Linking above and belowground interactions in agro-ecosystems:

An ecological network approach

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The James Hutton Institute

Outline

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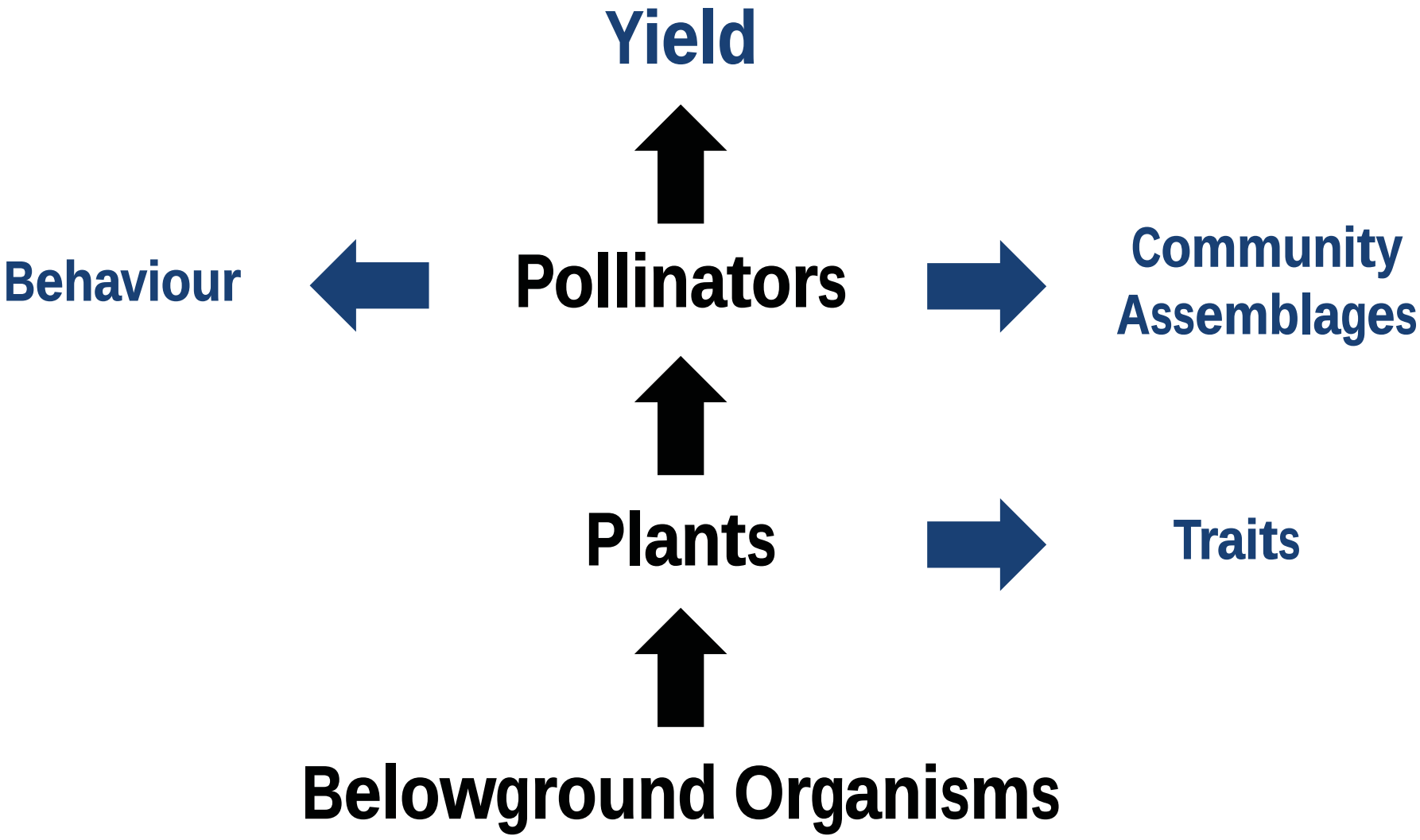
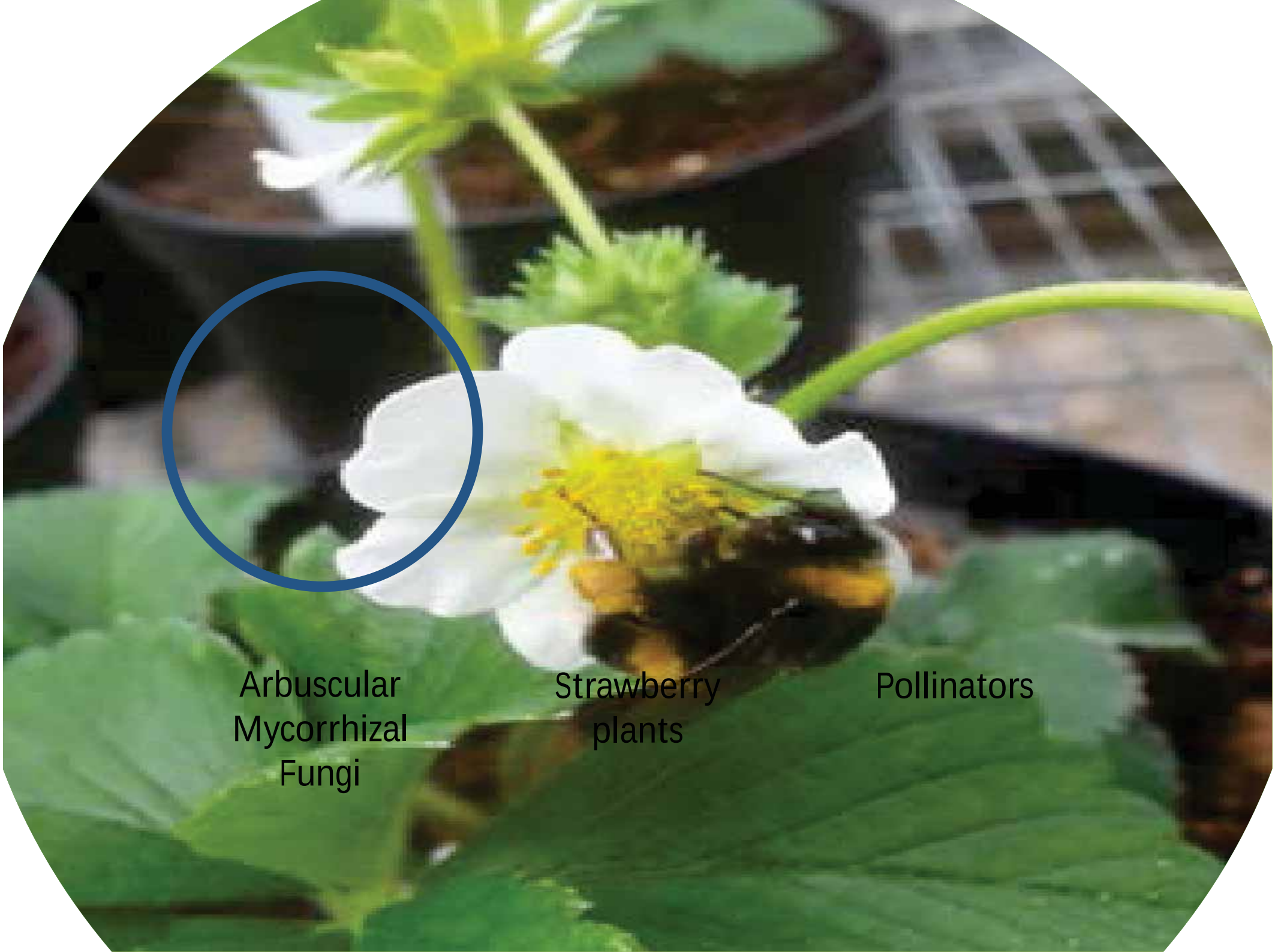
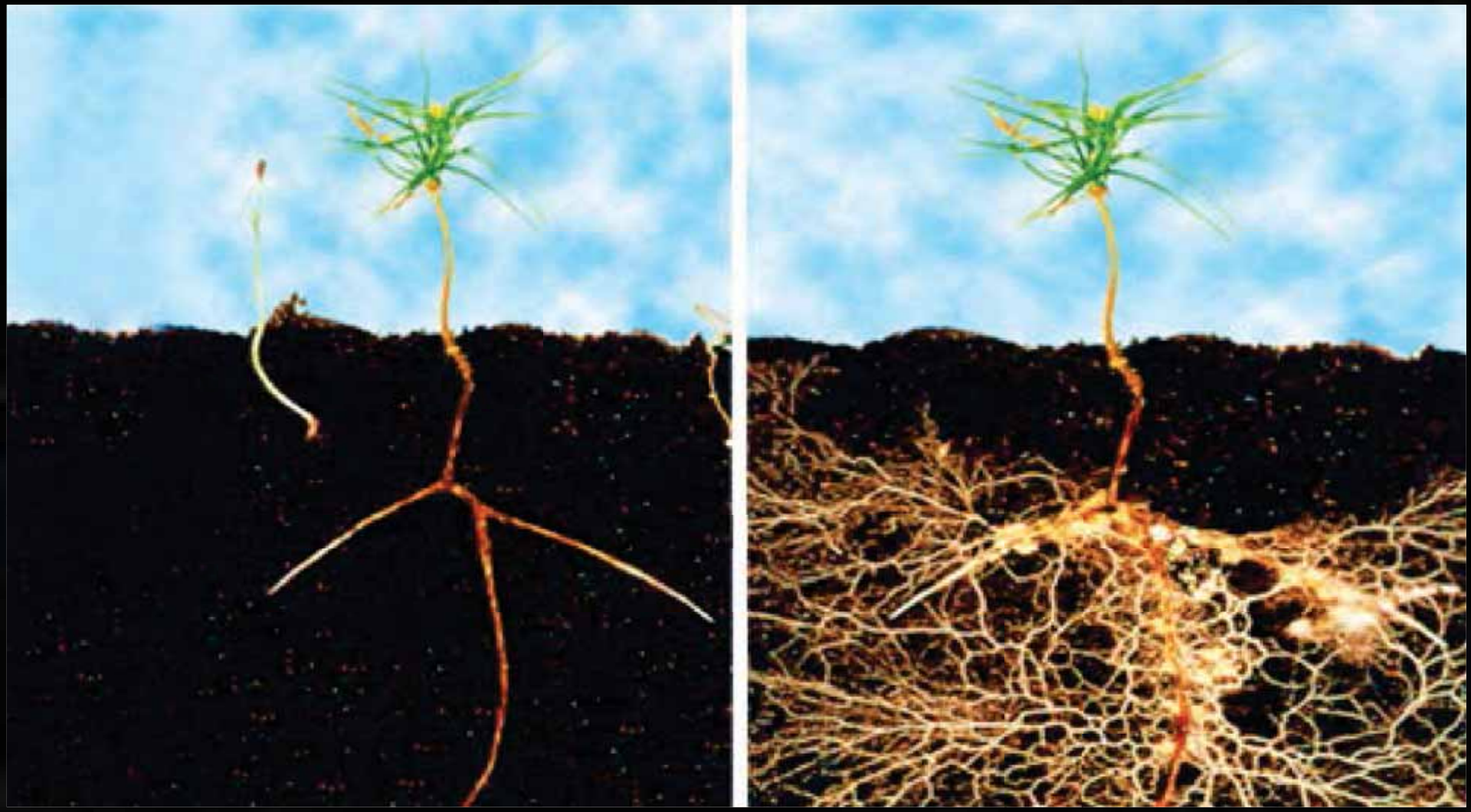
- Model system
- Results
- Above-Belowground Networks
- Future Plans

Overall Research Question




Arbuscular Mycorrhizal Fungi
Strawberry plants
Pollinators

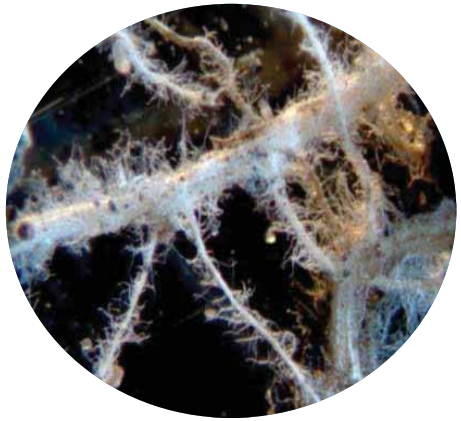
AMF – what are they?



Effects of AMF

- Biomass / Drought Tolerance
- Response to infection / Δ Gene expression

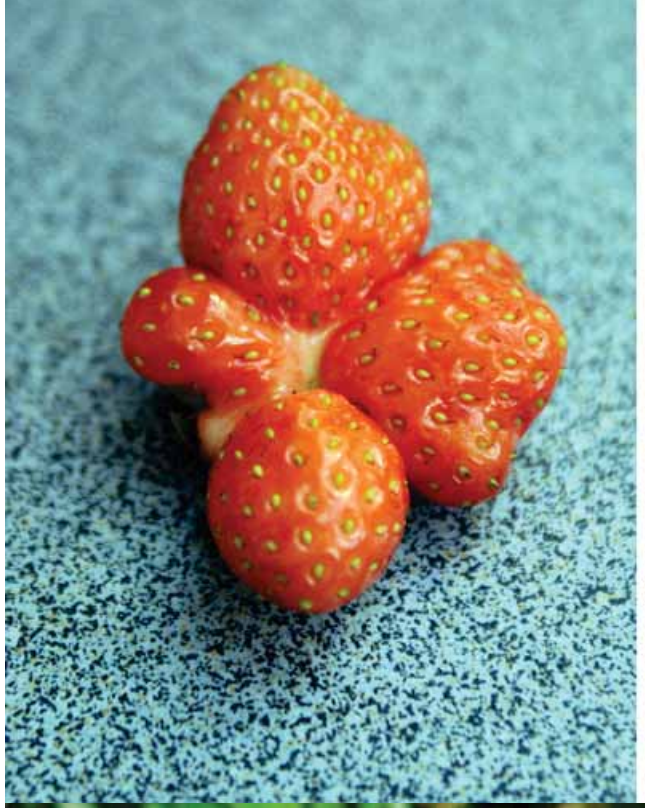
- Plant physiology
- Defensive compounds
- Reproductive effects



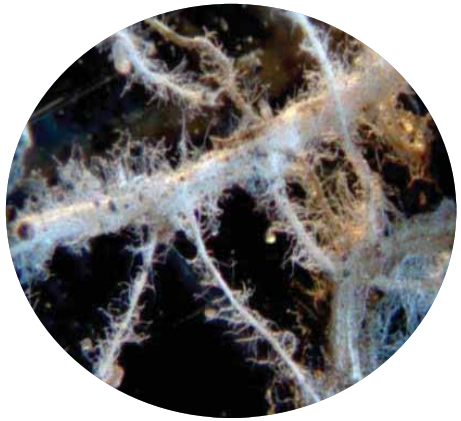
Arbuscular Mycorrhizal Fungi

Strawberry plants

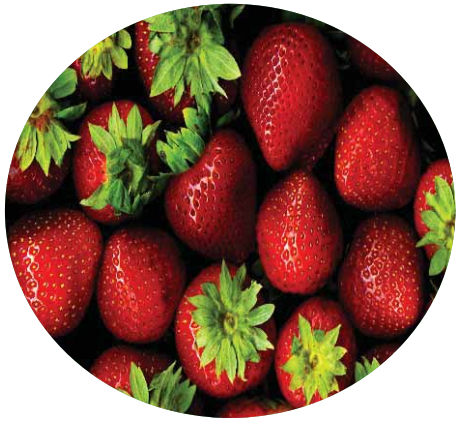
Pollinators





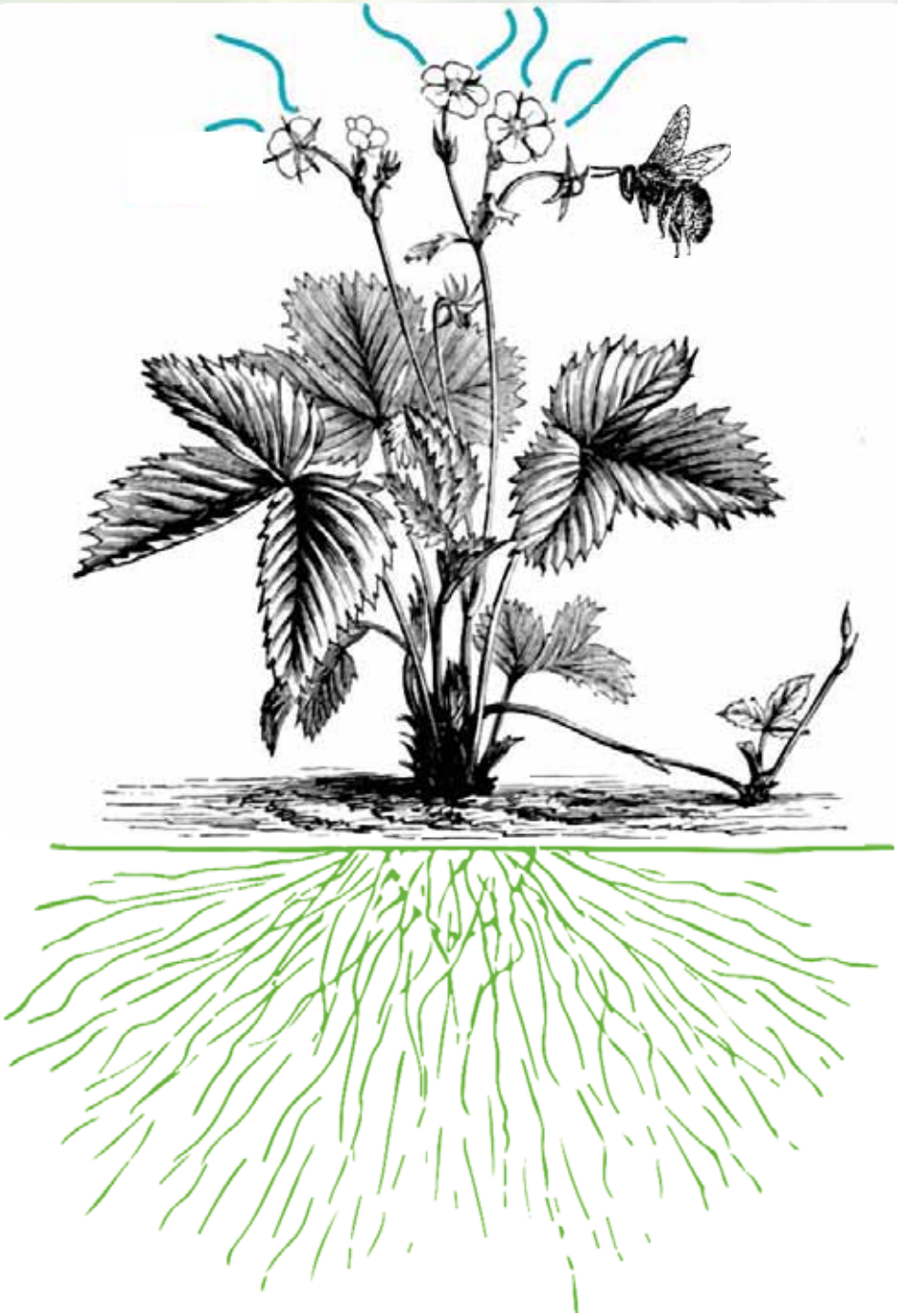


Arbuscular Mycorrhizal Fungi



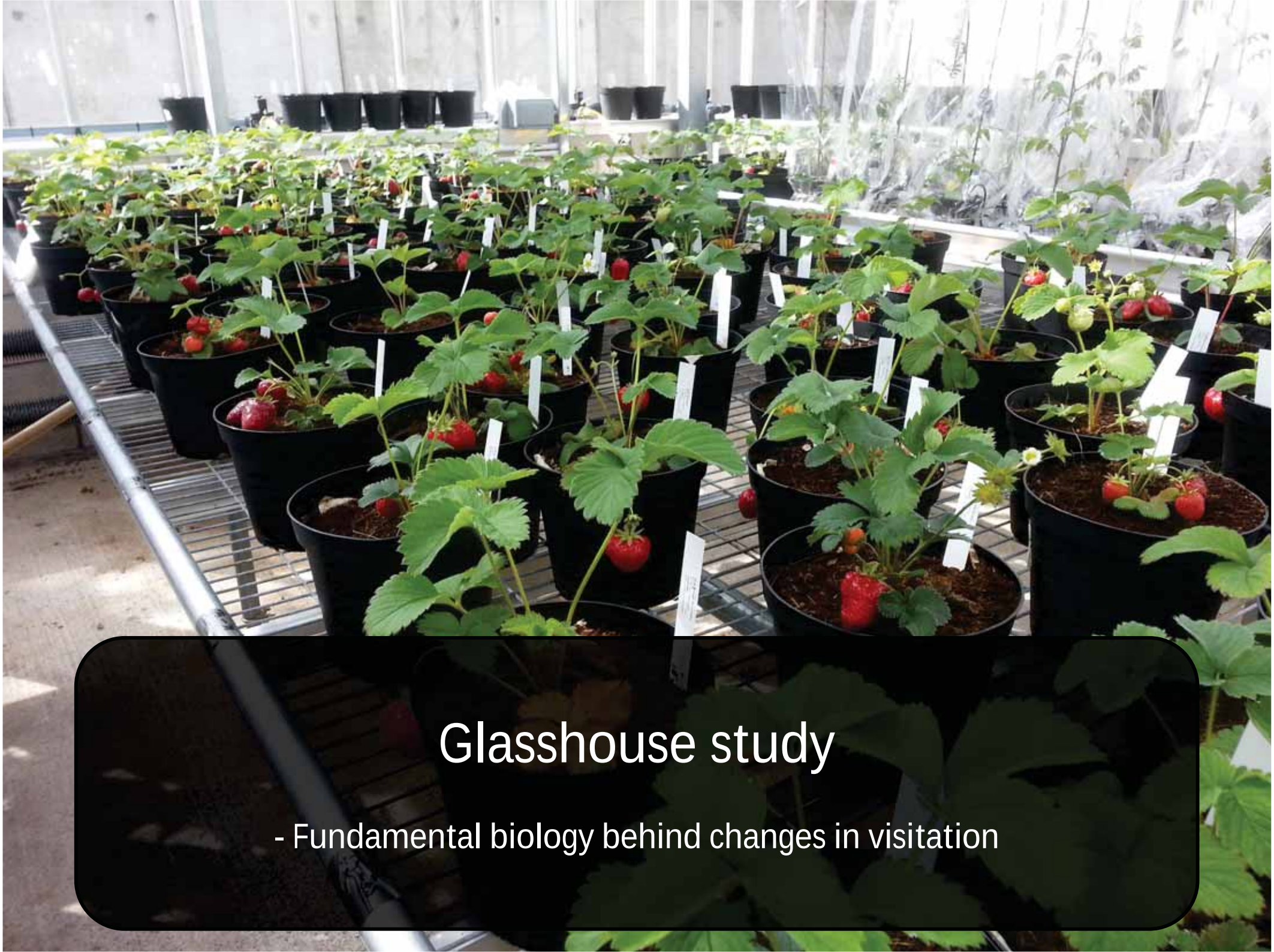
Strawberry plants

Pollinators



Experimental System

- Glasshouse and field experiment – 2 years
- 3 Varieties of Strawberry plants
- Manipulated belowground community:
  - 4 AMF treatments
- Pollinator transects
- Yield

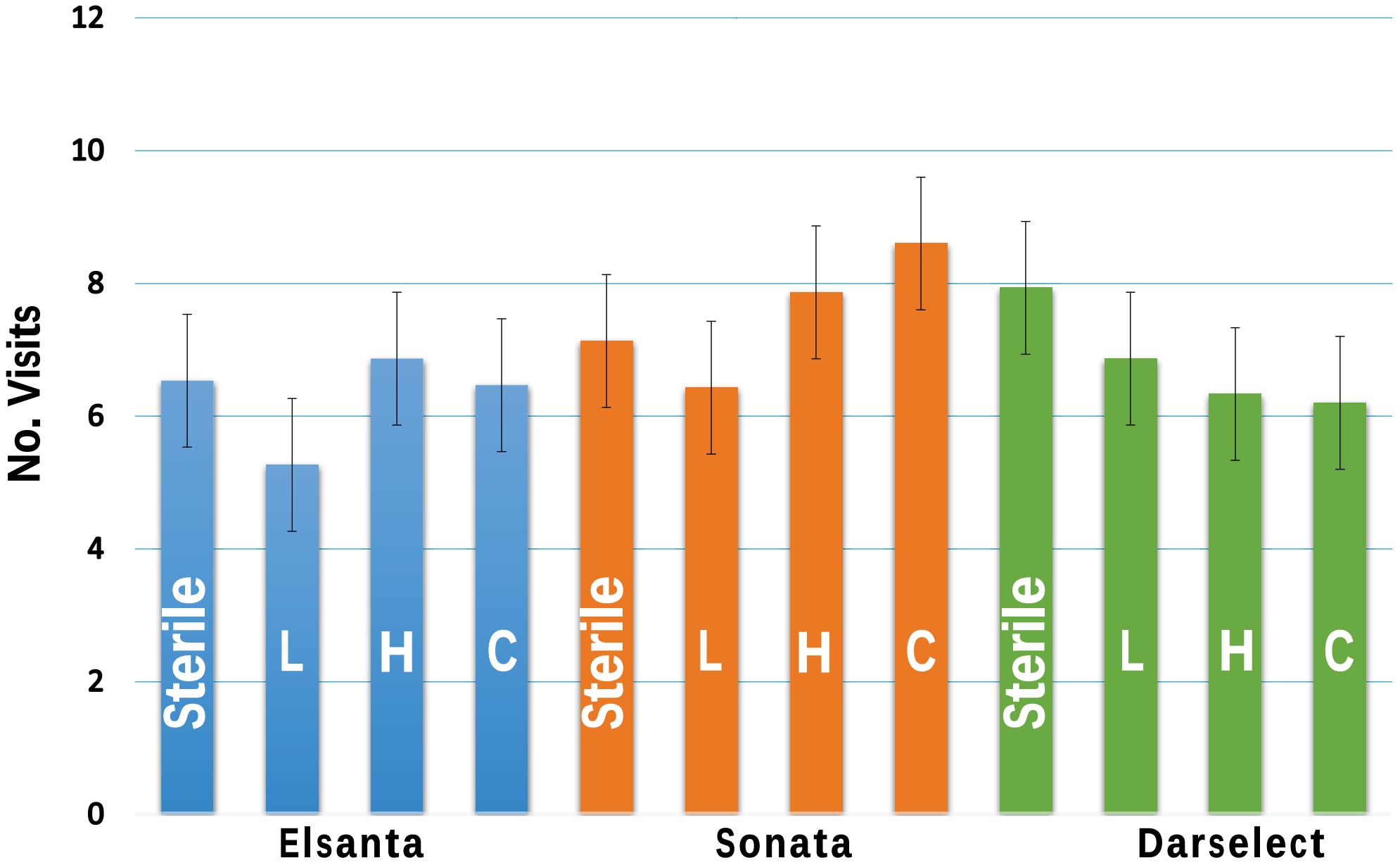


Glasshouse study

- Fundamental biology behind changes in visitation

Glasshouse

Variety and AMF does not influence *B.terrestris* visitation



Glasshouse

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Glasshouse

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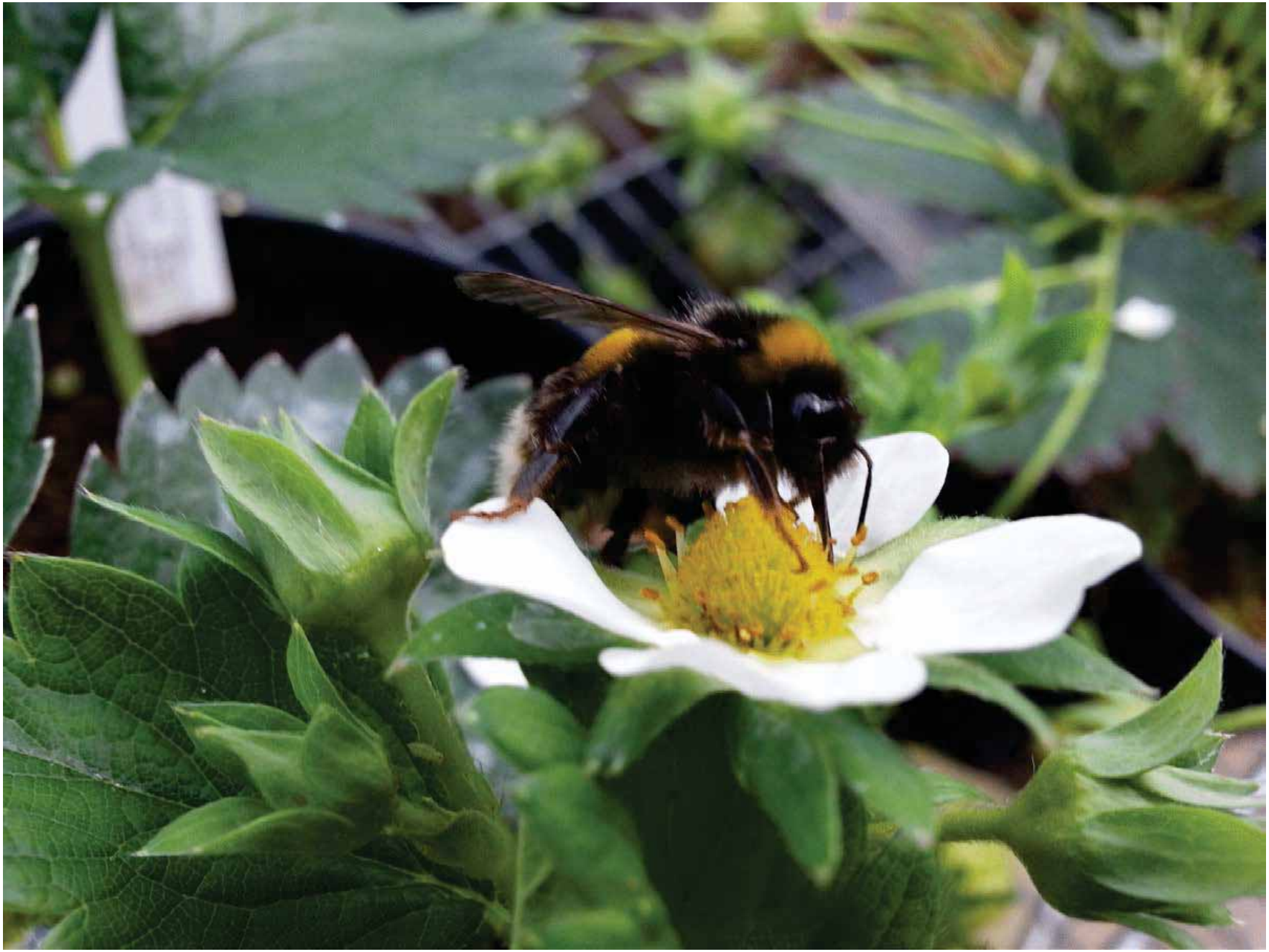

Glasshouse

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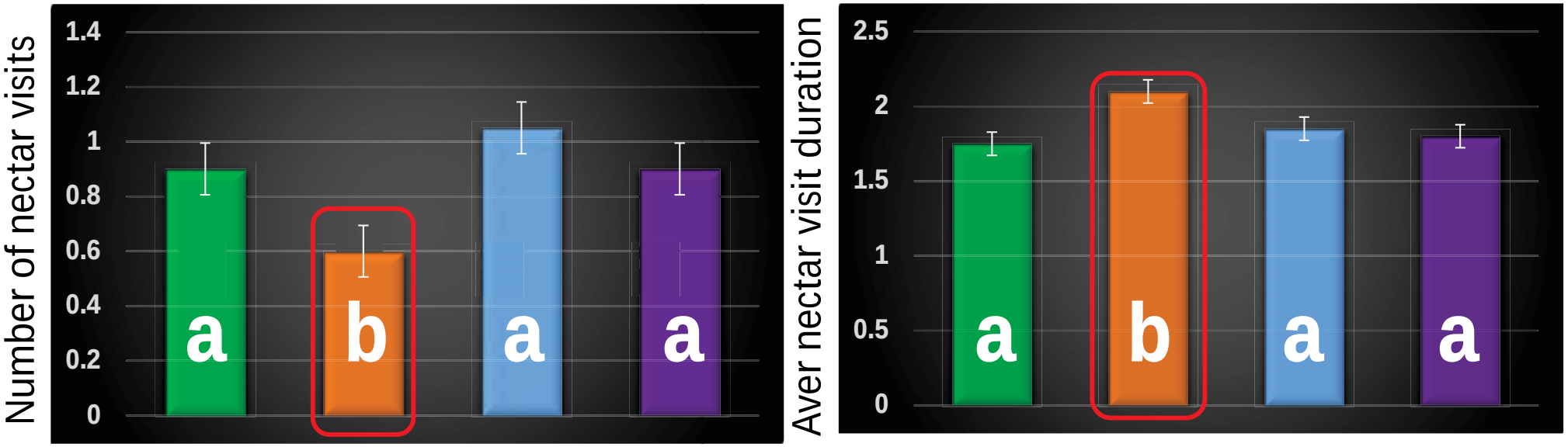
AMF community influences bumblebee behaviour



Glasshouse

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Why?

AMF / Genotype influence changes in:

Floral Volatiles → Attractant → Number of Visits / Species Attracted

Pollen & Nectar Quantity / Quality → Foraging Resource → Duration of Visits / Foraging behaviour

Glasshouse

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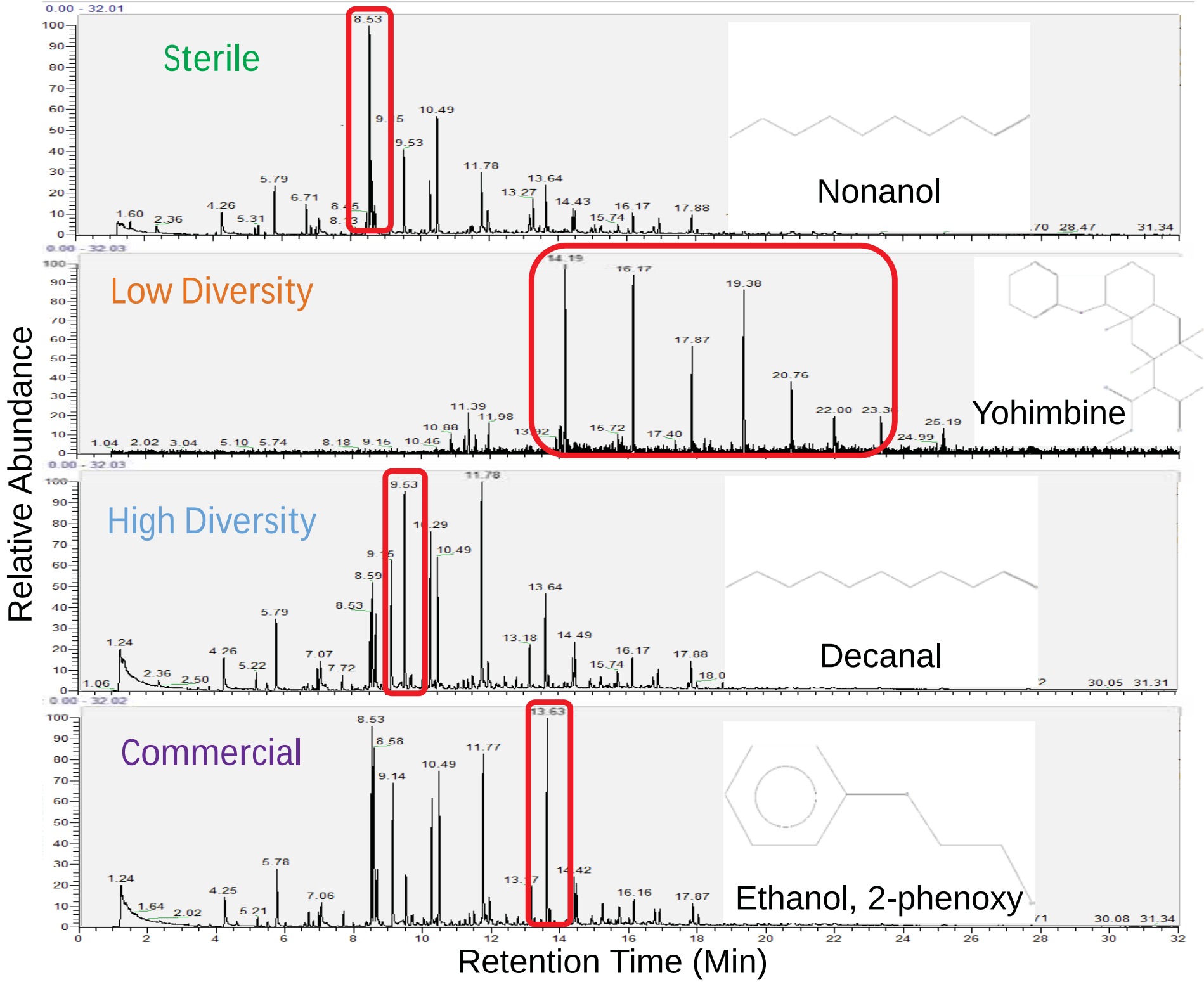
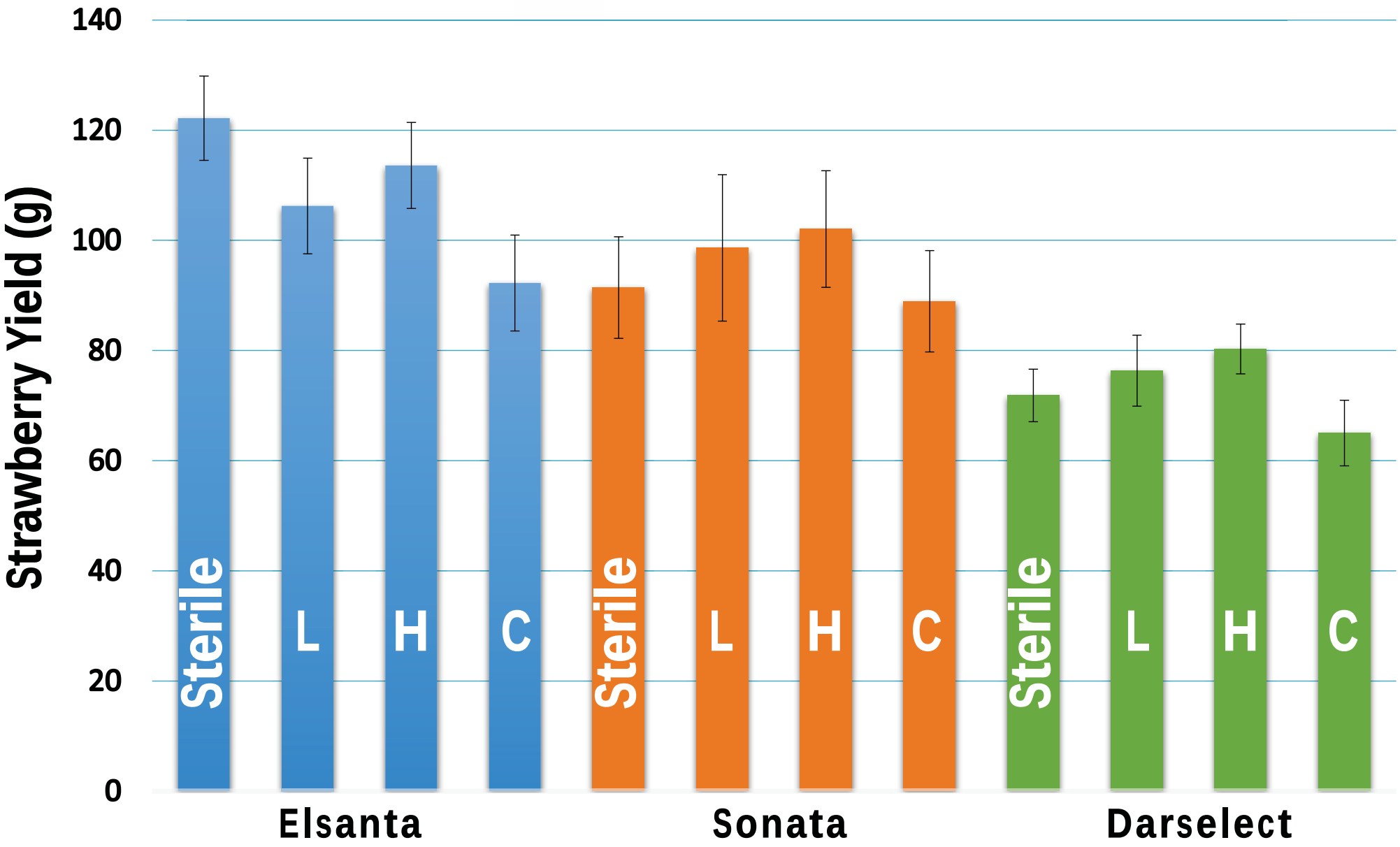
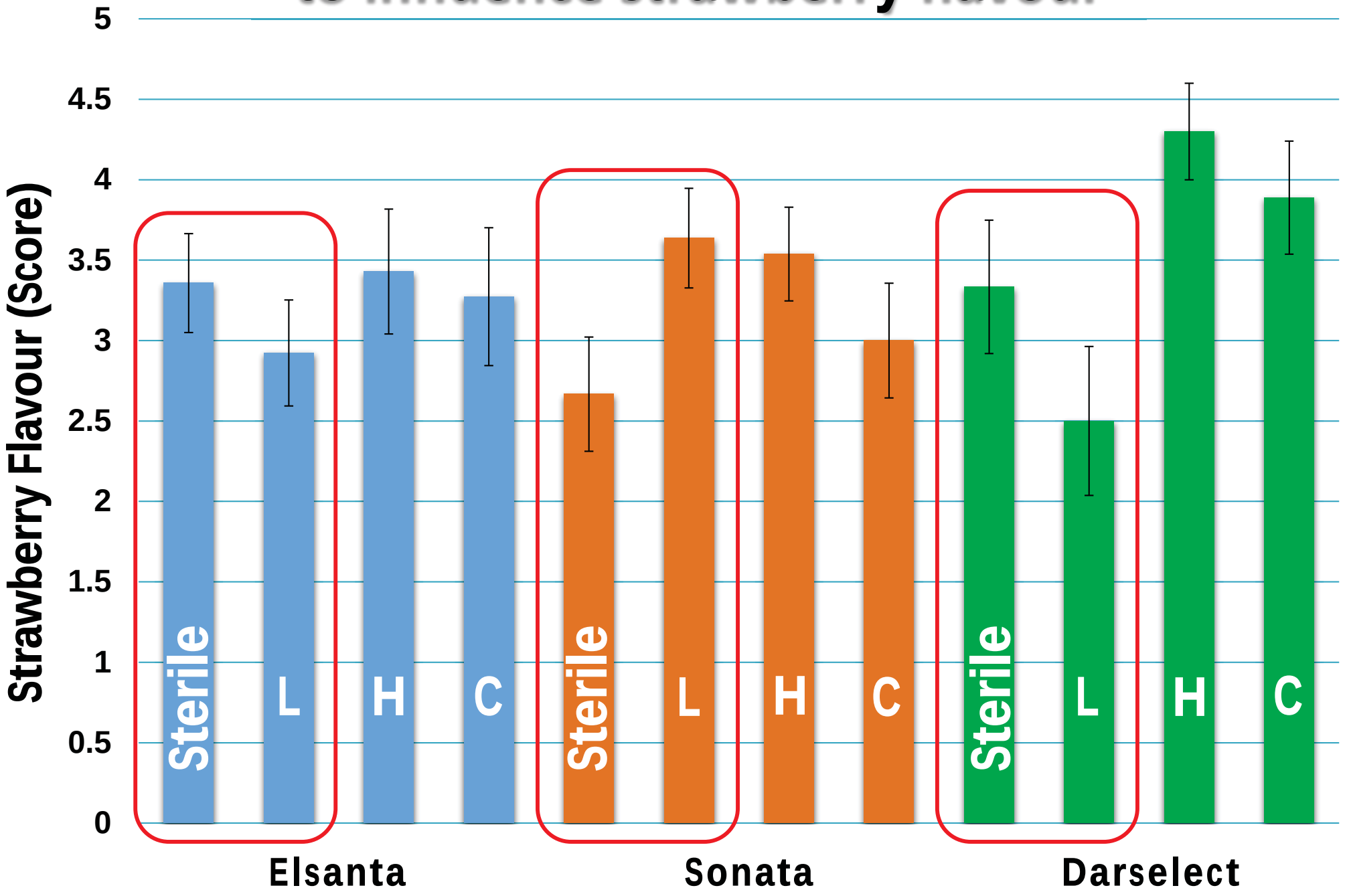

Sterile
Nonanol
Low Diversity
Yohimbine
High Diversity
Decanal
Commercial
Ethanol, 2-phenoxy
Relative Abundance
Retention Time (Min)

Variety strongly influences yield
AMF shows a trend to influence yield

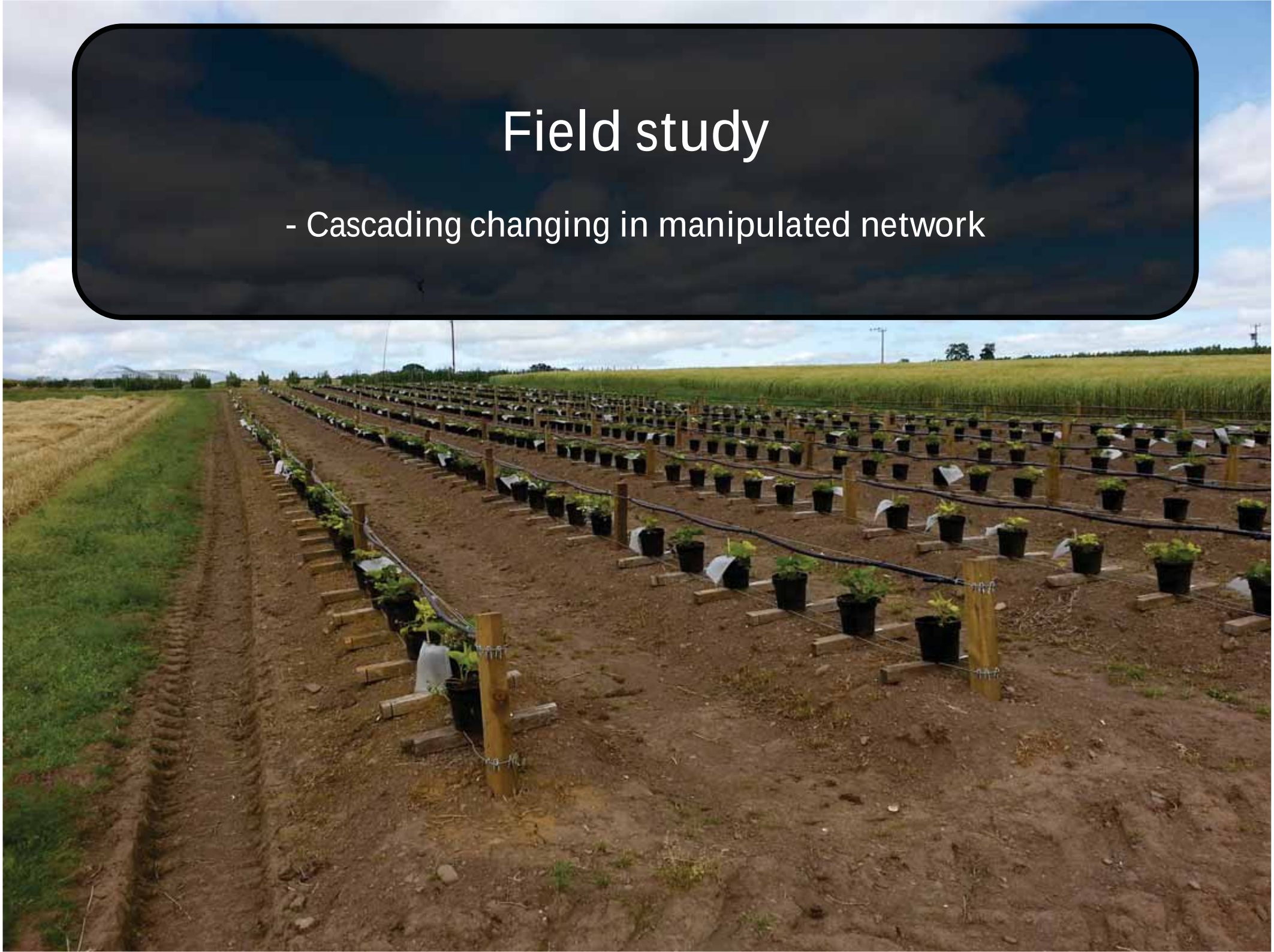


AMF and Variety interact to influence strawberry flavour



Field study

- Cascading changing in manipulated network



Field

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Plant Variety influences the visiting pollinator community

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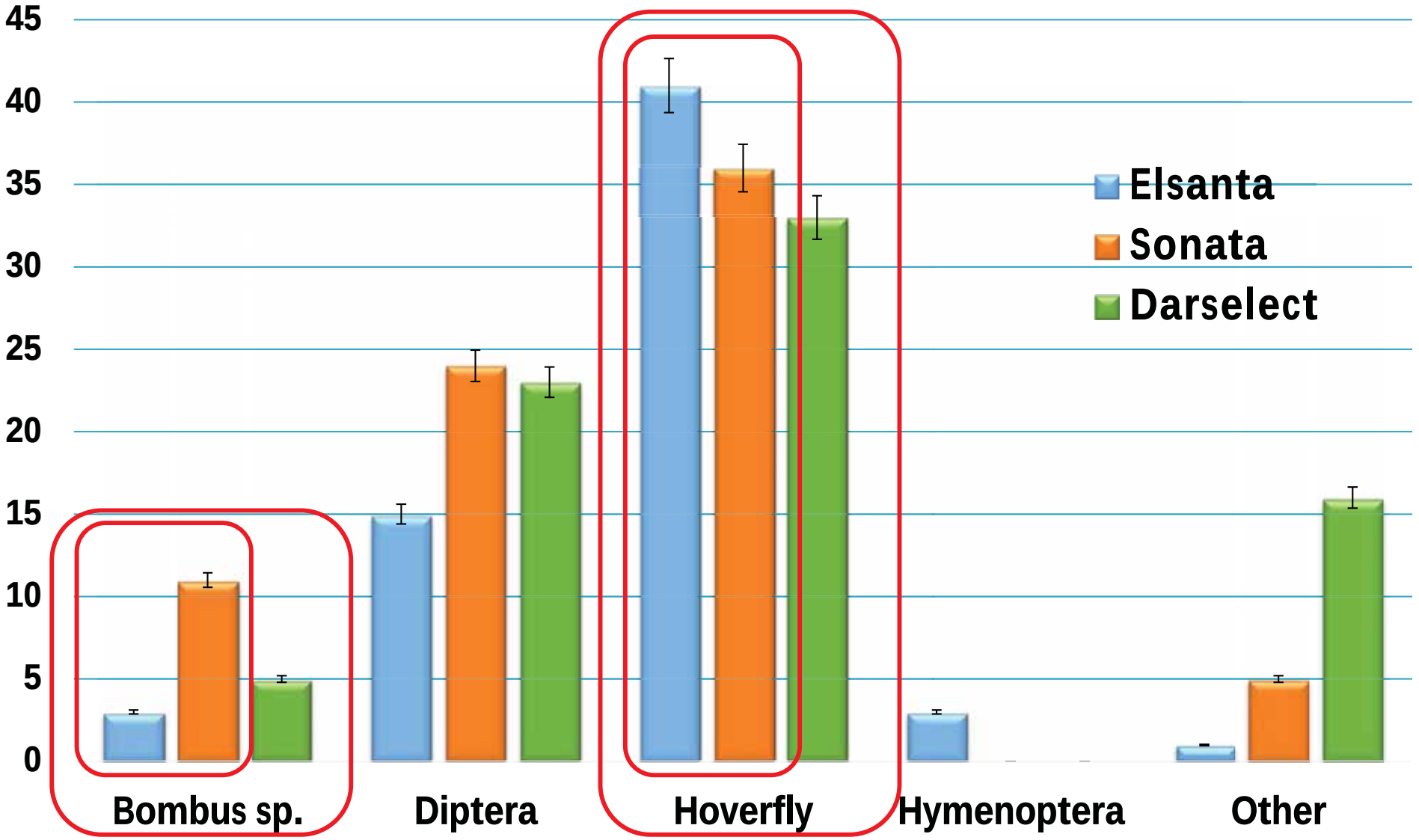

Example Network

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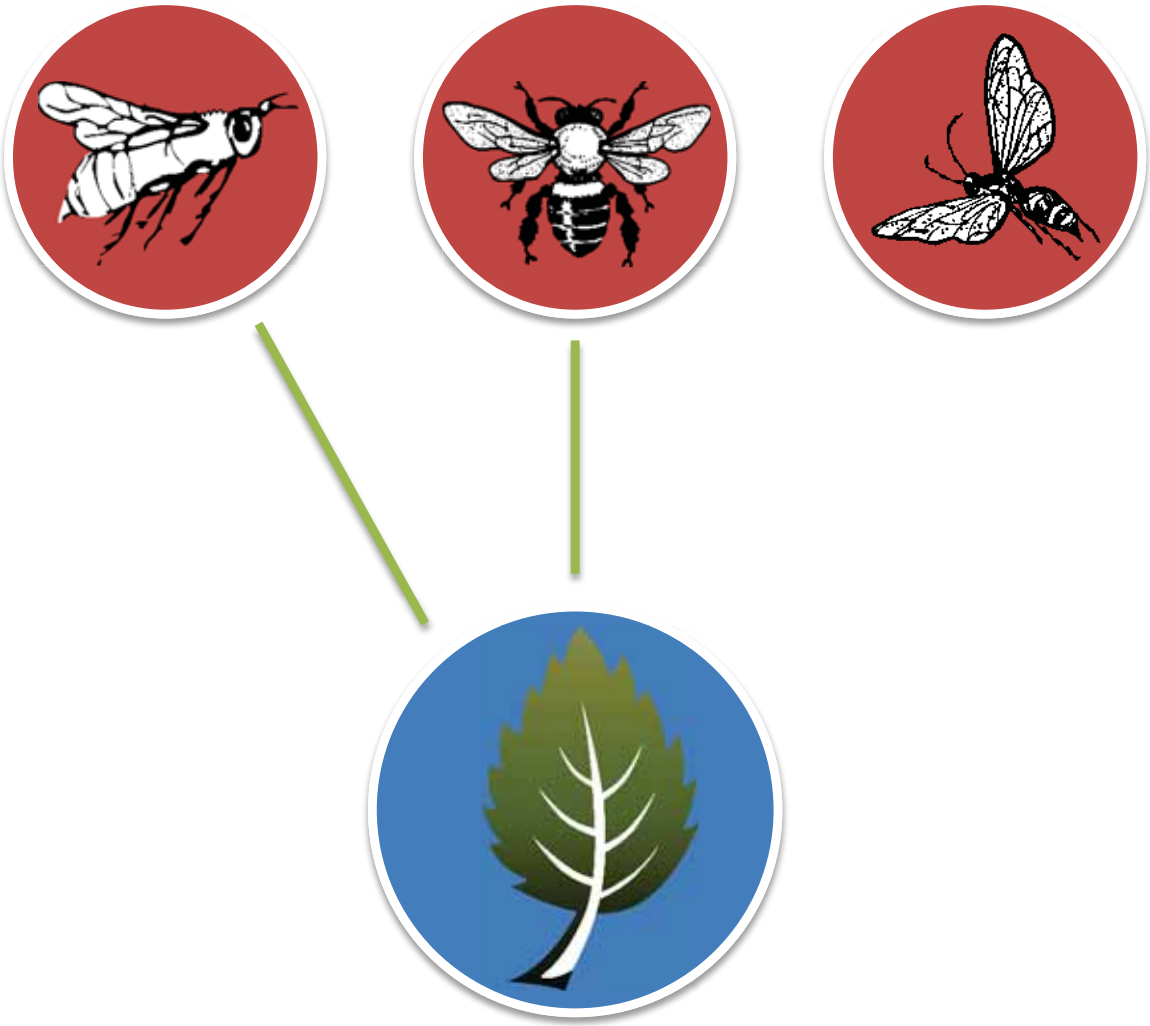

Example Network

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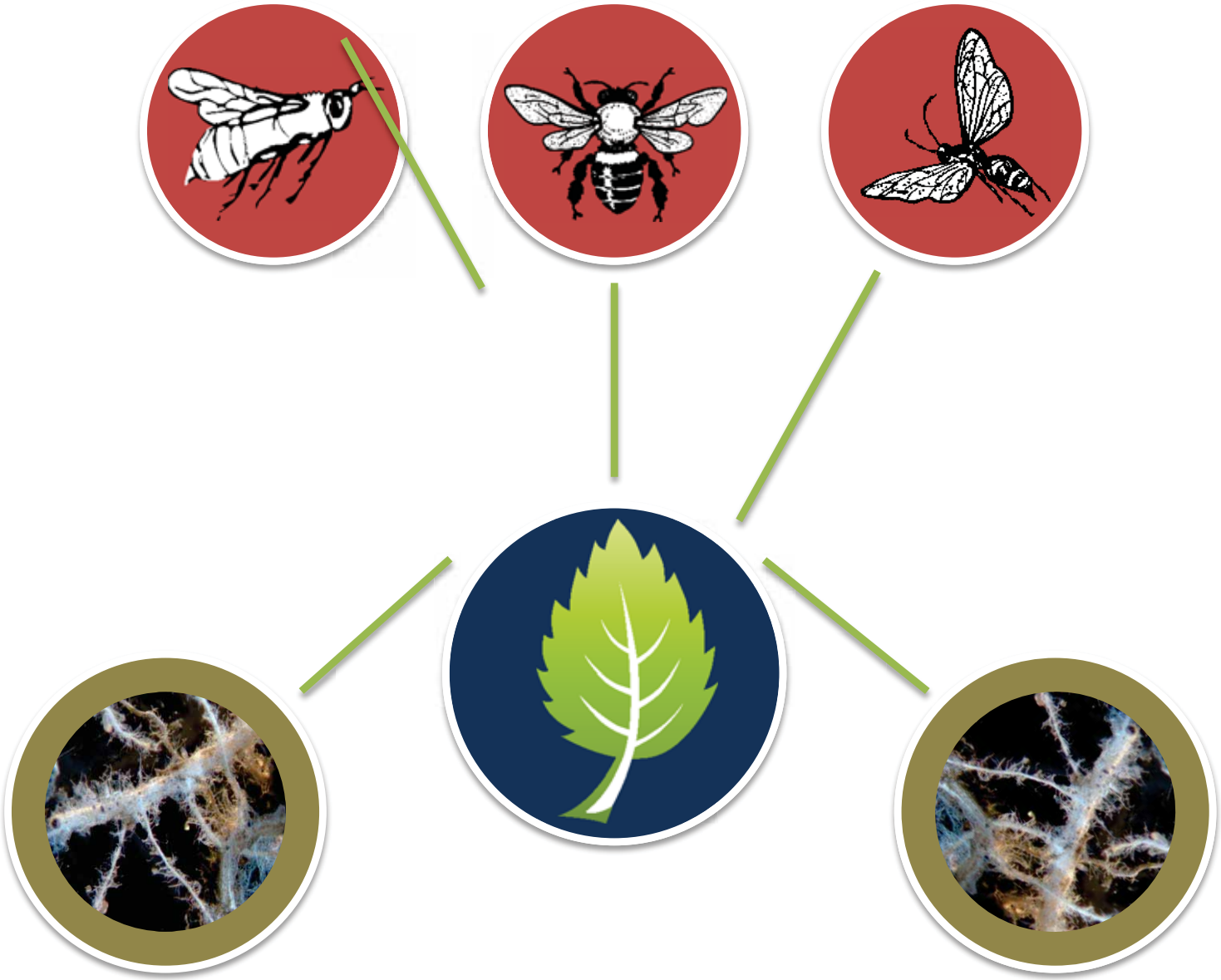
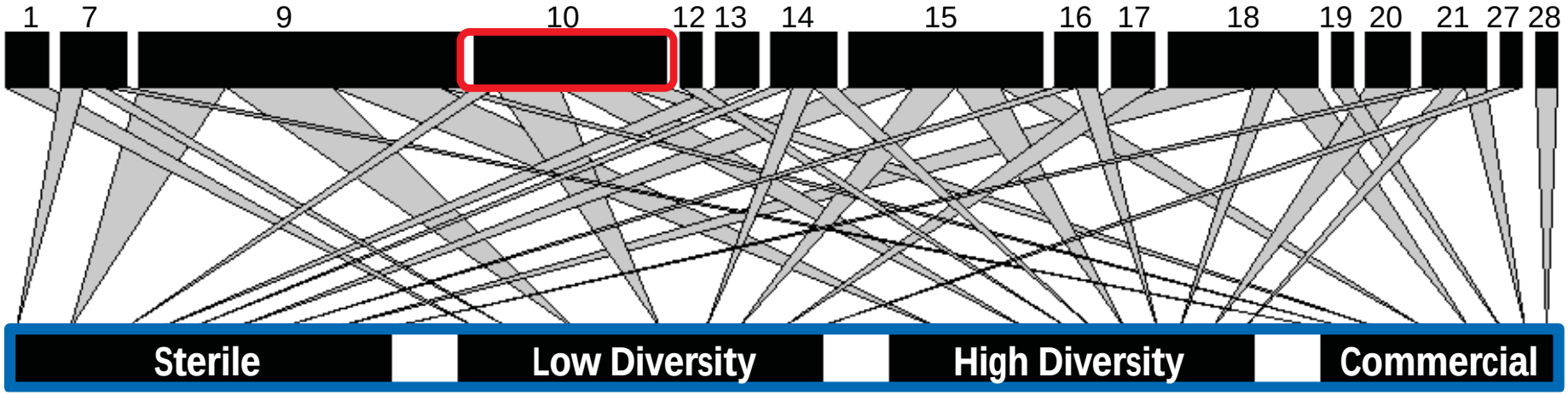


Plant genotype and inoculant influenced network structure



Conclusions

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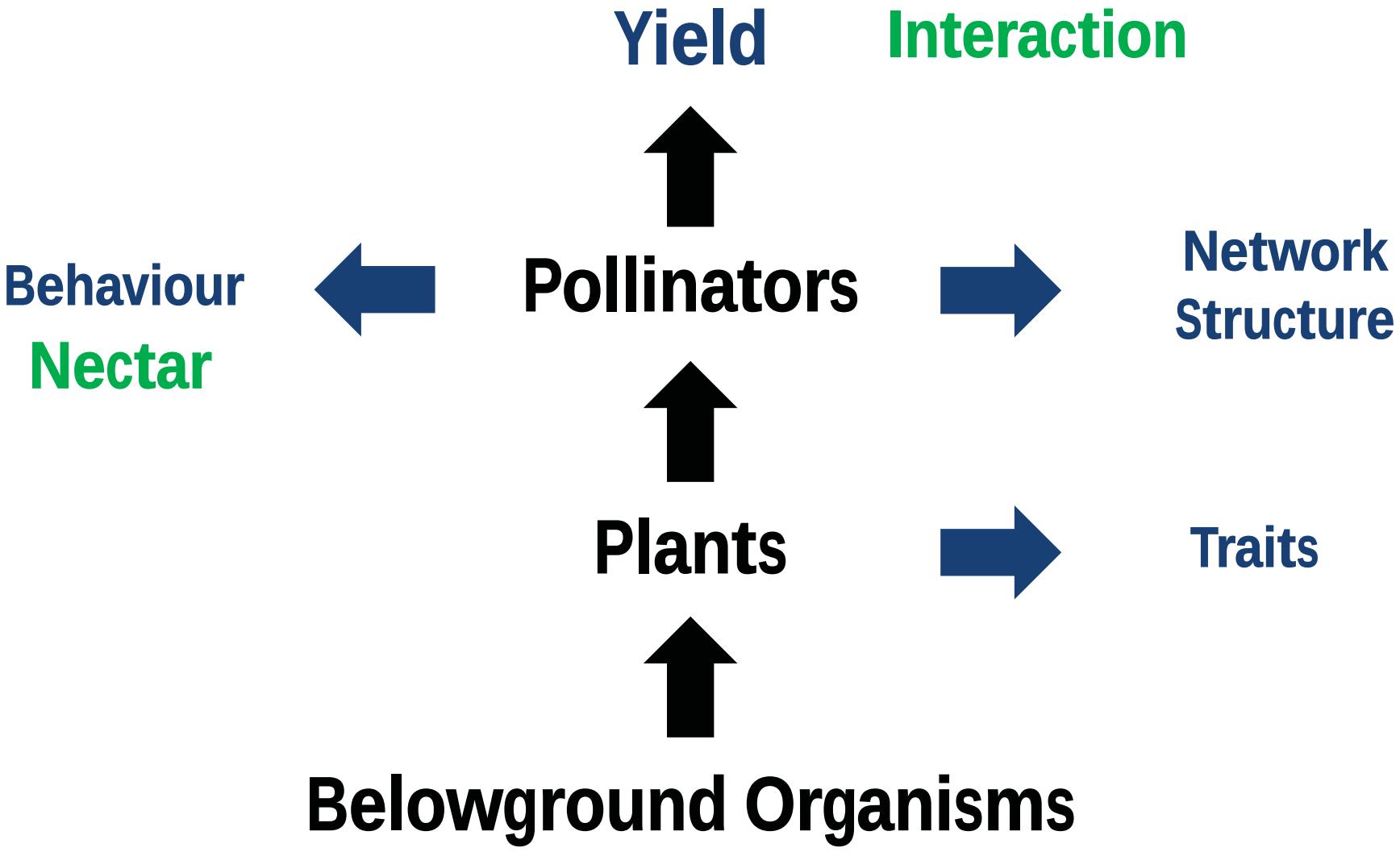

Wider context / Take home points

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- Cascading effects of altered network structure
- Interactions mediated by plant genotype traits
  - Dynamics behind networks
    - Influences on yields

Potential Applications

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- Control AMF in strawberry propagation
  - Yield quantity and quality
    - Fertilisation requirements
    - Pest and pathogen defence
- Breed crops to benefit from AG/BG interactions
- Breed ‘Designer’ belowground organisms

Future Plans

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- Second field season results
- Reproductive and growth variables
- Brix
- Socio - Economic analysis

Thanks!

Acknowledgements:

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