

PERIODOS FÉRTILES IRREGULARES, GESTIÓN DE CARGA DE CULTIVOS Y PRODUCCIÓN

IRREGULAR BEARING, CROP LOAD MANAGEMENT AND PRODUCTION

HARLEY SMITH



WAC

IX WORLD AVOCADO CONGRESS
- C O L O M B I A -

Understanding the physiological basis of yield associated traits for maximizing productivity



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Challenges in Avocado Production



Production

32.5 t/ha theoretical

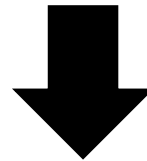
~10 t/ha average

15-20 t/ha 'accomplished growers'



Research & Development:

1. New management tools
2. Genetics & breeding



Maximize yield & reduce seasonal variation



Challenges in Avocado Production

**Genetics x Environment x Management x Age =
Yield**

- 1. Semi-domesticated (Genetics)**
 - 'Hass' dominates market (chance seedling)
- 2. Yield associated traits (G x E x M x A)**
 - Flowering
 - Fruit abscission
 - Fruit set (pollination to fertilization)
 - Biennial bearing
- 3. Disease (G x E x M)**
 - *Phytophthora* root rot



Challenges in Avocado Production

Genetics

Environment

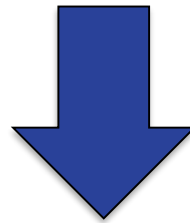
Management

Age



Yield associated traits (G x E x M x A)

- Flowering
- Fruit abscission
- Fruit set (pollination to fertilization)
- Biennial bearing



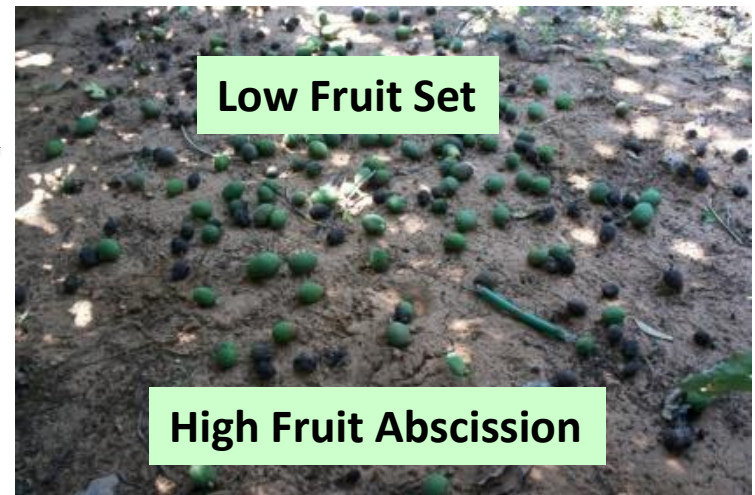
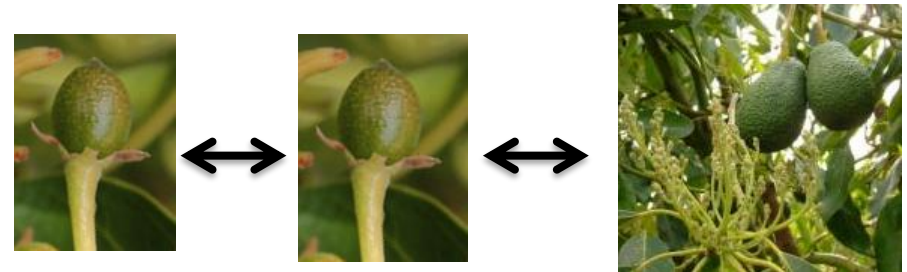
Reduced Yields and Variation in Annual Production

Coincidence of vegetative and reproductive growth

Spring:

Spring flush – flowering, fruit set, early fruit development

Spring Flush: High Growth Potential

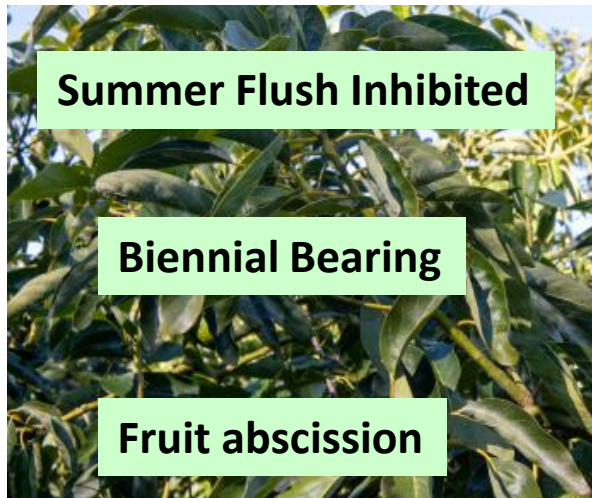


Coincidence of vegetative and reproductive growth

Summer:

Summer/fall flush – fruit development

Developing Fruits: High Growth Potential



Coincidence of vegetative and reproductive growth

-Spring:

Spring flush – flowering, fruit set, early fruit development

-Summer:

Summer & fall flush – fruit development

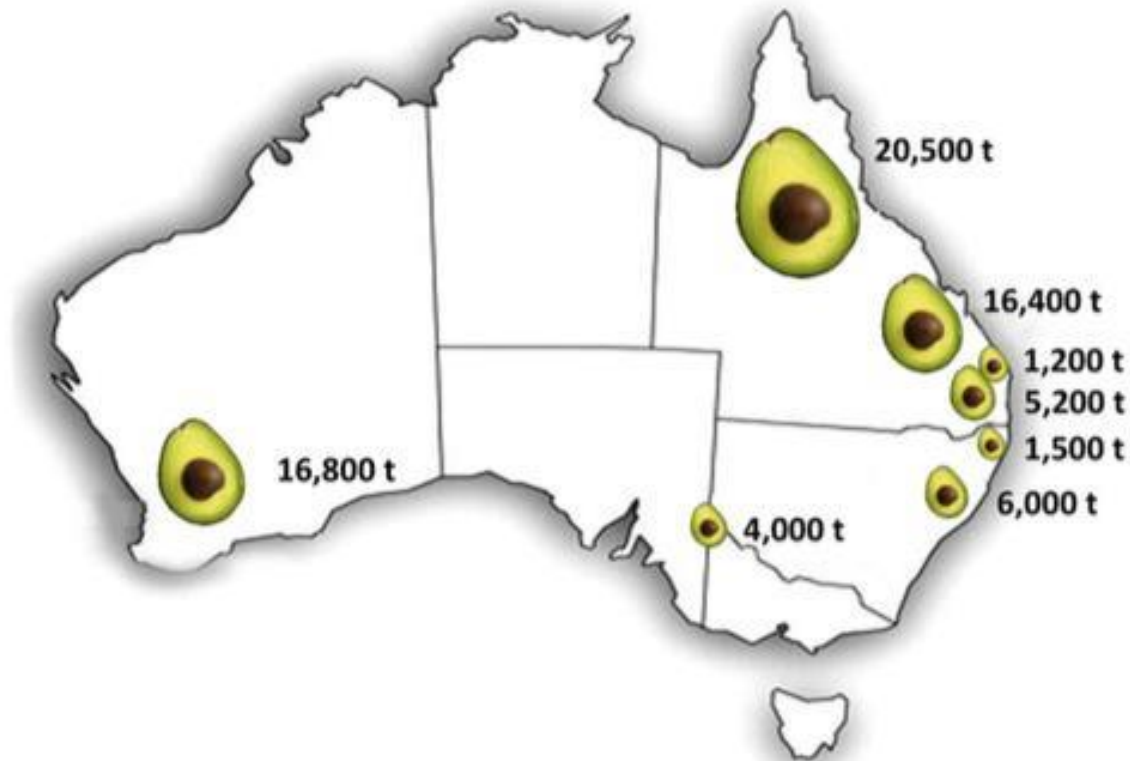


Resource Competition

Balance
Vegetative Growth – Fruit Growth

Avocados are produced in a wide range of environments in Australia

Annual tonnes produced in each region averaged over two years*: 2016/17 and 2017/18



<https://www.avocado.org.au/news-publications/statistics/>

Fruit Abscission



- Major yield associated trait
- Limits production in diverse climates
- Poorly understood in avocado (other fruit trees)



Research goal: Physiological basis of fruit abscission (tree & fruit)

Outcome: Develop new tools to limit fruit abscission

Fruit Abscission



- Major yield associated trait
- Limits production in diverse climates
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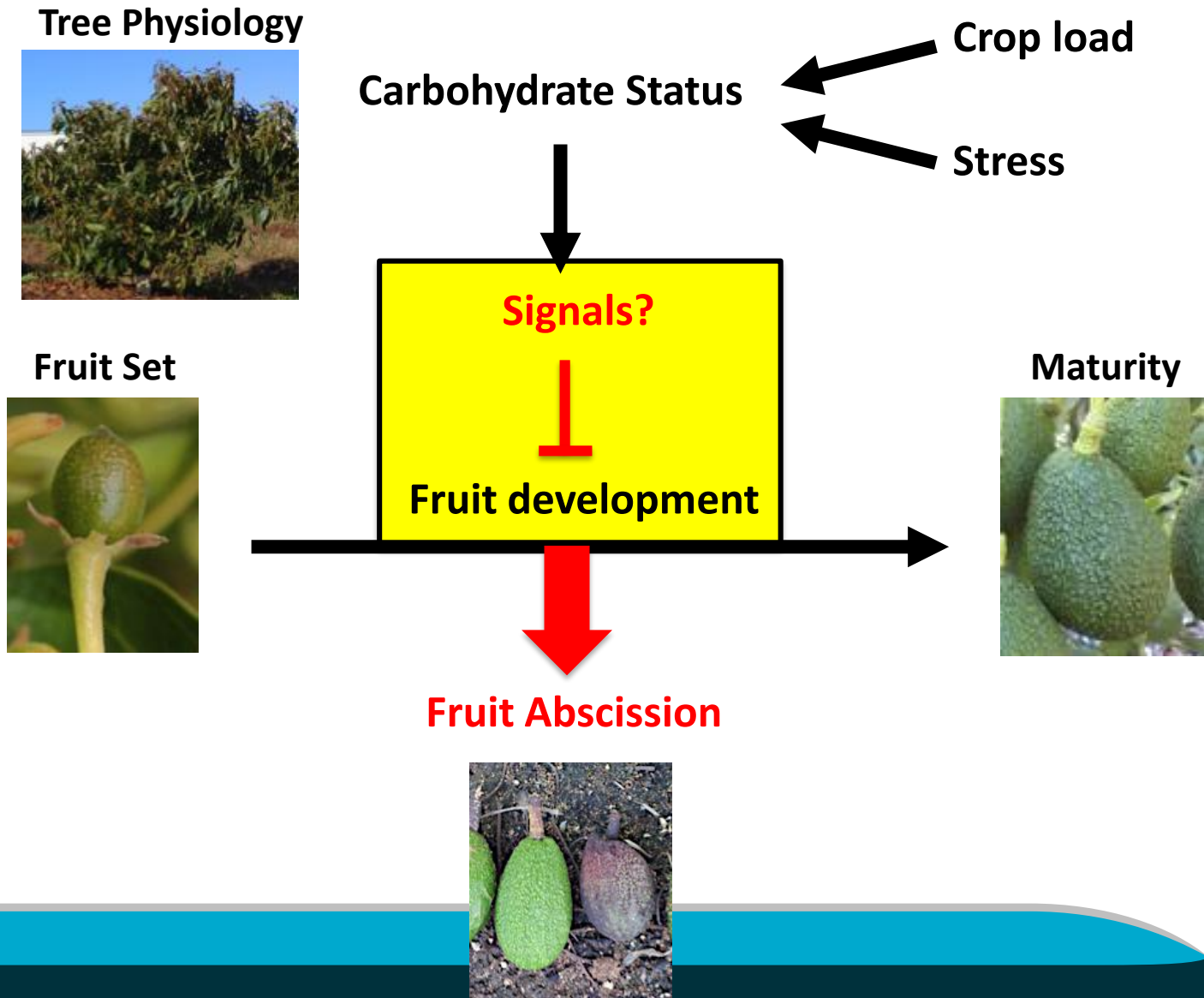


Physiological basis of resource competition in fruit trees

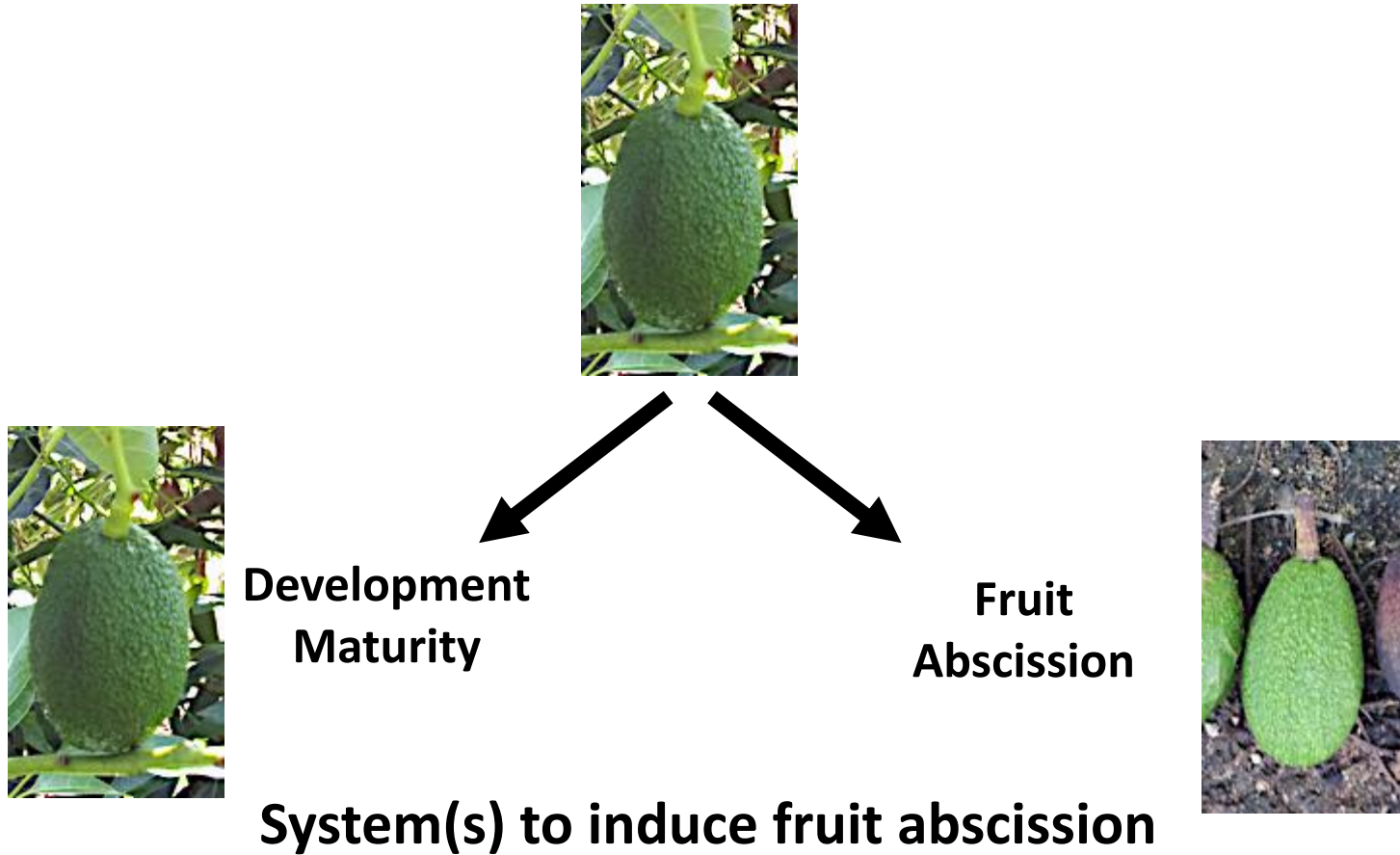
Fruit abscission is relevant to Columbia and Africa



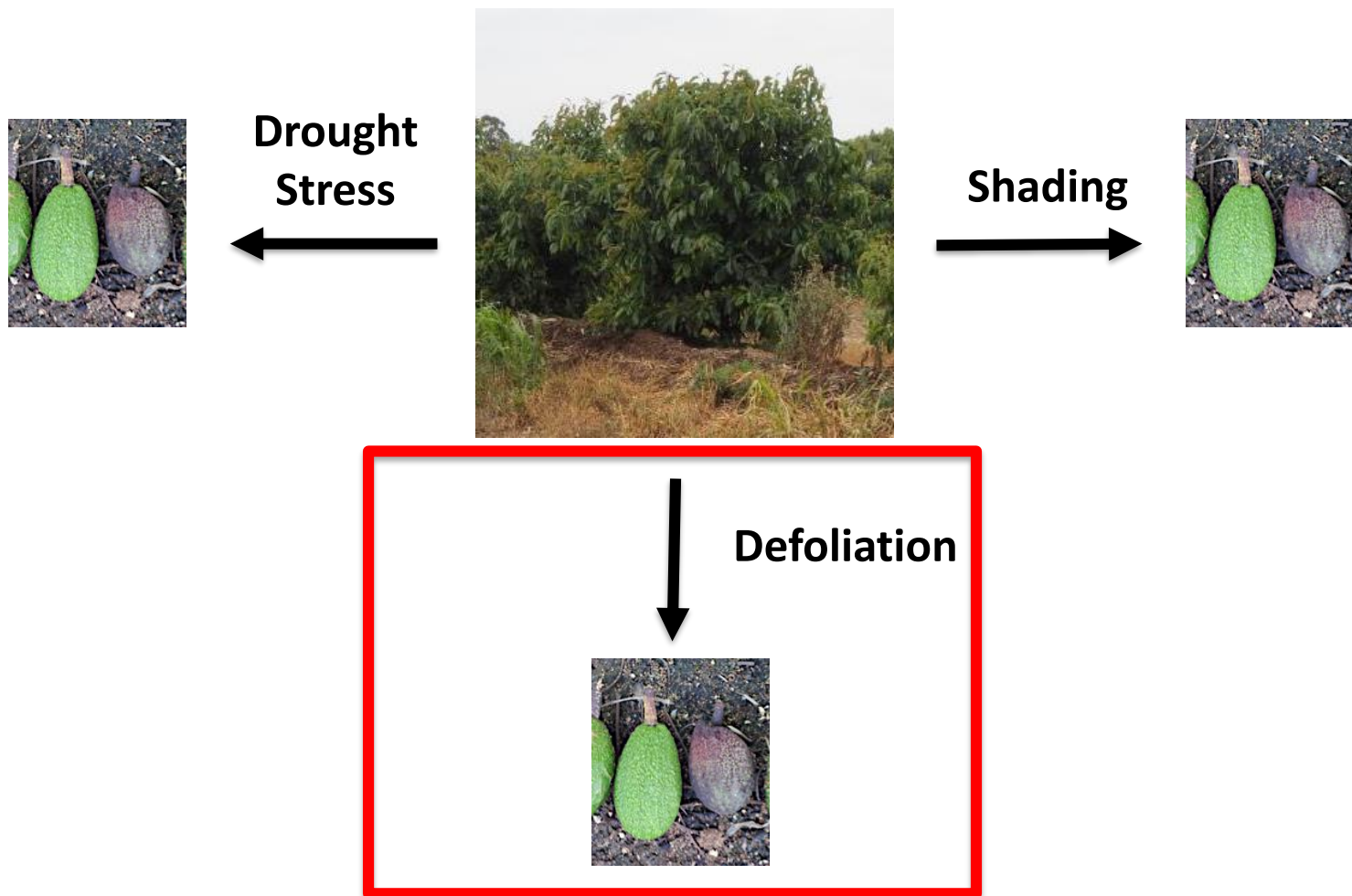
Physiology that drives fruit abscission in the tree?



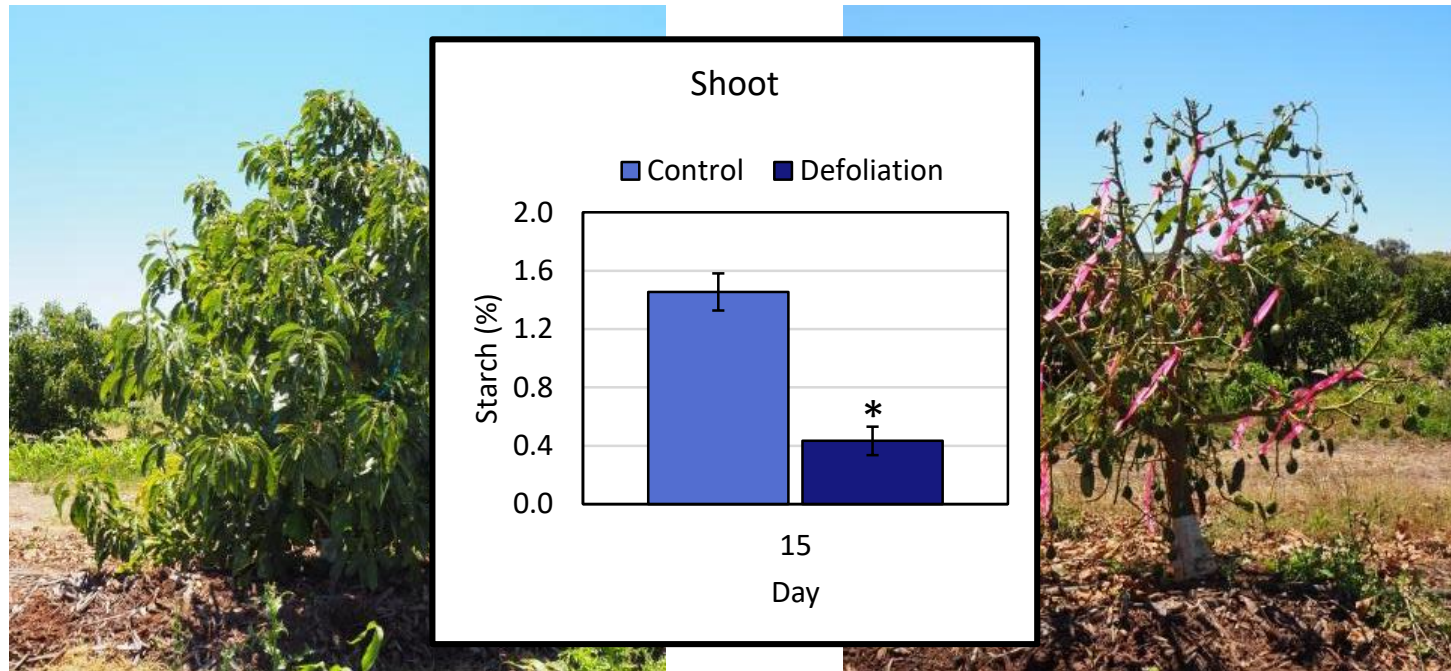
How to distinguish between fruits fated for maturity from fruits fated to abscise?



Development of inducible fruit abscission systems via reducing tree carbohydrate levels

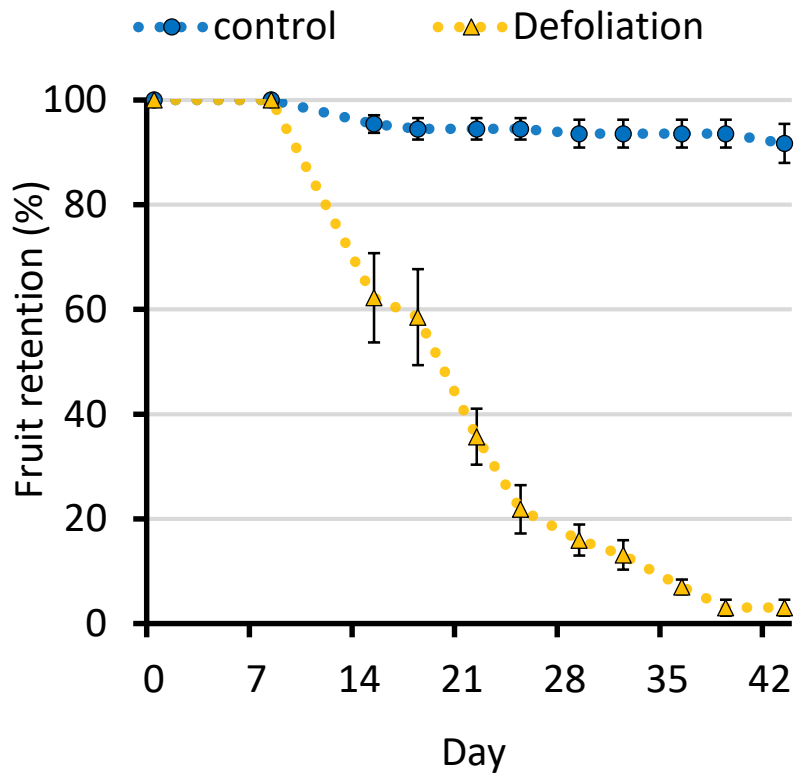


Reducing tree carbohydrate levels via defoliation



Defoliated shoots: Decrease sucrose, perseitol but not mannoheptulose

Defoliation induces massive fruit drop



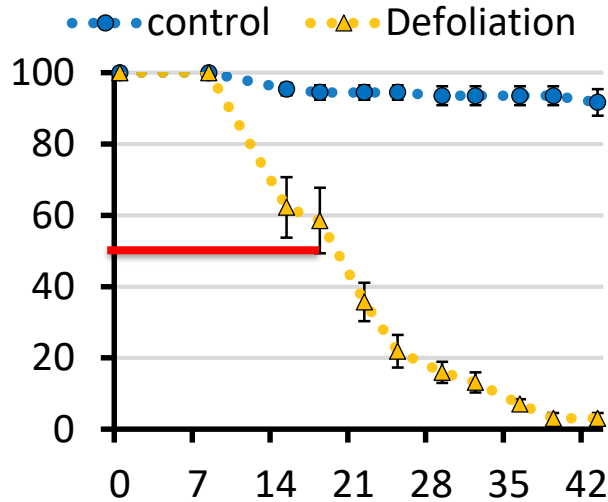
Defoliation

Systems to Induce Fruit Abscission: Defoliation



Cessation of fruit growth precedes abscission

Control



Defoliated



Developing/attached
0.27 mm/day



Developing/attached
0.17 mm/day

Abscising
a. -0.021 mm/day
b. Shrinkage

Fruit abscission, a multistep process initiated by growth arrest

Tree Physiology



Reduced tree carbohydrate status



Signal(s)?



Fruit Set



Arrest



Abscission

Fruit abscission, a multistep process initiated by growth arrest

Tree Physiology



Reduced tree carbohydrate status



Signal(s)?



Target?



Fruit Set

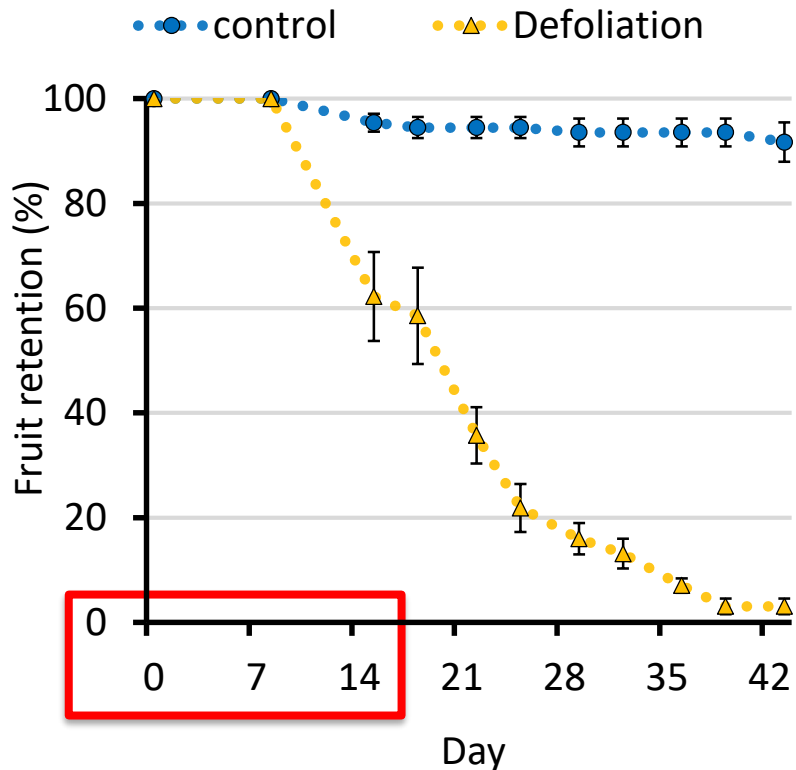


Arrest

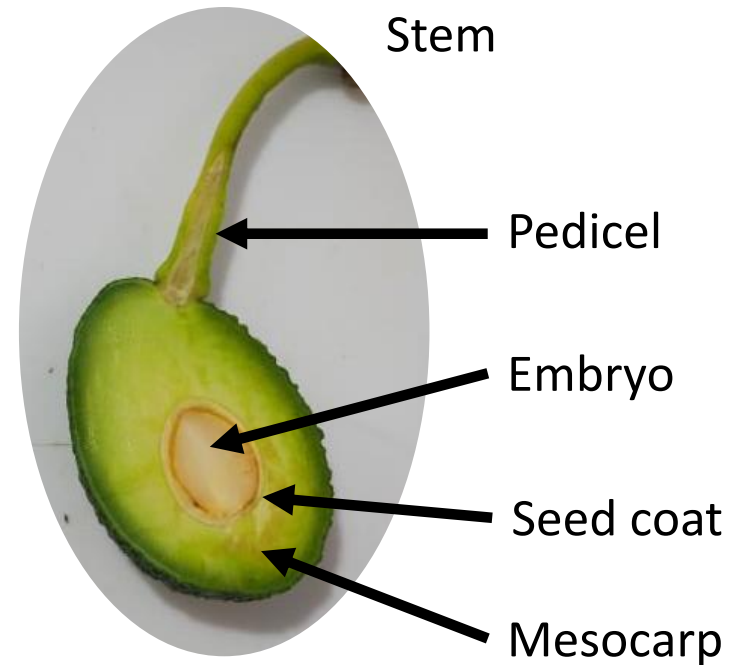


Abscission

Understanding the physiological basis of fruit abscission

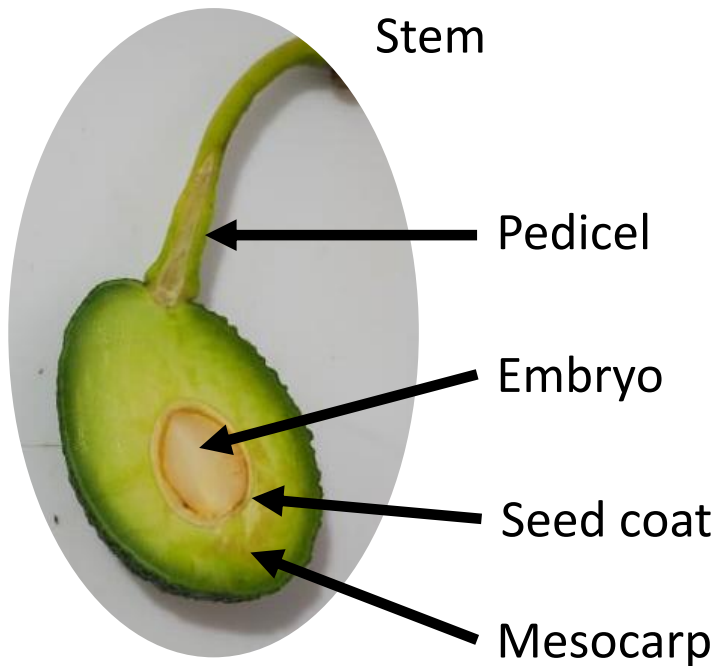


Fruit tissues for analysis:

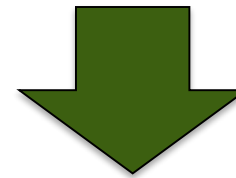


Temporal and spatial changes associated with fruit abscission

Understanding the physiological basis of fruit abscission

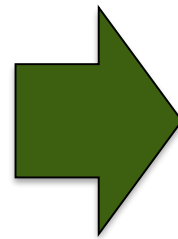
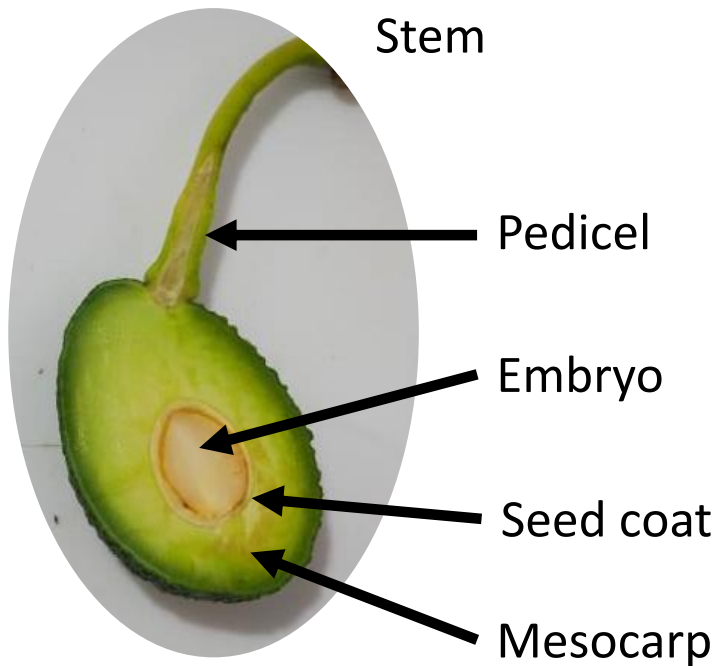


- Carbohydrates
- Hormones
- Metabolites
- Gene expression

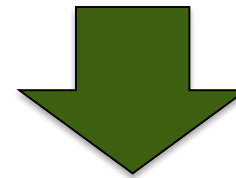


Fruit growth cessation & abscission

Understanding the physiological basis of fruit abscission

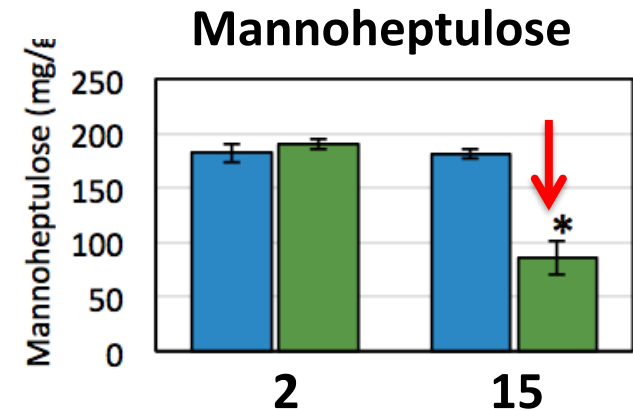
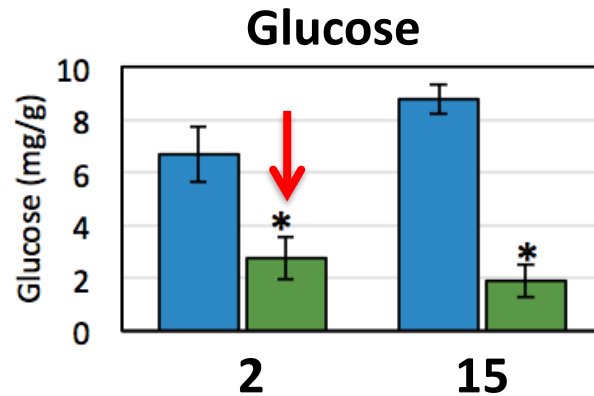
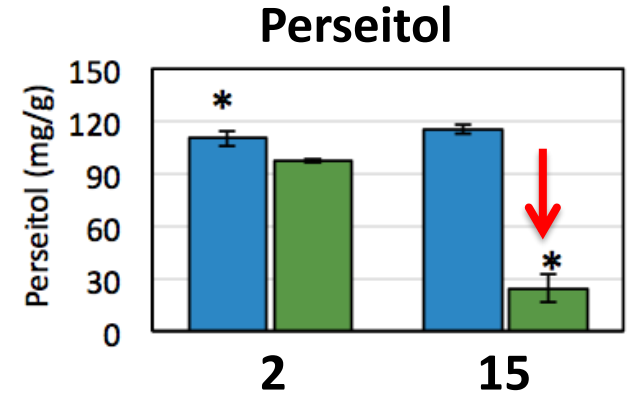
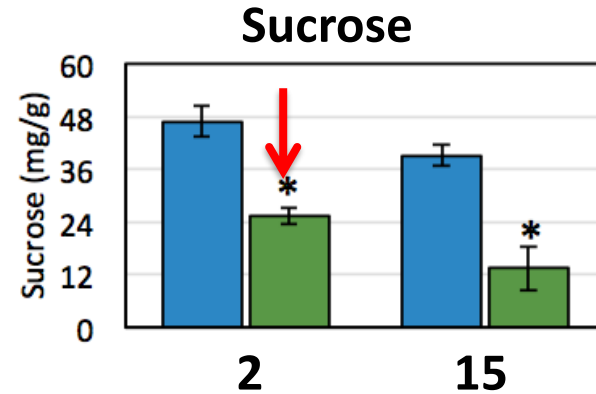
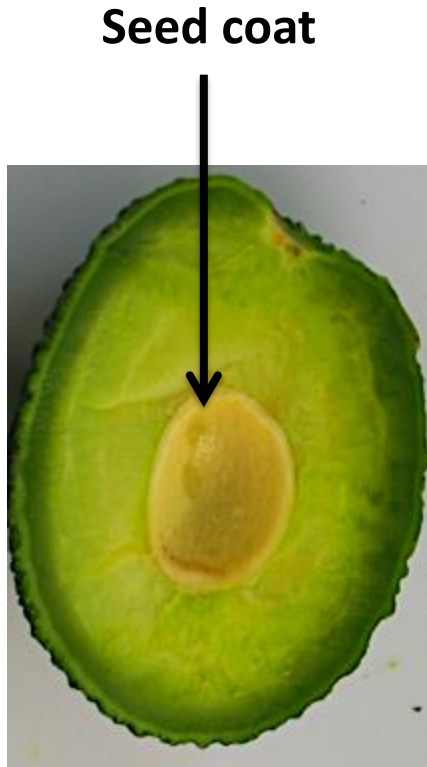


- Carbohydrates
- Hormones
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- Gene expression



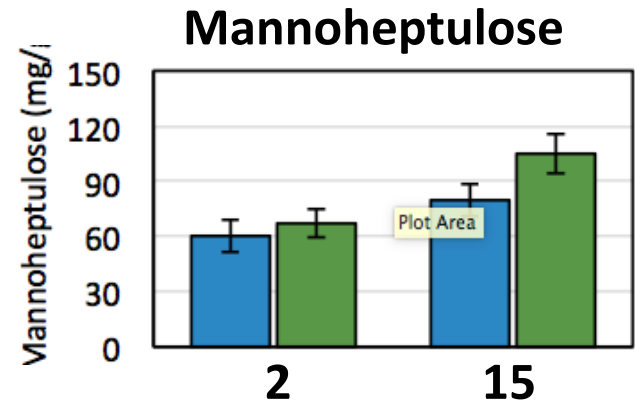
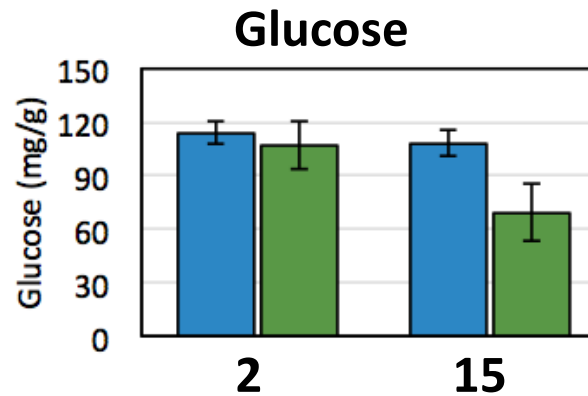
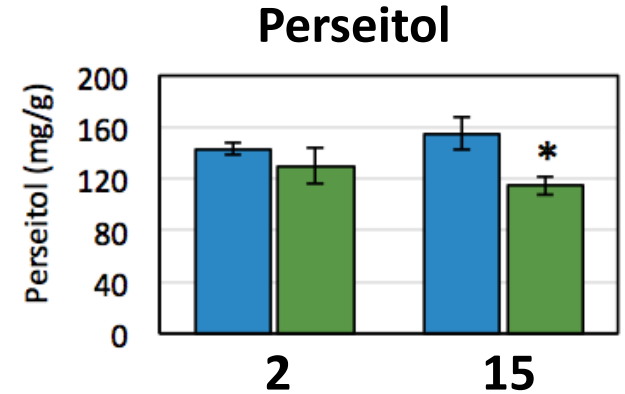
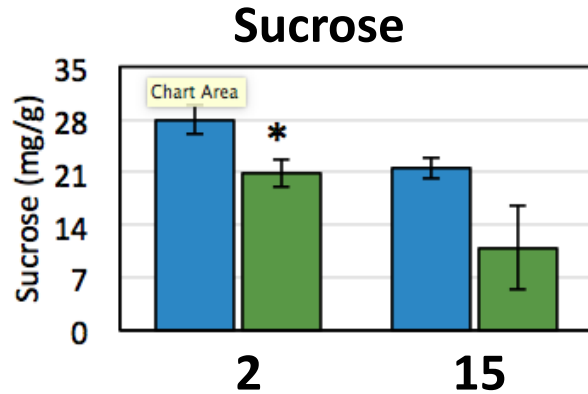
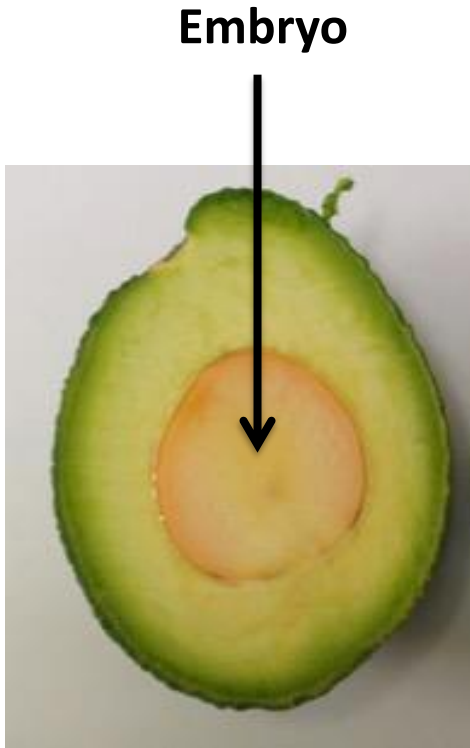
Fruit growth cessation & abscission

Seed coat carbohydrate respond rapidly to defoliation



Control Defoliation

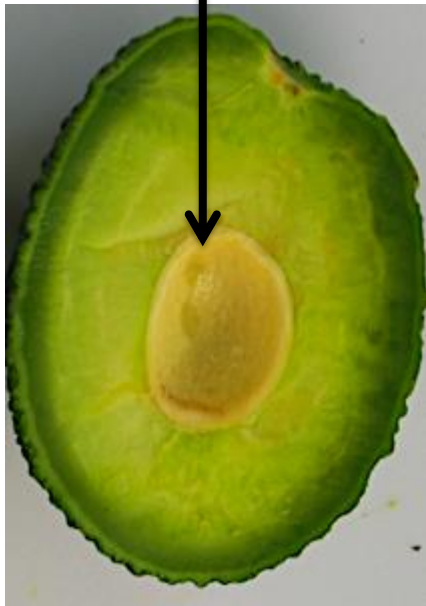
Embryo carbohydrate levels in response to defoliation



■ Control ■ Defoliation

Seed coat is highly responsive to defoliation

Seed coat



Rapid decrease in Sucrose, Glucose and Fructose levels in the seed coat

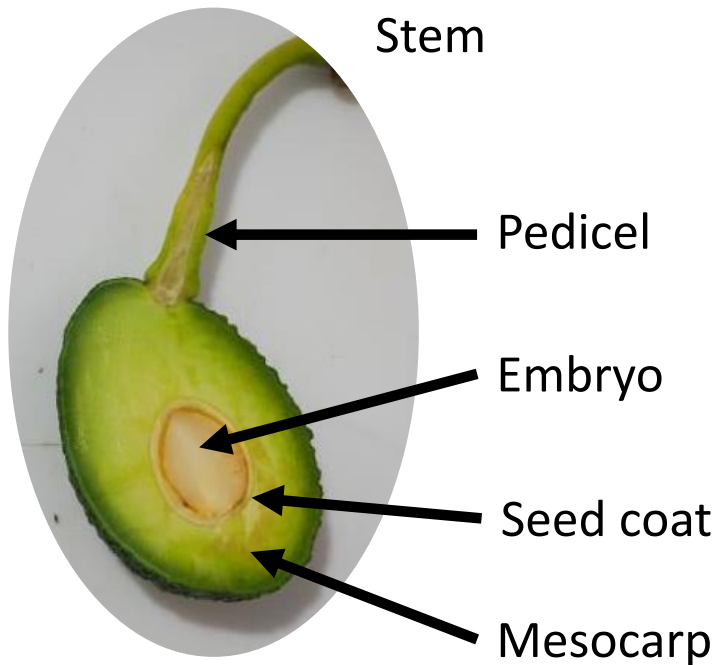


Facilitates the communication between tree and the fruit

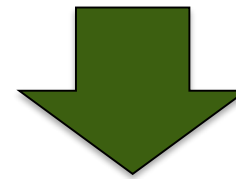


Fruit growth cessation and abscission

Understanding the physiological basis of fruit abscission



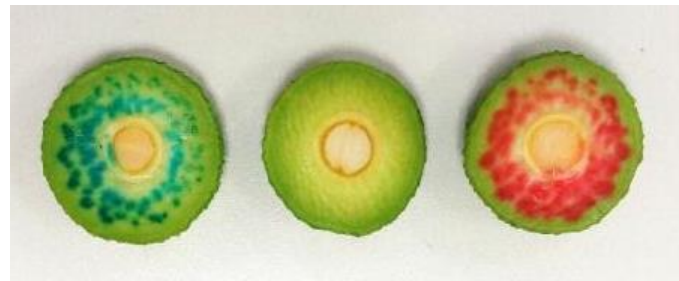
- Carbohydrates
- Hormones
- Metabolites
- Gene expression



Candidate factors of abscission

Functionally characterize factors correlated with fruit abscission?

Petiole Feeding-Functional Assay



Deliver hormones, metabolites and miRNAs to fruits

Summary

- Fruit abscission inducible system
- Link tree carbohydrate levels to abscission
- Fruit growth cessation
- Seed coat responds rapidly to defoliation
- Seed coat plays a role in abscission



Reduced tree carbohydrate status



Signal(s)?



Seed Coat



Fruit Set



Arrest



Abscission

Acknowledgements



Hort
Innovation



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Reuben Hofshi



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Muchas Gracias

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Muchas Gracias