Proactive Research: Working South of the Border for the California Avocado Industry

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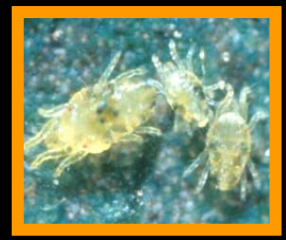
Invasions of Foliage Pests

2004

2004

Pesticide Use in CA Avocados


1982 1990 1996 2004

?

Persea mite

Avocado thrips

Ibs Applied (x 1000)

700
600
500
400
300
200
100
0

1989 1991 1993 1995 1997 1999 2001 2003

Year

No Avocado Fruit Feeding Pests

- No fruit flies

- No weevils

- No moths

- Why??
  - Quarantine & inspection regulations
  - Regular surveys for invasive pests
  - No fruit imports have been allowed from Central America since 1914
  - Thousands of tons of fruit to be imported – volume very different to smuggled plants & fruit

Fruit Imports

- In February 2007 Mexico legally began shipping avocados to California for the first time
- 1000's of tons of fruit are expected to enter California
- USDA-APHIS has worked with Mexican producers of Hass avocados to develop production, harvesting, and shipping guidelines to minimize the risk of new fruit pests entering California
- Theory from Invasion Biology and practical experience suggest that large scale movement of product over time will increase the chances of establishment for an invasive pest

Potential Fruit Pests

- **Several specialist pests of avocado fruit are a concern for California**
  - **Fruit flies**
  - **Avocado seed feeding weevils**
  - **Avocado seed feeding moths**
    - ***Stenoma catenifer*** **(Lepidoptera: Elachistidae)**
      - **A pest of avocado fruit in Mexico, Guatemala, Venezuela and Brazil**
      - **Economic status of this pest in Mexico and Guatemala largely unknown**
      - **Major impediment for commercial avocado production in Brazil**

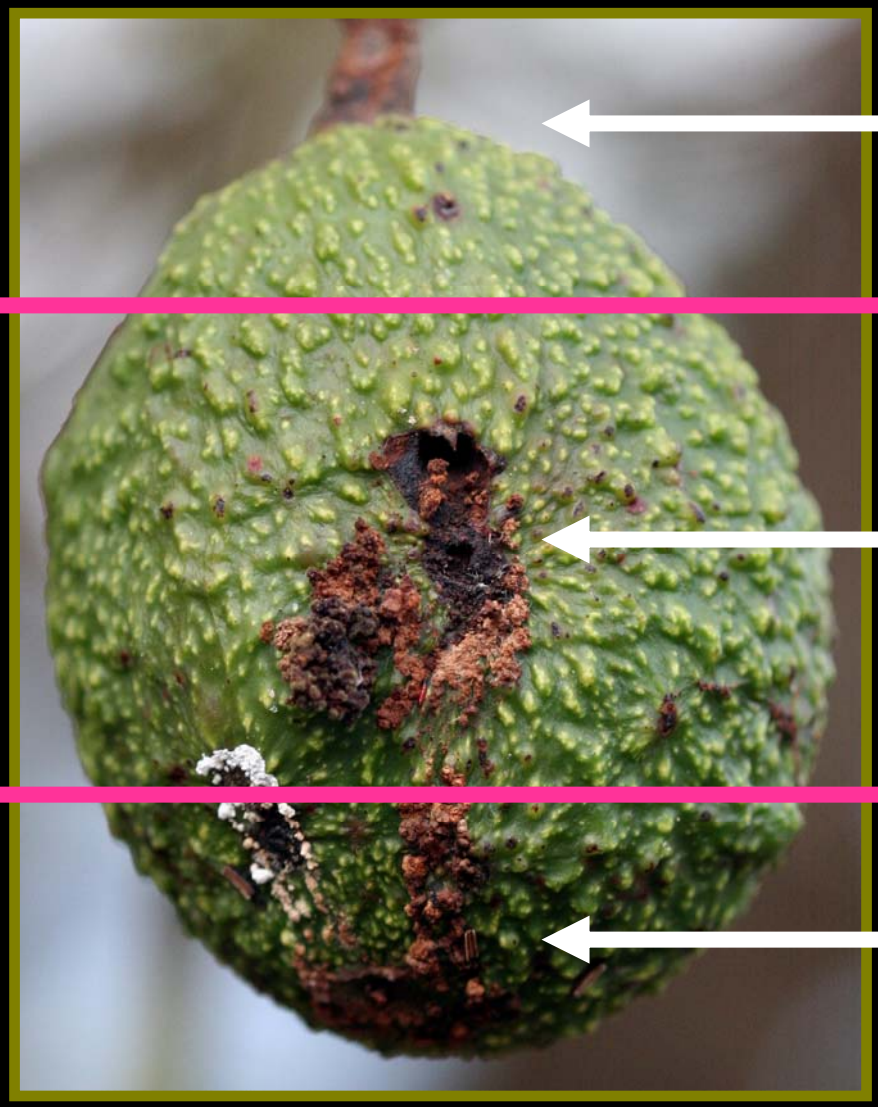
Stenoma catenifer

- **This moth is a specialist feeder on avocados and close relatives in the family Lauraceae**
- **Economic damage is caused to fruit by caterpillars boring into fruit and feeding almost exclusively on the seed in the center of the fruit**
- **California has native Lauraceae and fruit may be vulnerable to attack by this pest**

California Bay Laurel

Stenoma catenifer Life Cycle

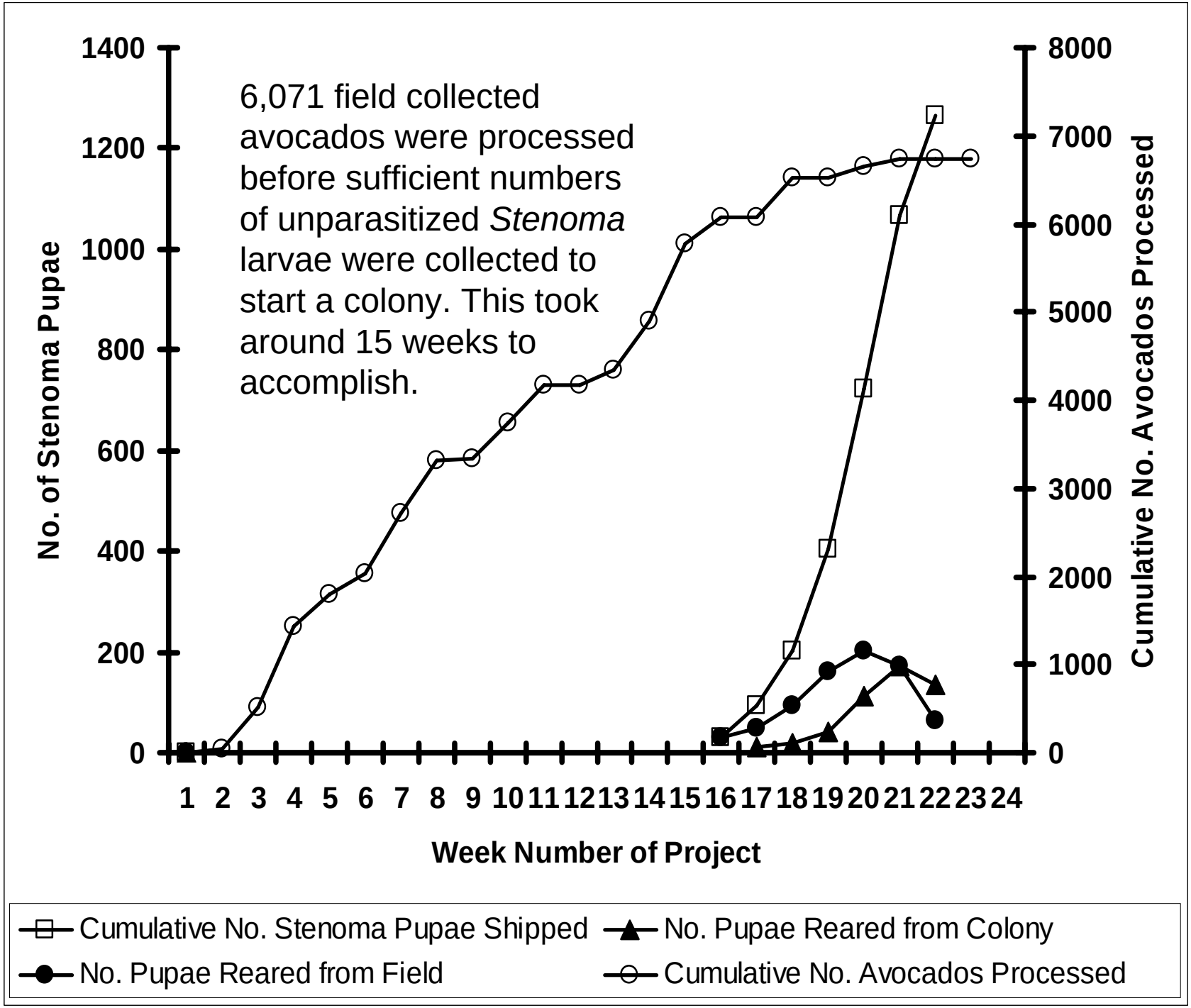
Where Do Stenoma Larvae Attack the Fruit?



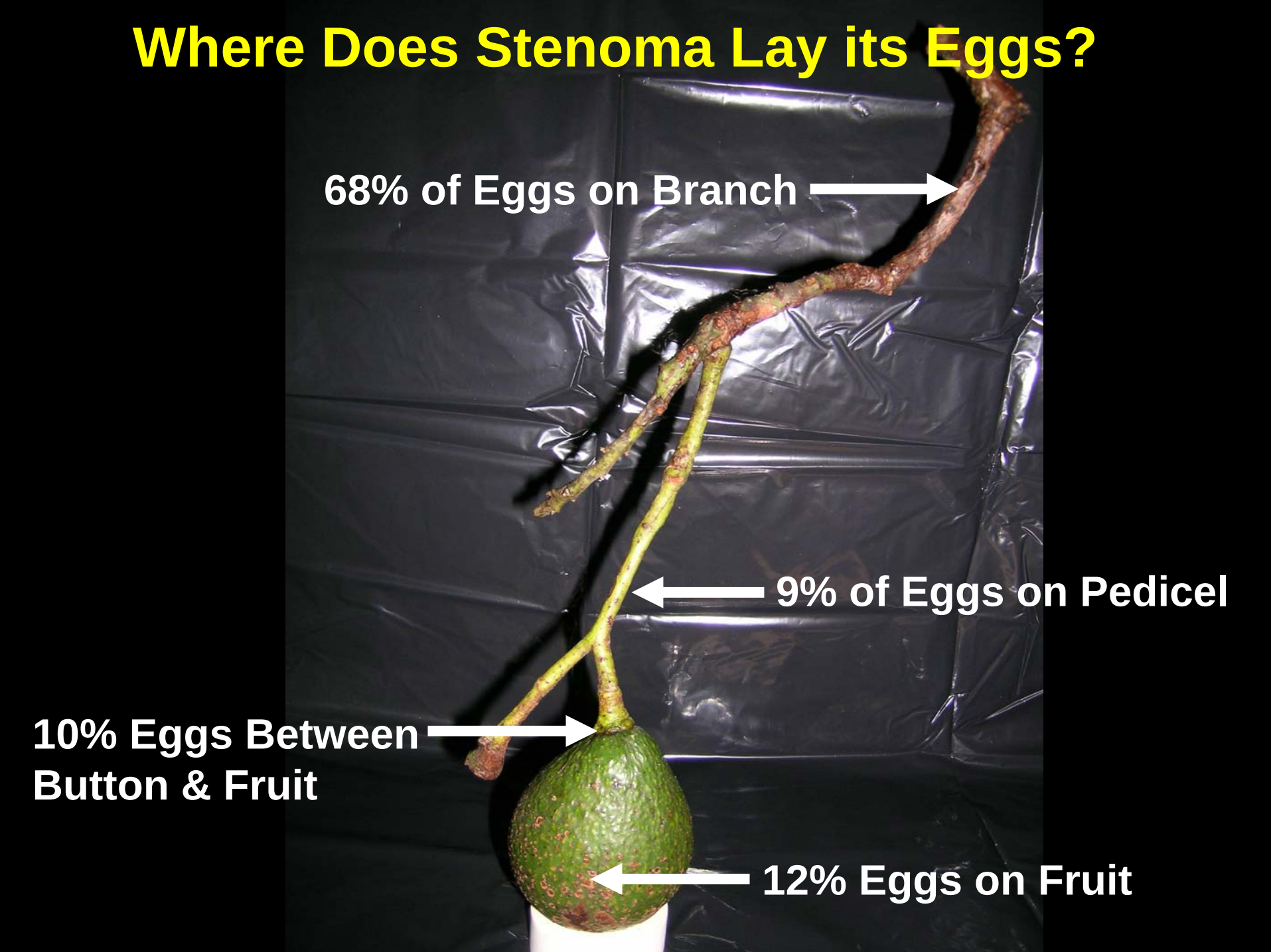
14% of fruit have more than one *Stenoma* hole (1-4 holes)

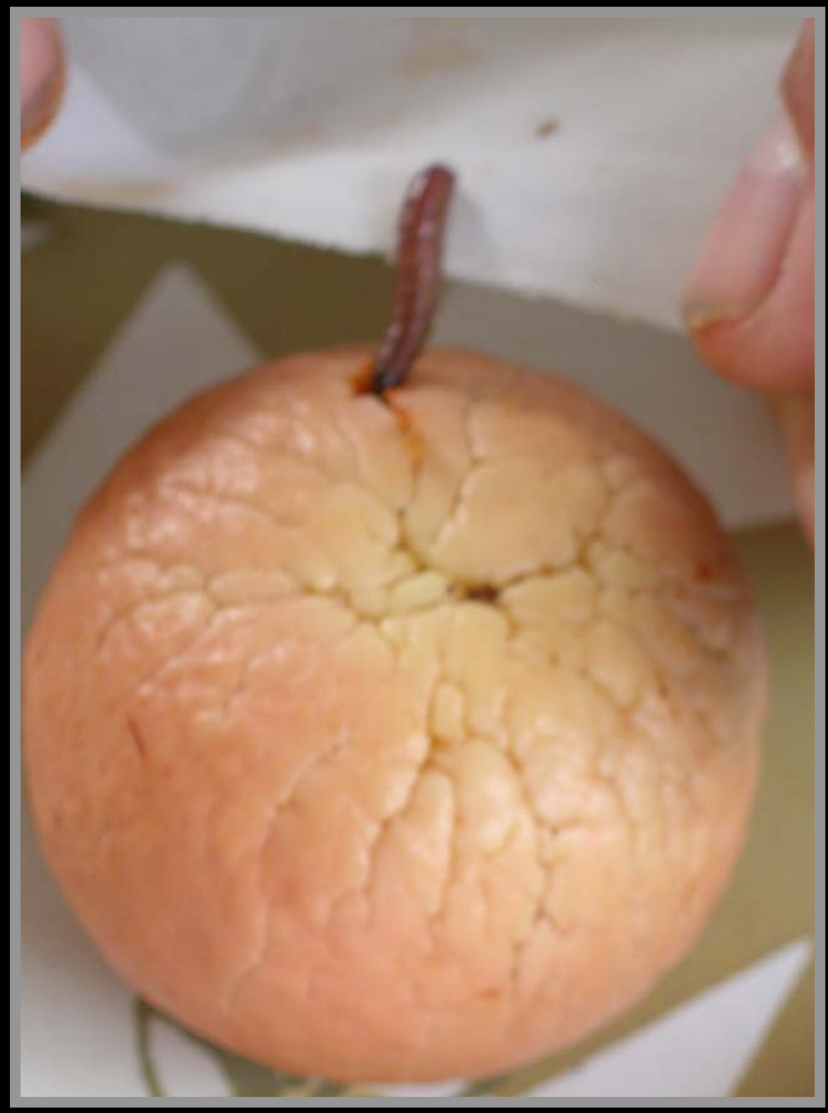
What Size Fruit Are Attacked?


Super
Regular
Diesel
ALCOSA
QUETZAL
SAN FRANCISCO

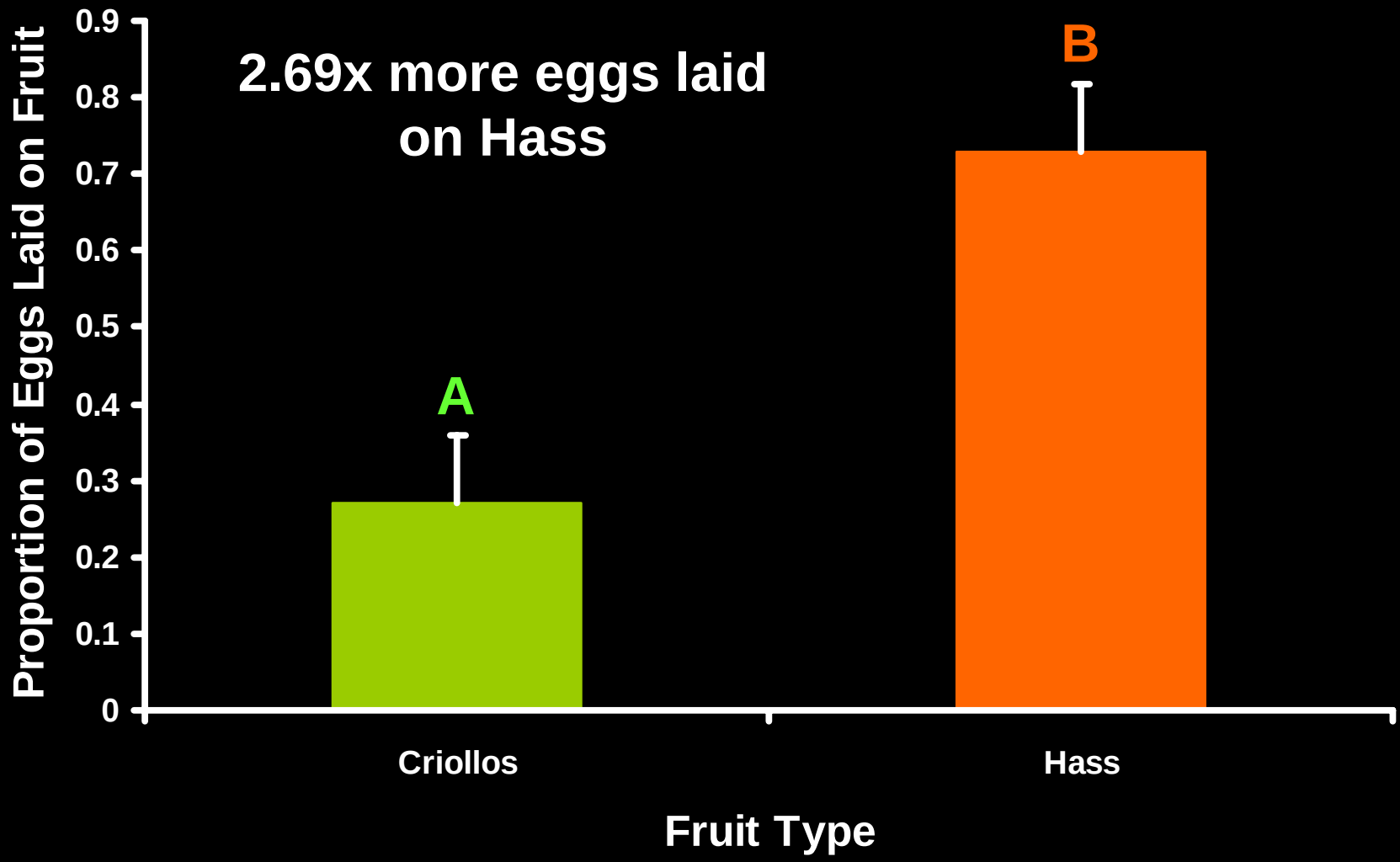

6,071 field collected avocados were processed before sufficient numbers of unparasitized *Stenoma* larvae were collected to start a colony. This took around 15 weeks to accomplish.
No. of Stenoma Pupae
Cumulative No. Avocados Processed
Week Number of Project
0
200
400
600
800
1000
1200
1400
1000
2000
3000
4000
5000
6000
7000
8000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Cumulative No. Stenoma Pupae Shipped
No. Pupae Reared from Colony
No. Pupae Reared from Field
Cumulative No. Avocados Processed

Where Does Stenoma Lay its Eggs?





Does *Stenoma* Prefer Hass or Criollos for Oviposition?



Final Goal of the Stenoma Project

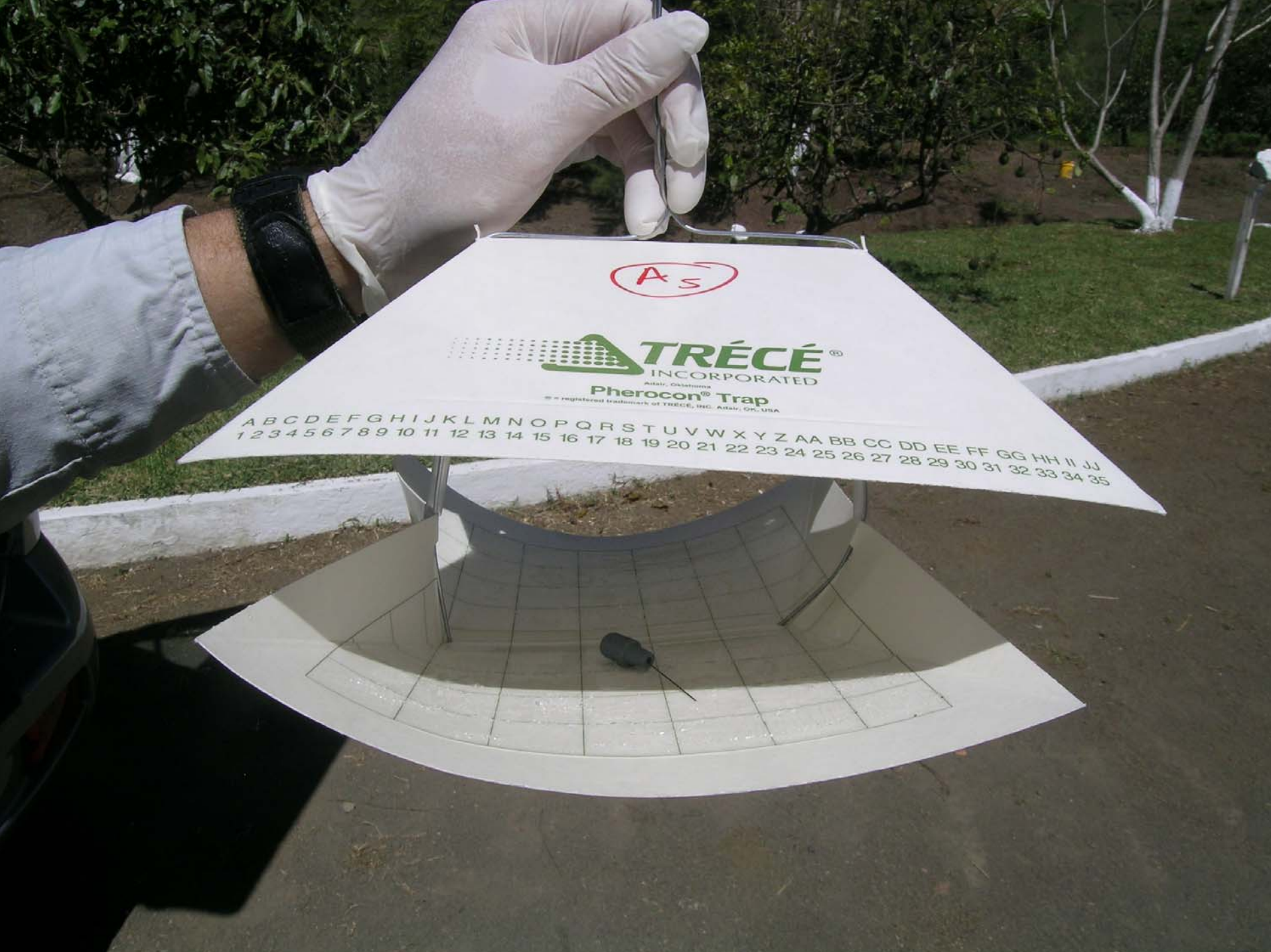
- Isolate and synthesize the sex pheromone for this pest
  - Detect invasion into California
  - Monitoring tool for growers in California & Central America
  - Aid scientific studies of this pest
    - Yearly population cycles
    - Geographic distribution
    - Develop action thresholds


Rubbermaid

Extraction, Isolation & Identification of the *Stenoma* Sex Pheromone

- **The sex pheromone of *Stenoma* is a new class of natural compound not seen before in nature or the lab**
  - **Class of compounds dienyne – a triple bond alkyne with conjugated double bond dienes with an alcohol as a the terminal group**


A5
TRÉCÉ
Pherocon® Trap
B5
TRÉCÉ
Pherocon® Trap
C5
TRÉCÉ
Pherocon® Trap


A5
TRÉCÉ®
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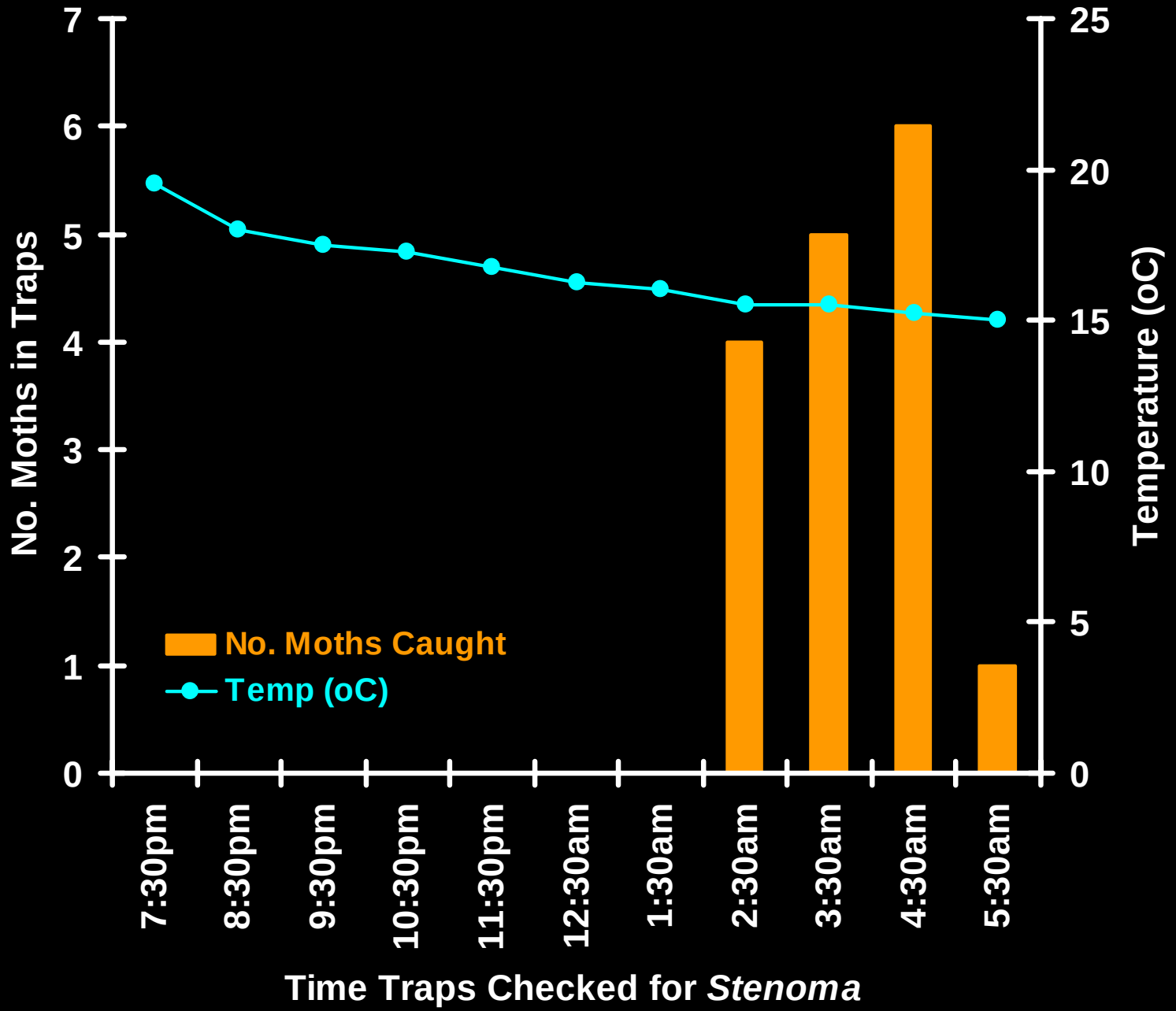
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z AA BB CC DD EE FF GG HH II JJ
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35


TREC


RIVERS

What Time of Night Do Male *Stenoma* Fly to Lures?



Stenoma **larvae are heavily parasitized by a *Cotesia* sp. (Hymenoptera: Braconidae)**

Estimated parasitism ranges 50-80% depending on location

 # Cocoons 4-20^{+} per larva

Pupation Biology of *Stenoma*

- ~ 95% of mature larvae abandon seeds and fruit and look for pupation sites away from food source
- Larvae will walk for ~12-24 hrs looking for a pupation site before pupating
- Pupate in the top 1-2 inches of soil
- How vulnerable is this phase of the life cycle to generalist predators??

Diurnal Behavior of Adult *Stenoma*

- Observations in the lab suggested that adult *Stenoma* are only nocturnal
- Any light in the lab flying stops immediately and moths drop to floor and hide
- Do adults hide on the orchard floor during the day?

Is it Risky to Hang out on the Orchard Floor?

- Larvae, pupae, and adult *Stenoma* spend a lot of time on the orchard floor
- Study orchard had a large population of lycosid spiders working the orchard floor during the day and the night
- Would these spiders eat *Stenoma* larvae, pupae, & adults if they found them?

Lycosid Spiders Eat all Free Living Stages of *Stenoma*!

Stenoma Project Achievements

- Processed >9,000 avocados (from trees & dropped fruit) in Guatemala
- Established a *Stenoma* colony and developed simple rearing strategies
  - Shipped ~2,000 pupae to UCR
  - Extracted DNA and analyzed
  - Extracted pheromones
  - Pheromone tested and it works!!
- Identified parasitoid fauna
  - Quantified parasitoid & predator impact on Stenoma larvae
  - DNA extracted and analyzed
- Investigated:
  - Criollos vs. commercial Hass avocados
    - Choice expts – Hass preferred over Criollos
    - Commercial Hass orchards ~43% fruit infested

Cryptaspasma sp.

- Discovered in Guatemala during Stenoma survey work
- Known from avocados in Mexico, Caribbean & Sth America
- Guatemala part of the natural range?
- Status as a pest uncertain
  - Does it only feed on dropped avocados?
  - Exposed avocado seeds?
  - Attacks fruit on the tree and ground?

Unidentified species of parasitoid reared from field collected *Cryptaspasma* from Coban – Hass & Criollos. DNA extracted and analyzed

Cryptaspasma Accomplishments

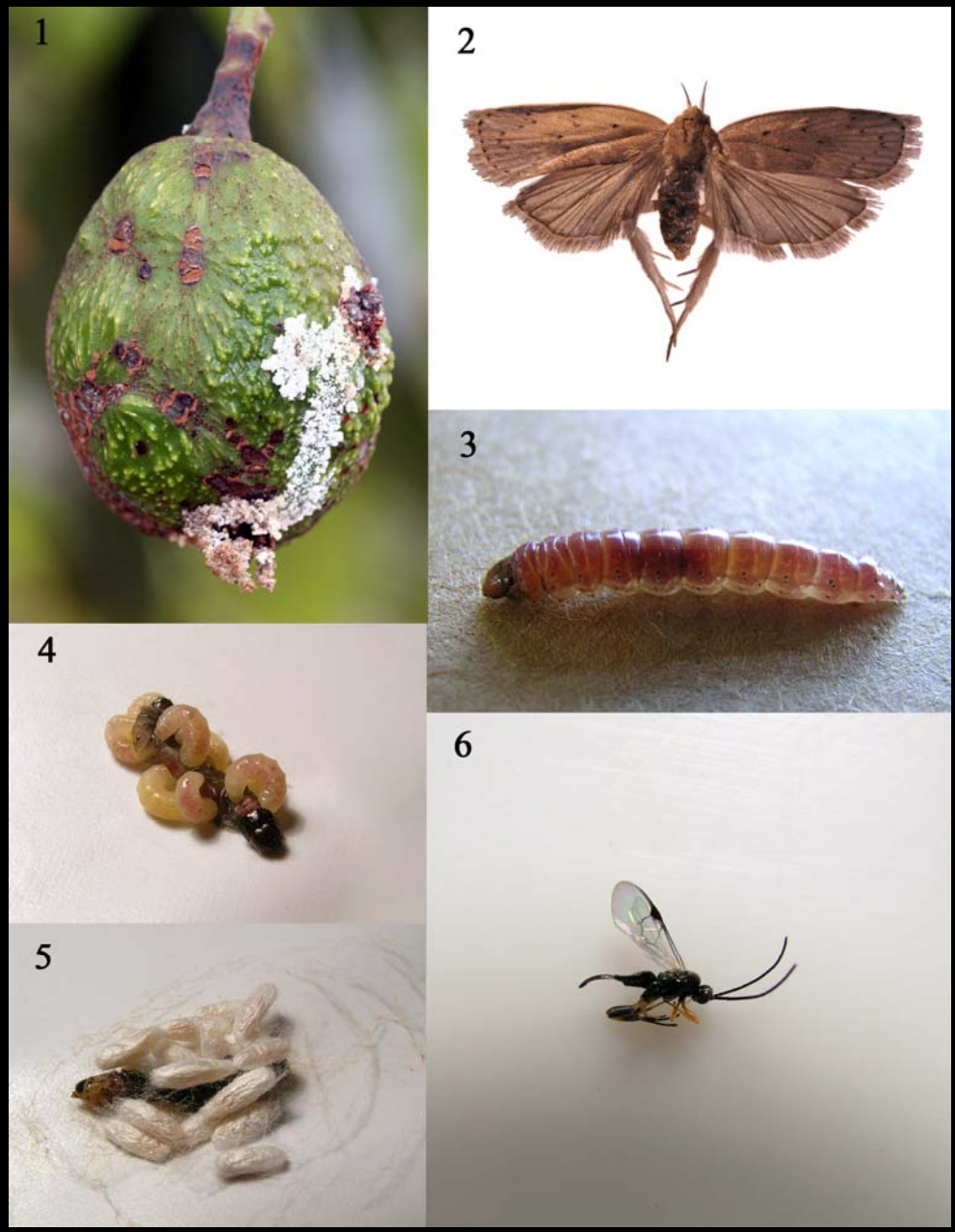
- We established a colony of this moth
  - It is very easy to rear and develops very quickly
- Pheromone extractions completed and blend components identified
- We collected larval parasitoids
- We ran field experiments to determine if this moth attacks dropped fruit, exposed seeds, or fruit on the tree
- We have data on the geographic distribution of this moth in Guatemala
- DNA extracted & analyzed

Five Other Moth Species Found – Two Species New to Science

Histura persevora – A Serious New Pest of Avocados

Rogue's Gallery

Have you Been Paying Attention?!

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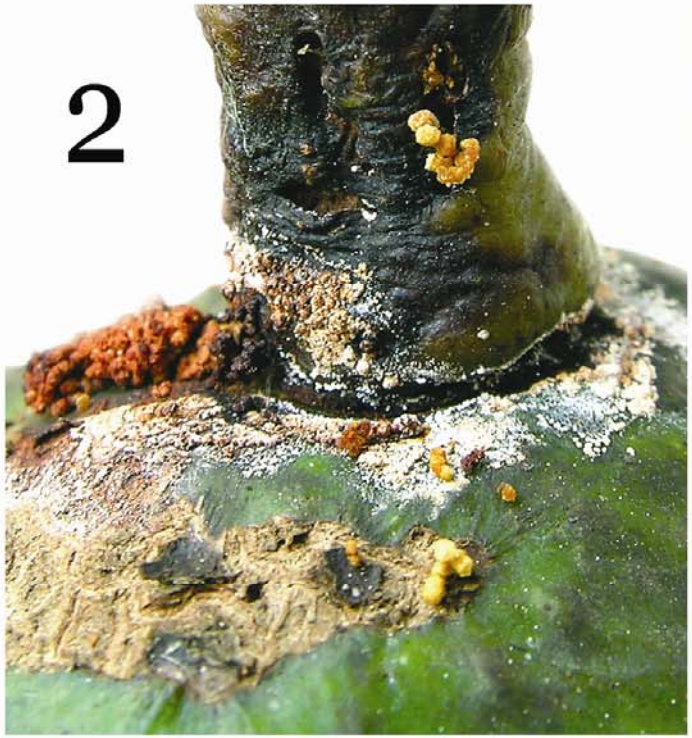
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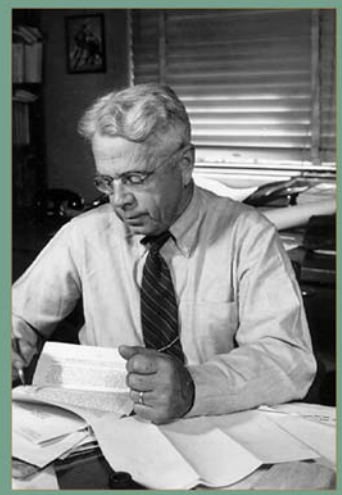
Department of Entomology

Harry Scott Smith Scholarship Fund to Support Students in Biological Control



Harry Scott Smith
1883 to 1957

Where to Go for More Information?

www.biocontrol.ucr.edu