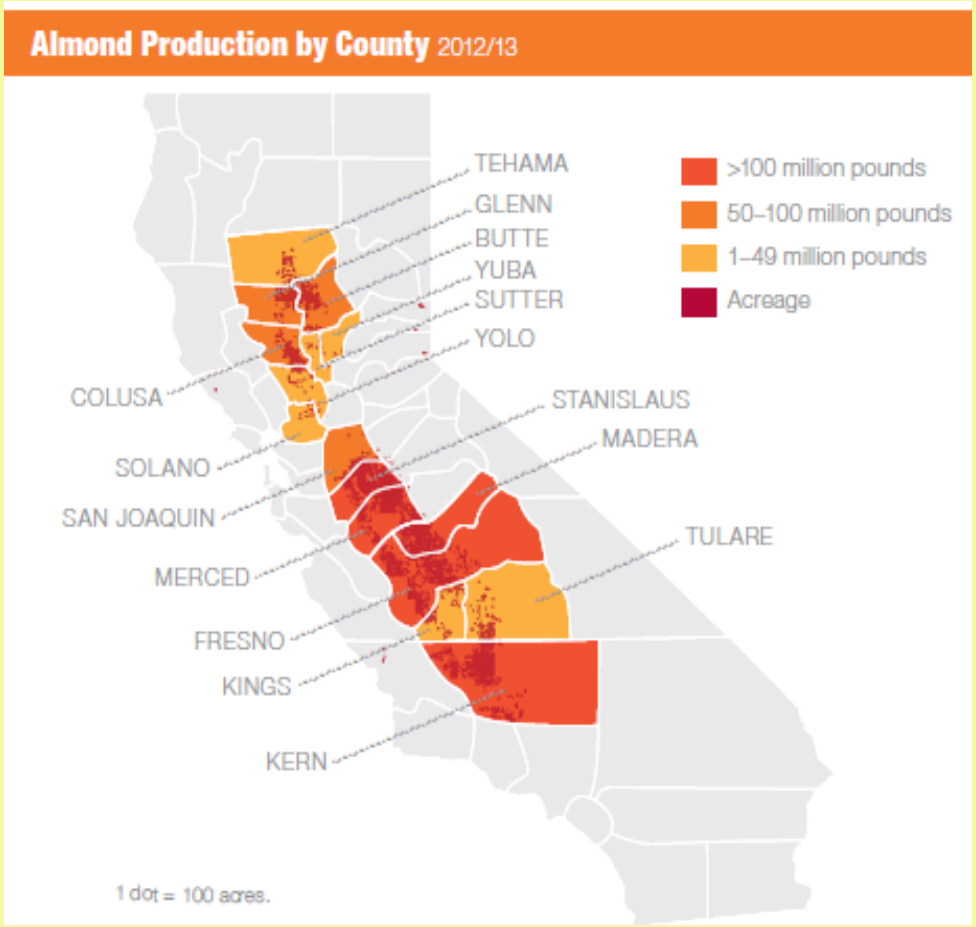
Bees, Pollination and Almonds

Protecting a Crop and Protecting the Pollinators

Gordon Wardell, PhD Paramount Farming Company

The Scope of the California Almond Industry

- Spanning 500 miles throughout the Central Valley
- 6,500 growers
- 105 handler/processors
- $4.8 billion in farm value (2012)*
  - 2nd most valuable California crop
  - 3rd largest acreage in California
  - At current pricing, farm value about $6 - 7 billion
- 100% of U.S. production
- 82% of worldwide production
- $3.4 billion export value (2012)**
  - California's #1 ag export***
  - 47,000+ jobs created
  - Top U.S. specialty export crop
- Largest Pollination Demand in the US



Sources:
*USDA National Agricultural Statistics Service, Pacific Region (NASS/PR)
**U.S. Department of Commerce, Foreign Trade Statistics
***Agricultural Issues Center, University of California 2011

What's Happening to Our Bees?

The adult bees in the hive are not living long enough


Pests


Parasites


Pathogen


Pesticides

Pasture

Project Apis m.

What PAm is doing to increase bee forage

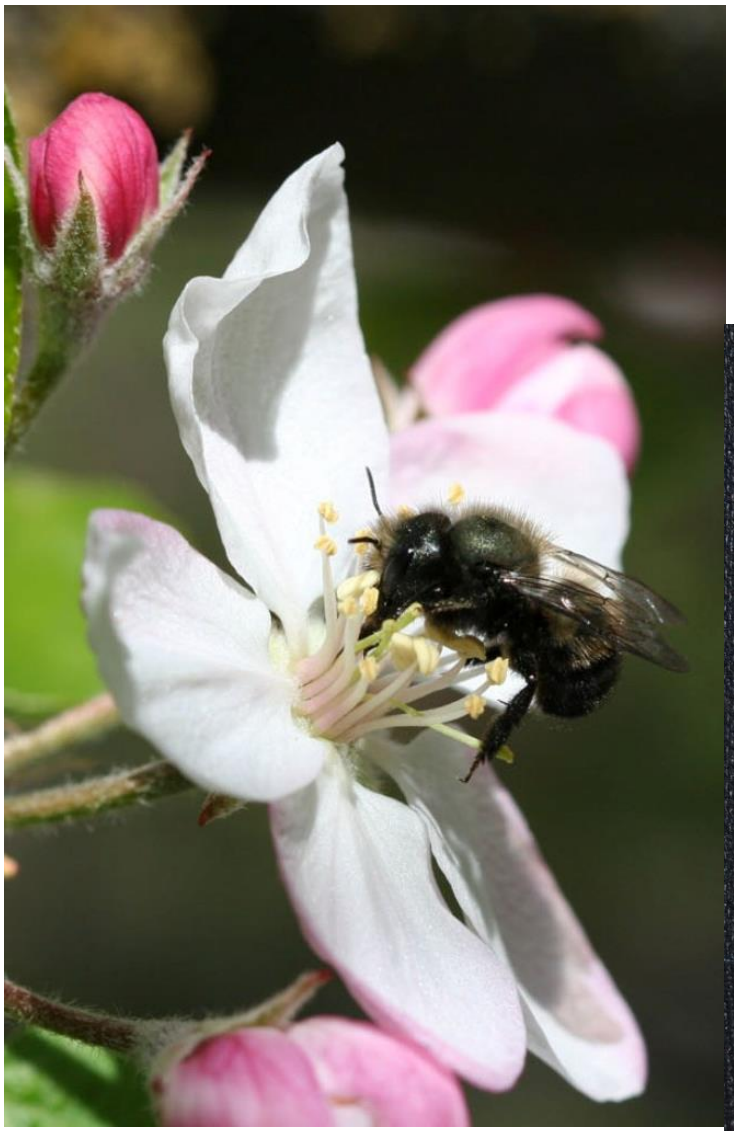
- Identifying seed mixes for Fall and Spring
- Sourcing seed suppliers
- Initiating forage plots - California & Upper Midwest
- Justifying economical & ecological benefits to landowners

Almonds Should Be and Can Be the Safest Crop Pollinated by Bees.

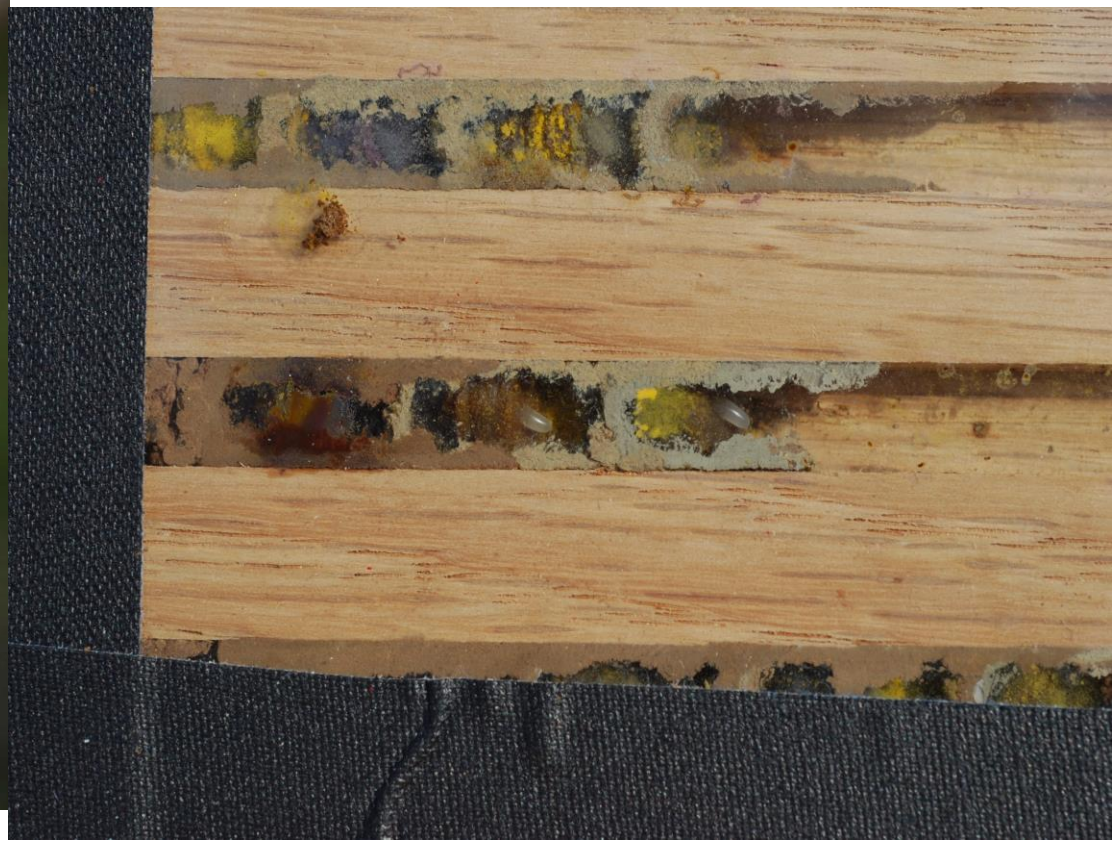
2014 Almond Pollination Season

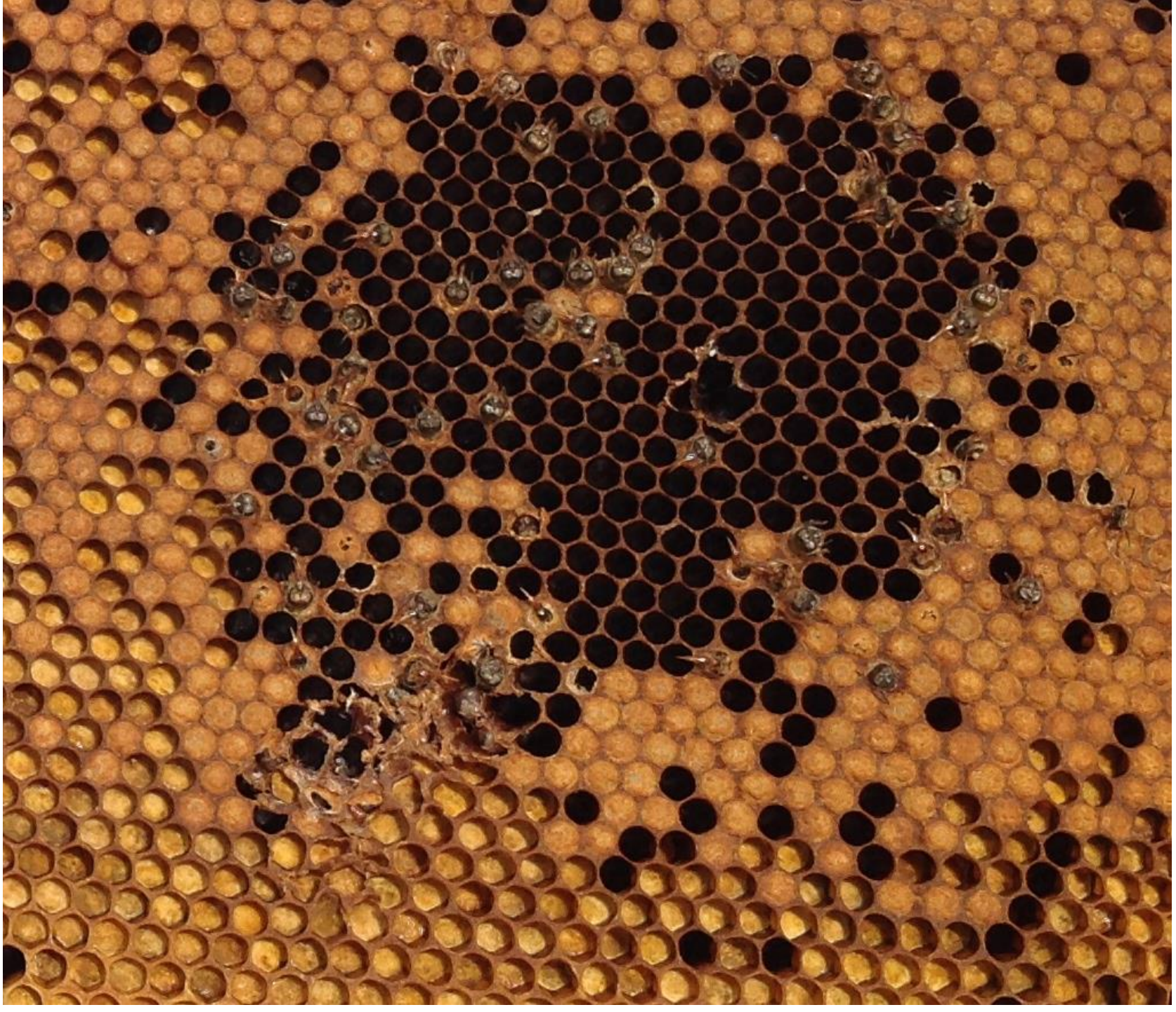
- One of the best pollination seasons on record, warm temperatures, good overlap between varieties, modest rain
- Unfortunately over 80,000 colonies were reported to have experienced spray damage during or immediately after bloom
  - Most were attributed to tank mixes with fungicides

The Blue Orchard Bee



Osmia lignaria





Herbicide Bee Kill - Tank Mix:
A generic weed killer
A second herbicide
Spray Oil
Liquid AMS (ammonium sulfate)

Insects and Plant Evolution

Honey Bee Basics

Honey Bees and Plants Evolved Together

It Doesn't Have To Be An Either / Or

vs.

We Can Protect the Crop and Protect the Bees

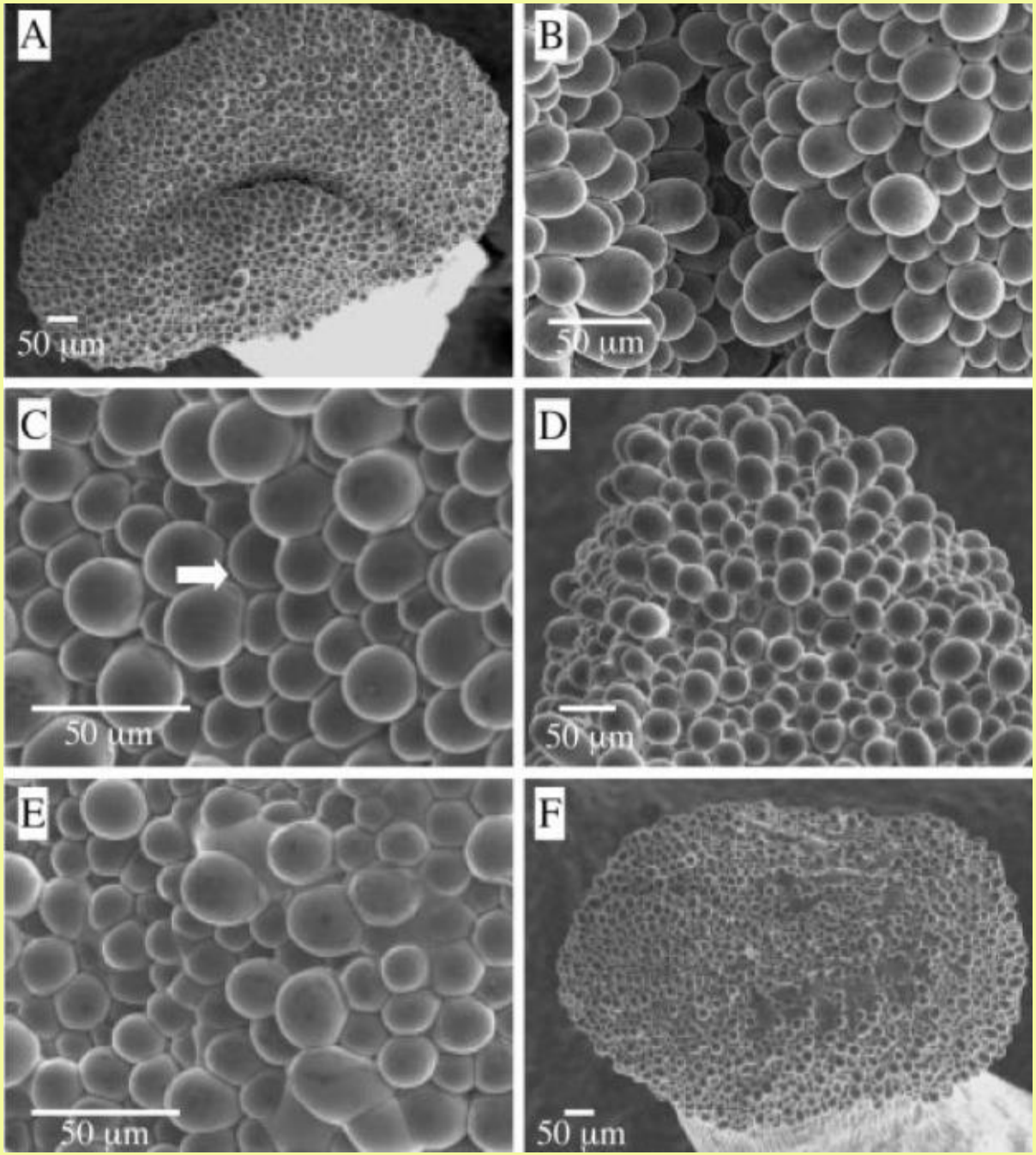
The four basic rules to follow to protect honey bees during the pollination season are:

1. If it is necessary to spray the orchard during bloom, do so in the late afternoon or evening.
2. Until more is known through research, do not tank-mix products to spray during bloom.
3. Avoid applying insecticides during bloom until more is known about the effects on honey bees.
4. Maintain clear communication among all parties involved.

Almond Board of California 2014

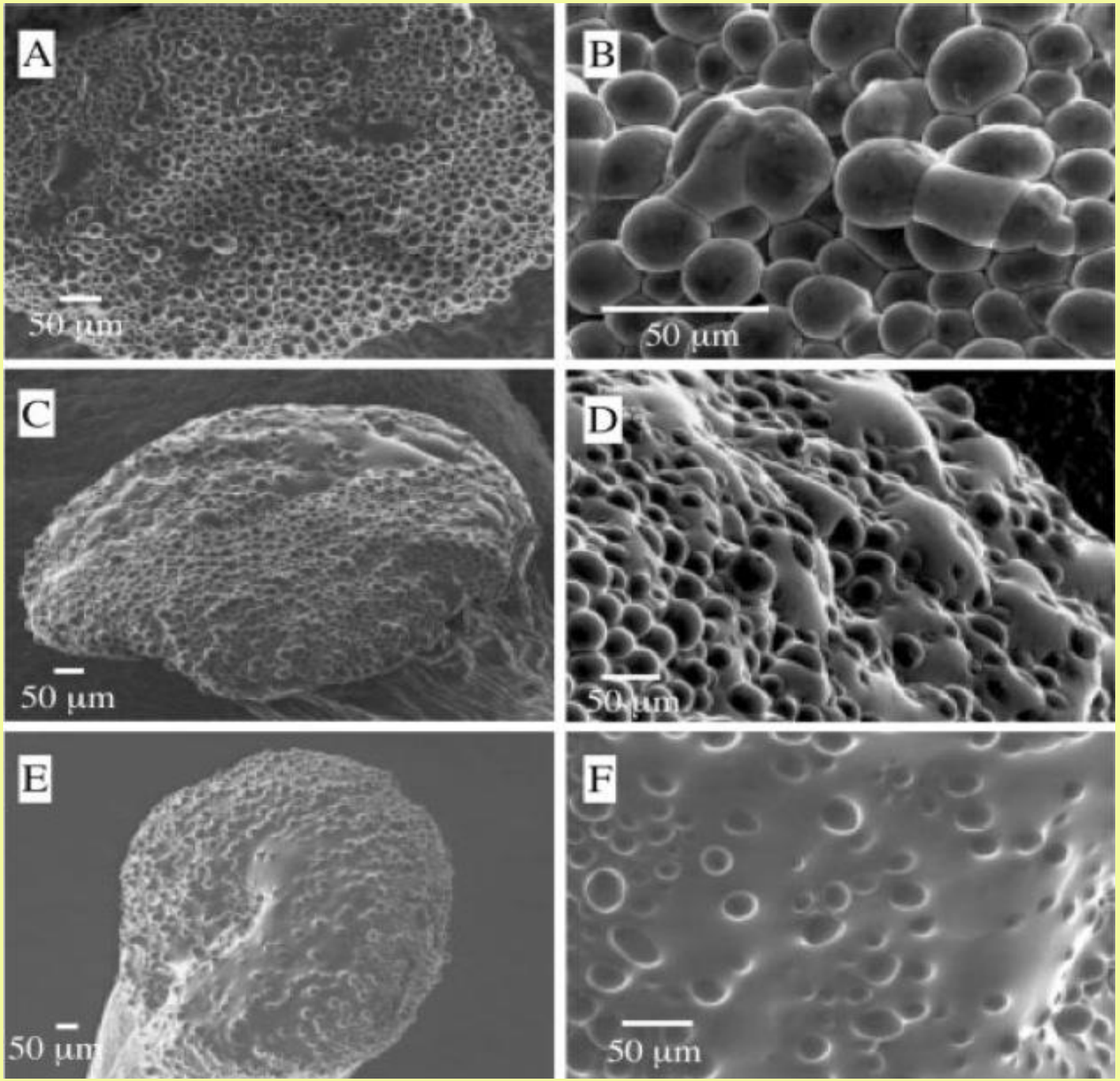
Daytime Applications: What's at Risk

- Daytime spray applications reduce potential yields!
  - Sprays harm foraging worker bees
  - Daytime sprays change the scent of the orchard and change foraging patterns
  - Sprays can potentially damage the stigmatic surface of the flower
  - If the brood population is damaged, the need for pollen in the colony is reduced and a percentage of bees will switch from pollen foraging to nectar foraging



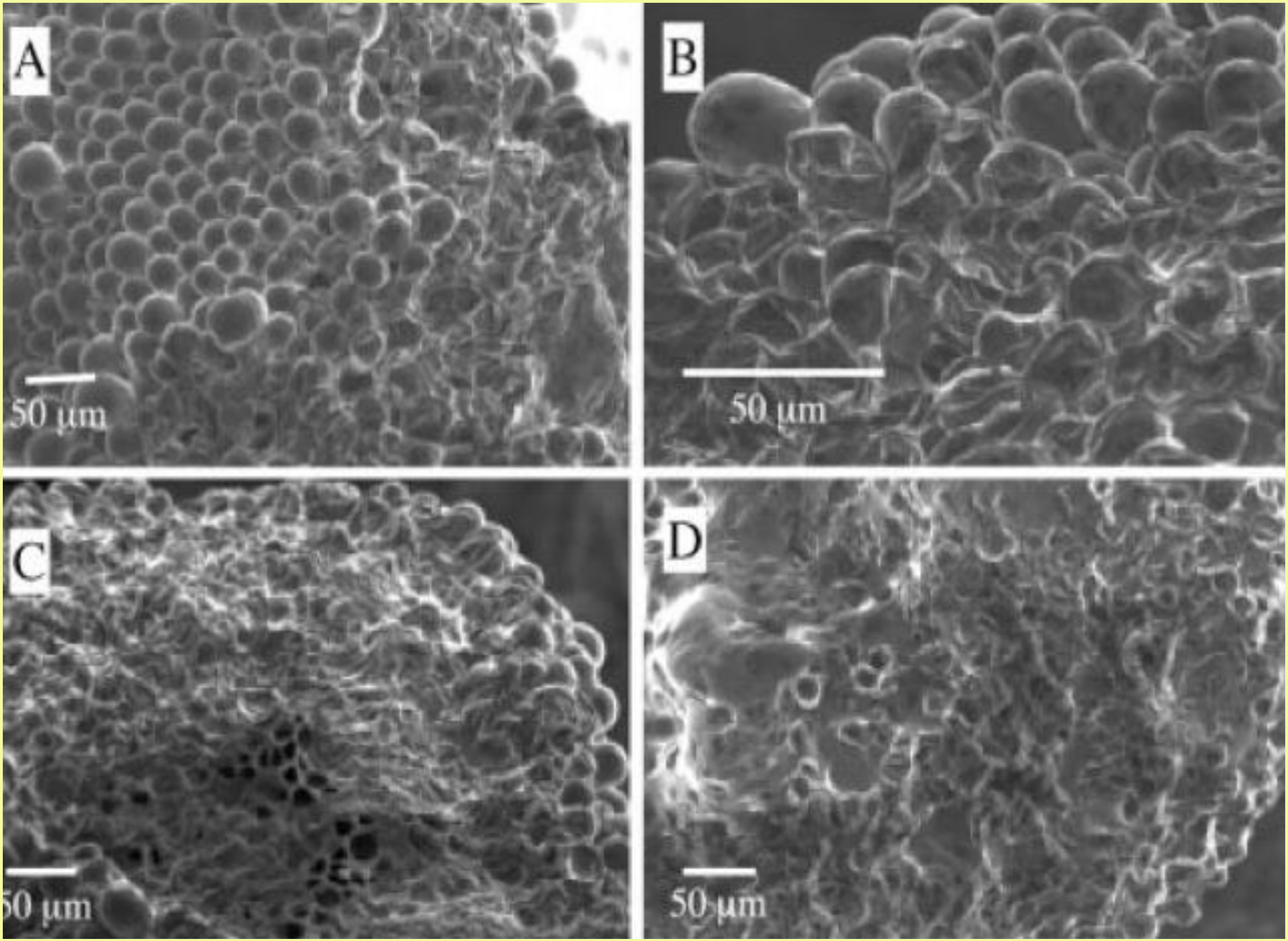
Healthy
Almond
Stigma

Yi, Law and Wetstein 2003 Annals of Botany

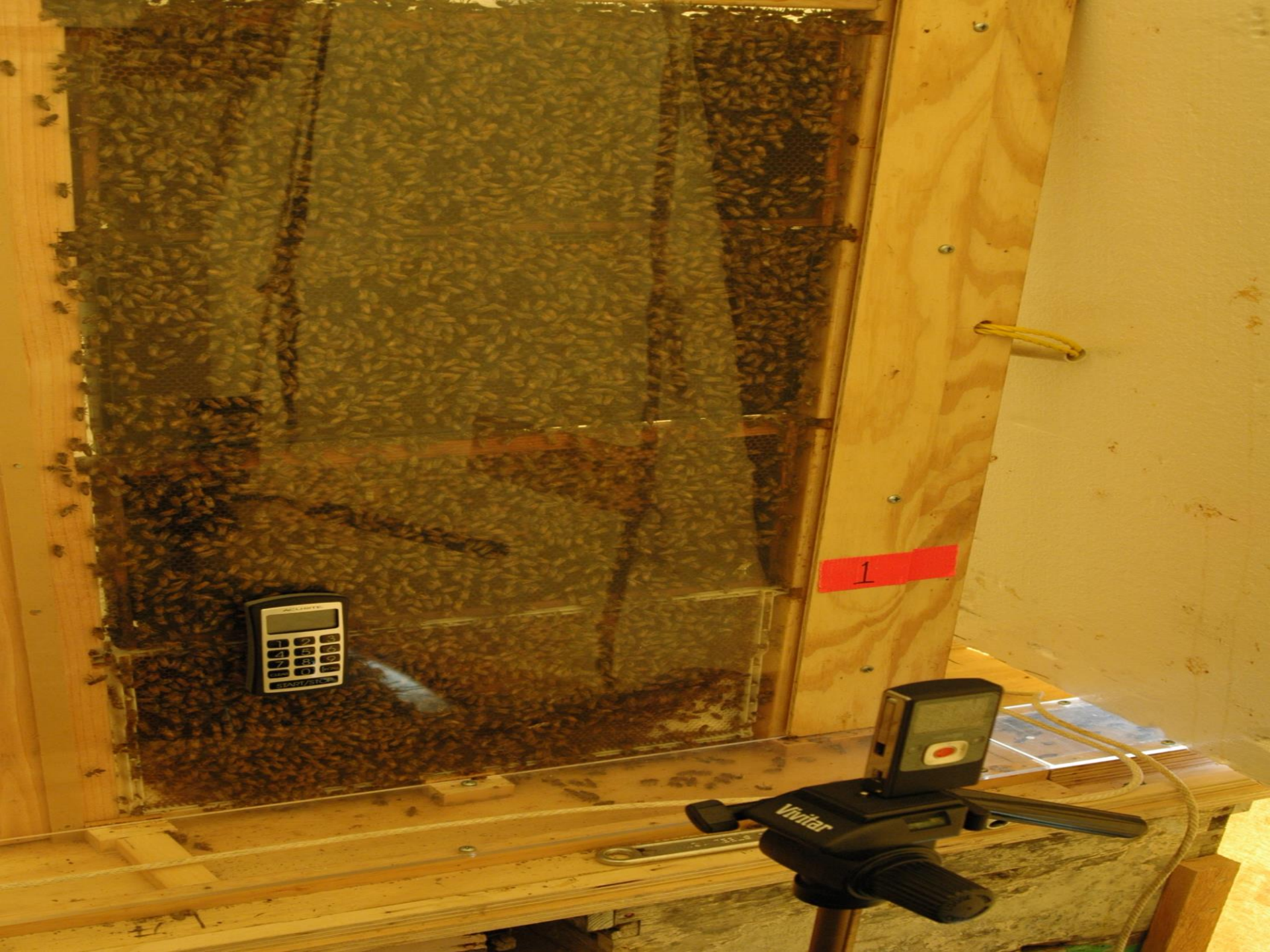


Almond Flower Stigma Damaged By Fungicide Spray

Yi, Law and Wetstein 2003 Annals of Botany


A
50 µm
B
50 µm
C
50 µm
D
50 µm


Bees have wings
They have a choice
Other consequences of bloom-time spray application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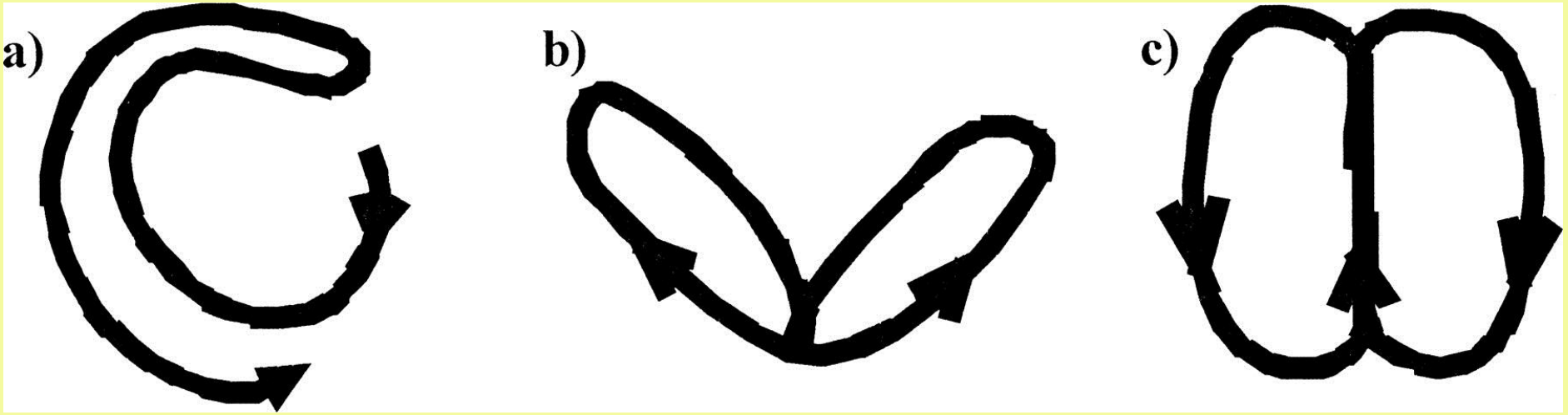
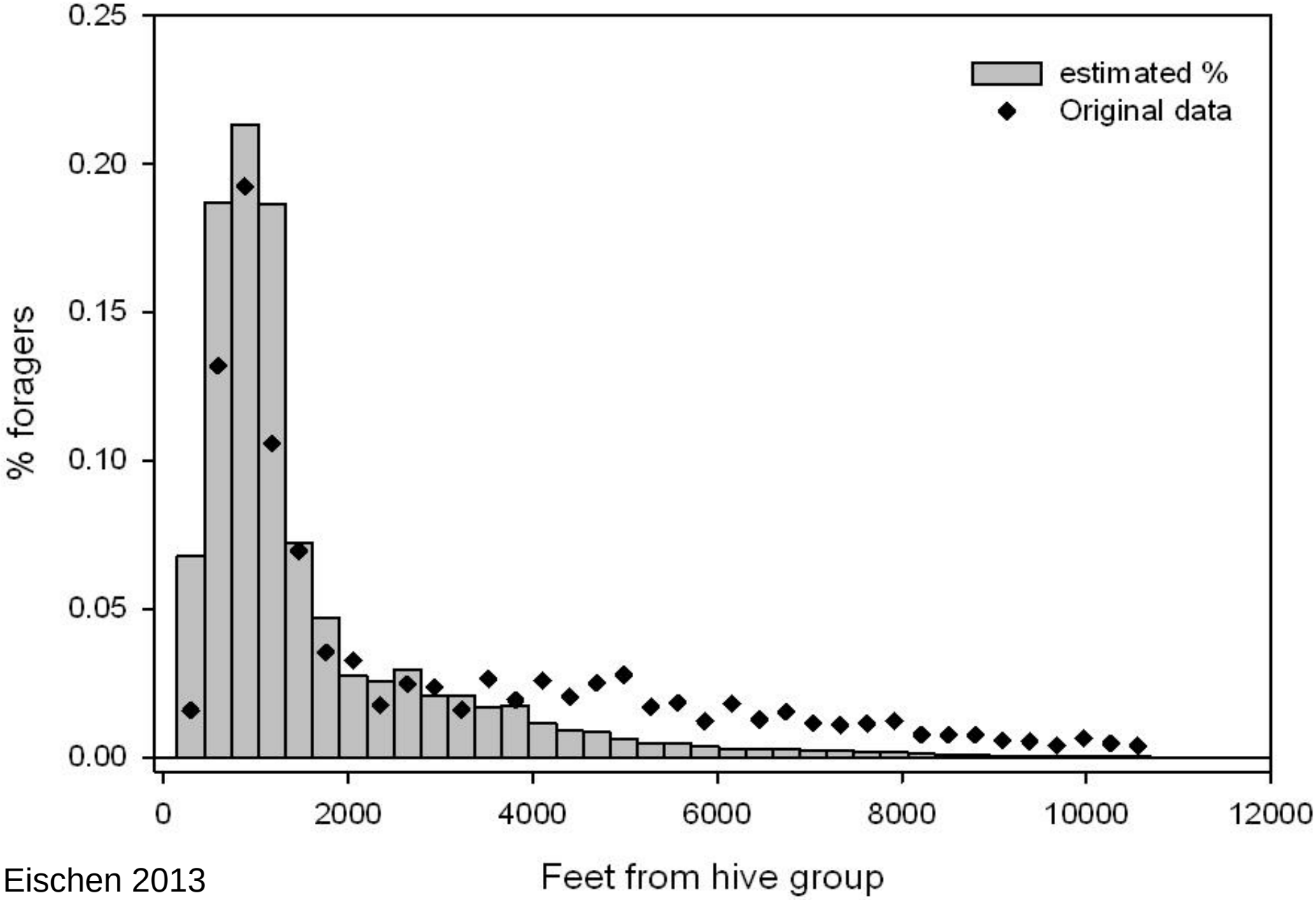
Vivitar

Honey Bee Dance Language

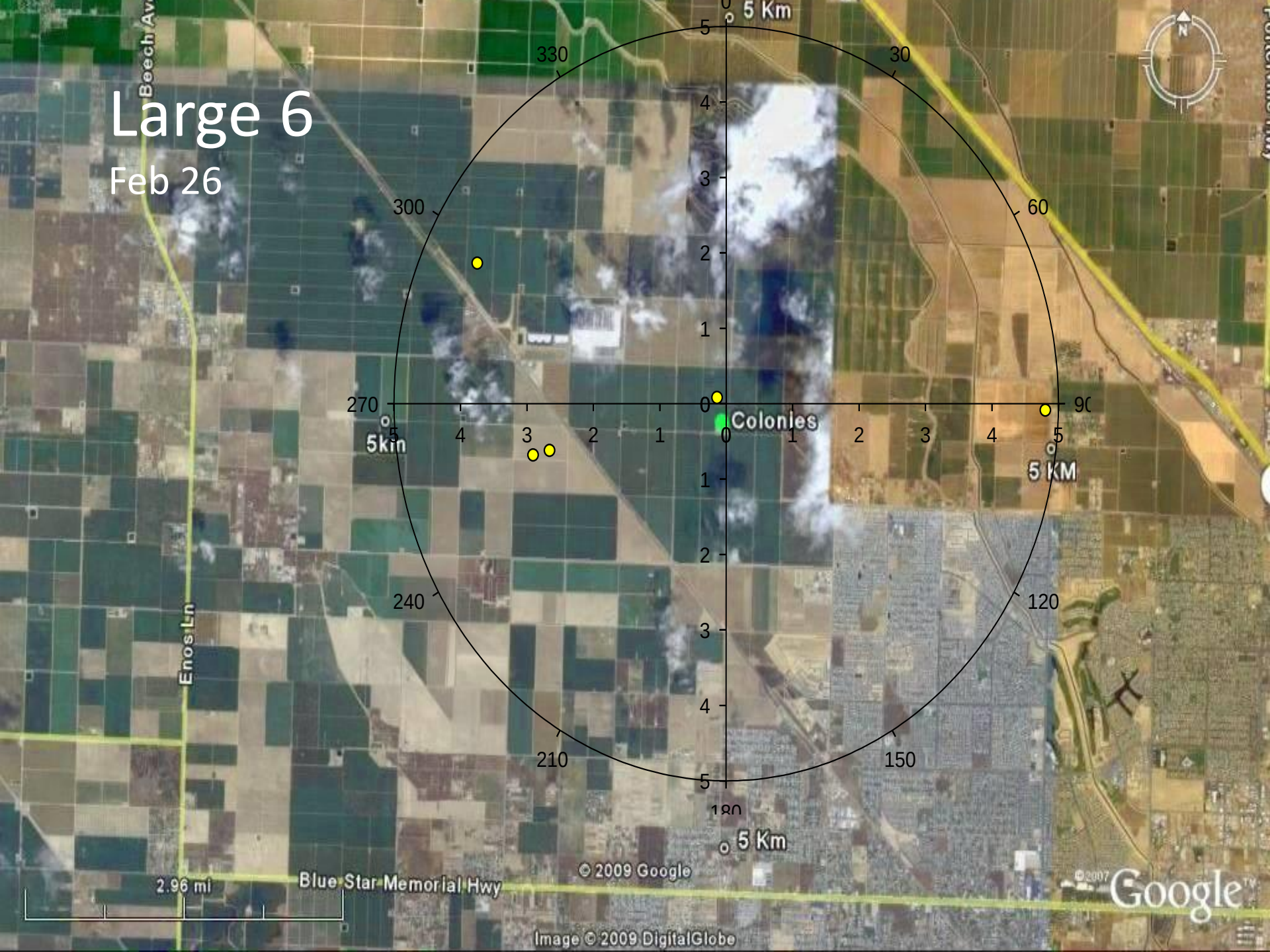
Outside the hive | 50 to 150 Meters | > 150 Meters



- Direction and Distance to the flowers
- Scent of the flowers
- Taste of the nectar



Eischen 2013


Large 6
Feb 26
5 Km
330
30
300
60
270
90
240
120
210
150
180
5 Km
Colonies
5km
5 KM
Beech Ave
Enos Ln
Blue Star Memorial Hwy
2.96 mi
© 2009 Google
Image © 2009 DigitalGlobe
Google

A Little Bee Biology

Three Distinct Populations in a Colony

- The Immature Bees (Brood)
  - Eggs, Larvae, Pupae
- The Hive Bees
  - Nurse Bees, Hive Cleaners, Wax Builders, Honey and Pollen Processers, Undertakers and Guards
- Field Bees (Foragers)
  - Pollen Foragers, Nectar Foragers, Water Foragers, Propolis Foragers

Honey Bee Brood

Undertaker Bees

Guard Bees

Foragers

BEEOGRAPHY

Bees without Borders

In the U.S., many farmers cannot rely on native bees or even local honeybees to sufficiently pollinate their vast swaths of cropland. Rather they rent honeybee hives from the 1,600 or so migratory beekeepers who traverse the country between February and November. This annual migration mingles sick insects with healthy ones and deprives bees of proper nourishment when on the road.

Each February most migratory beekeepers converge in the Central Valley to pollinate more than 800,000 acres of almonds. Apples, plums and cherries in California and nearby states require honeybee pollination, too.

In summer months, many commercial beekeepers head to North and South Dakota, where they allow their bees to gorge on fields of alfalfa, clover and sunflowers and to produce the bulk of their honey for the year.

In the spring and summer, some beekeepers travel to blooming blueberry fields in Michigan and cranberry bogs in Wisconsin. Others opt for watermelons, cantaloupes and cucumbers in Texas, which also draws beekeepers in the fall for pumpkin pollination.

Because Florida's climate varies from subtropical to tropical, some plant or other is always flowering in the Sunshine State. Florida depends on honeybees to pollinate blueberries as early as February, tupelos and gallberries in April and Brazilian pepper trees in September.

Migratory beekeepers travel up and down the East Coast year-round as well, visiting apples, cherries, pumpkins, blueberries, cranberries, lettuces, and various veggies in Maine, Pennsylvania, Massachusetts, New York and New Jersey.

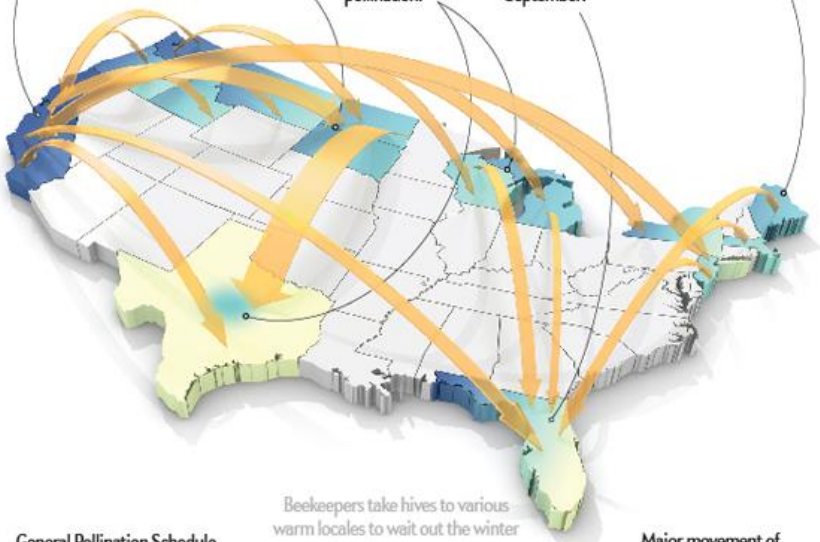


Illustration by Bryan Christie, for SCIENTIFIC AMERICAN