Polinización en California

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Historical perspective –
avocado pollination in
California
The early days - 1920’s

• Recognition of floral dichogamy – Stout
  - A and B flower types

• Recognition of the importance of pollinators – Clark
  - Caging studies

The next steps - Bergh and Gustafson

• Recognition of proximity effects in trials looking at Fuerte fruit set as a function of distance from pollinizer varieties

• Recognition of the potential of the honeybee as a pollinator for avocados
Status by the end of 1970's

- Native vegetation – wild honeybees plentiful
- No significant use of introduced hives
- When used, growers did not pay for honeybees
- Beekeepers place hives in avocado groves following almond pollination
- Honeybees were not kept in groves for entire flowering period
- Some controversy over the need for pollinizer varieties

Steps backwards - 1980's

- The rise of Hass as the dominant variety and subsequent loss of value of "greenskins"
- The introduction of varroa mite and decimation of feral honeybees

RESULT - Loss of pollinizers and pollinators throughout the industry
Rekindling of interest - 1980’s and 90’s

• Loss of productivity industry wide
• International Research focused on pollination/pollinizers
  • Sedgley - Flower stages, temperature and fruit set
  • Robbertse et al - Boron and fruit set
  • Köhne, Robbertse - pollination in South Africa
  • Davenport - flowering and pollination in Florida
  • Degani, Gazit et al - importance of cross pollination and fruit retention
  • Vithanage - visitors to avocado flowers
  • Ish-Am, Eisikowitch - honeybee behavior
  • Ish-Am, Gazit - searching for the native pollinator of avocado

Understanding and manipulating flowering and fruitset in California

Funding of research by the industry - Focused on the Plant

• Genetic analysis for determining outcrossing
  - Ellstrand (isozymes); Clegg (RFLP, microsatellites); Davenport/Schnell (microsatellites)
• Shifting flowering
  - Salazar-Garcia, Lovatt (Gibberellins, boron)
• Selection of new varieties as pollinizers for Hass
  - Bergh et al (SirPrize, BL667, BL516)
• Pollinizer Trials
  - Arpaia et al (DeBusschere Pollinizer Trial)
Understanding and manipulating flowering and fruitset in California

Funding of research by the industry - *Focused on the Pollinator*

Honeybee visitation and other pollinators
- Visscher and Sherman

Honeybee races
- Hofshi (Carniolan vs Italian)
- Fetscher, Waser, Hofshi, Arpaia (perseitol to monitor pollination efficacy) has led to collaborative research with Israel - Shafir, Dag, Arpaia, Davenport

![Chart showing comparison between New World Carniolan and Italian honeybee strains](image)

*Figure 3. Total volume of crop contents (g/dl) mean ± SE of foragers caught upon return to their hive from Italian (1) and New World Carniolan (NWC) colonies placed in a California prunus orchard (CA2). 1200 females above the error bars are the sample size. The type of flower visited by a given forager was inferred by the presence or absence of pollen on the crop sample.*

Appreciating Proximity once again
DeBusschere Pollinizer Trial - Coastal Ventura County

Pollinizer Varieties: 8
Field trial replicates: 6
Pollinizers interseted with Hass

2004 Data

Cumulative Data
Planting multiple pollinizers in the same hole
Increasing the % of pollinizers and the placement of pollinizers

**Goal:** Maximize the opportunity for cross pollination

An example where Bacon, Zutano and Ettinger planted in same hole

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**Trends in California**

**Honeybees**
- Placement (on pallets)
- Honeybee race (???)
- Paying for bees (~$18-30/hive)
- How many hives? (avg. 2-4 hives/HA, as high as 10)
- Keeping the hives for the entire flowering season

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M. L. Arpaia (September 2004)