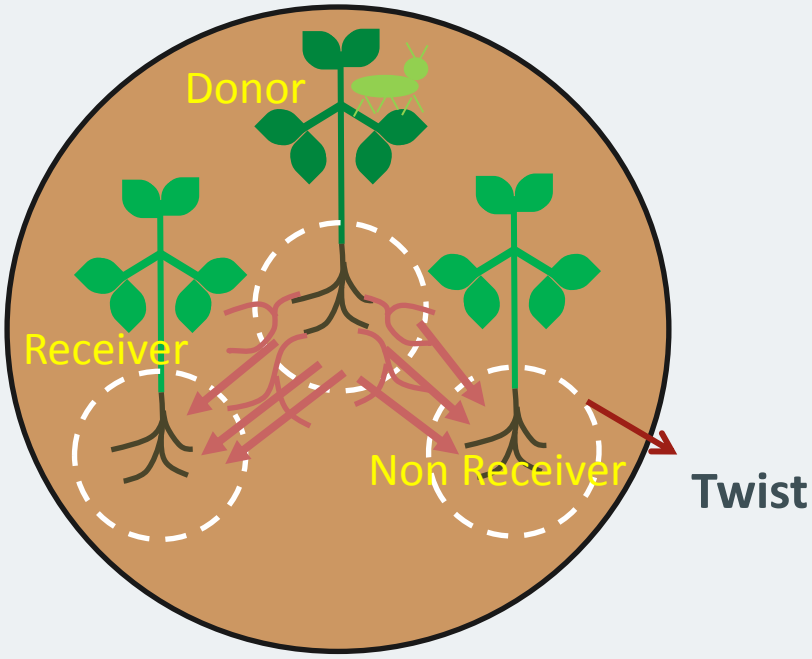
2. Similar profiles but AMF or aphids?

1. Colonised but connection established?

4. Potential response

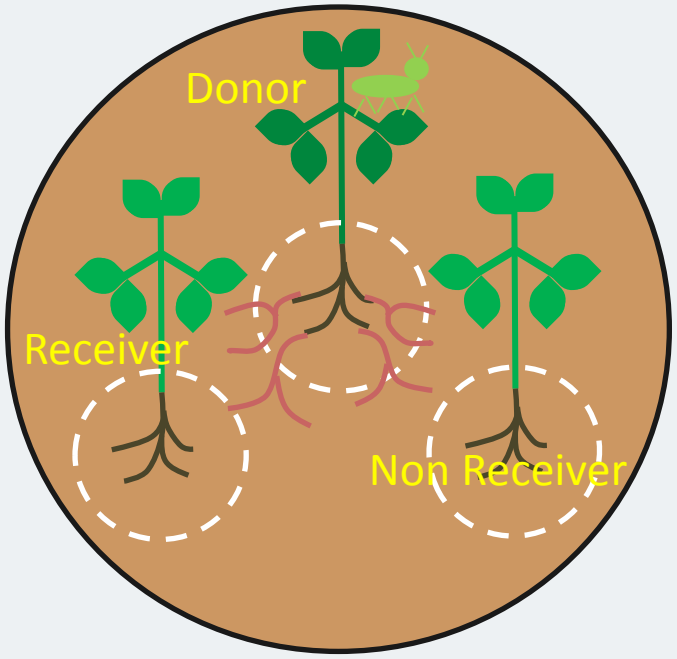
No evidence of plant relatedness impacting on mechanism

Future Work



Twist

Timings?



Plants that DON'T share same insect pest

Why is this Important?

- **Implications for Farm Management**
  - Reduced Pesticides
  - Enhancing Biodiversity
  - **Intercropping**
  - Field Margins
  - Ecosystem Services
    - Pollination and **Biocontrol**
  - Landscape Management

Monoculture

Intercrop

Acknowledgements



Ali Karley's Lab Group

Alison Bennett's Lab Group

- Sandra Caul
- Peter Orrell
- Antonino Malacrino

Tom Shepherd

Scottish Food Security Alliance Crops