Honey Bees and Avocados

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A brief pollination review

Honey bees and pollination

Honey bee BMPs for pollination

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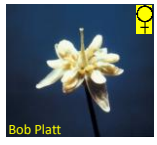
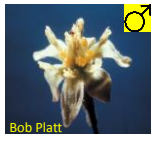
Honey bee BMPs for pollination

Avocado flower

- Transfer of pollen from an anther (male) to the stigma (female)
  - Cross-pollinating
- Avocado has a "perfect" flower
  - Female – Pistil: stigma, style and the ovary
  - Male – Stamen: anther (contains pollen) and a filament
  - A and B varieties





M. L. Arpaia & R. Hofshi

Avocado pollination

- Insects contribute to higher cross-pollination (Ish-Am and Lahav 2011)
  - * Ying et al. 2009
  - Native range (Ish-Am 1999)
    - Flies
    - Beetles
    - Bees and wasps (Mexican honey wasp, Stingless bees)
  - Non-native range
    - Honey bee hives placed into groves for pollination

Number of fruit on each caged tree

	Beeless	Bees
Zutano	4	120
Hass	5	284

Peter Peterson (1955)

Ish-Am et al. 1999. Revista Chapingo Serie Horticultura 5: 137-143.

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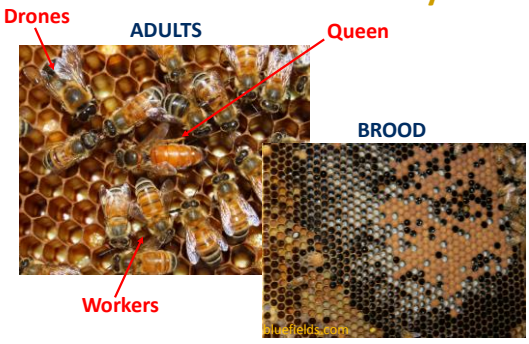
A look inside the colony



CSBA 2014 POLLINATION SURVEY RESULTS

CROP	NUMBER OF RENTALS	HIGH FEE	LOW FEE	AVERAGE FEE	TOTAL $ INCOME	NUMBER OF BEEKEEPERS
ALFALFA SEED	2,860	$ 55.00	$ 35.00	$ 48.76	$ 142,300.00	4
ALMONDS						
KERN-MADERA	62,564	$ 194.00	$ 150.00	$ 181.06	$ 11,327,850.00	12
MERCED-SAN JOA	25,093	$ 194.00	$ 160.00	$ 179.81	$ 4,509,759.00	8
SACRAMENTO-NORTH	31,818	$ 194.00	$ 155.00	$ 169.46	$ 5,391,800.00	8
TOTAL CA	119,462	$ 180.00	$ 135.00	$177.71	$ 21,229,350.00	28
APTIES	2,830	$ 50.00	$ 25.00	$ 36.35	$ 102,900.00	3
APRICOTS						
AVOCADOS RENT	2,325	$ 50.00	$ 25.00	$ 27.42	$ 63,750.00	3
AVOCADOS N/C	4,110					
BLUE BERRIES						
BUSH OR CANE BERRIES						
CHERRIES (LATE)	3,080	$ 50.00	$ 30.00	$ 36.04	$ 111,000.00	7
CHERRIES (EARLY)	378	$ 194.00	$ 100.00	$ 168.13	$ 63,552.00	4
CLOVER SEED						
CUCUMBERS	435	$ 36.00	$ 35.00	$ 35.80	$ 15,575.00	2
CORRIANDER						
KIWIS RENT	100	$ 35.00	$ 35.00	$ 35.00	$ 3,500.00	1
MELONS (WATERMELONS)	910	$ 36.00	$ 35.00	$ 35.82	$ 32,600.00	2
MELONS (ALL OTHERS)	2,180	$ 37.50	$ 31.00	$ 32.00	$ 69,760.00	4
ONION SEED	145	$ 50.00	$ 25.00	$ 35.00	$ 5,075.00	1
PLUMS	3,520	$ 170.00	$ 16.00	$ 39.83	$ 140,200.00	3
PLUOTS	8	$ 125.00	$ 120.00	$ 125.00	$ 1,000.00	1
PUMPKINS	8	$ 50.00	$ 50.00	$ 50.00	$ 400.00	1
PRUNES						
PRUNES N/C	2,000					
QUINCE						
SQUASH	585	$ 65.00	$ 35.00	$ 36.03	$ 21,075.00	2
SUNFLOWERS RENT	5,630	$ 180.00	$ 35.00	$ 44.55	$ 250,800.00	3
VEGETABLE SEED (HIVES)	1,391	$ 136.00	$ 35.00	$ 72.21	$ 100,445.00	3
VEGETABLE SEED (NUCS)	80	$ 100.00	$ 100.00	$ 100.00	$ 8,000.00	1

TOTAL NUMBER OF LIVE COLONIES SURVEYED 123,390

AVERAGE WINTER MORTALITY RATE (2013-2014) 20%

AVERAGE PROJECTED 2014 ALMOND POLLINATION FEE $ 184.51

PROJECTED VS. ACTUAL ALMOND POLLINATION FEES FROM PREVIOUS SURVEYS

YEAR	PROJECTED	ACTUAL	DIFFERENCE
2012	$154.74	$153.42	-$1.32
2013	$ 154.03	$ 157.31	$3.28
2014	$ 168.13	$ 177.71	$9.58
2015	$184.51		

Pollination by honey bees

Avocado pollination by honey bees

- **Stocking rate recommended:**
  - **4 hives/acre (normal), 2.5 (dry), 5 (high nectar flow)**
- **Hives and bees in the grove**
  - **Sunny location with entrance facing east (*)**
  - **Pollinizers near by since HB forage in a limited area (couple of rows)**

Attracting honey bees to bloom

- **Use pheromone lures**
  - **Bee Here®**
  - **Bee Lure®**

- **Sugar solution (6 carbon sugars)**
  - **Avocado nectar contains perseitol (7C)**

Honey bee races

- **Different races have different proclivity for avocado nectar** (Dag et al. 2003)
  - **New World Carniolan collected more honey from avocado than Italian (*)**
- **Can Inst. Ins. honey bees so potential for breeding "avocado-loving" bees**

What we study

- Queen is the only reproductive female
  - Anything that affects her will affect the colony
  - Factors that regulate mating and reproductive processes in queens

- Behavioral observations
  - Mating flight attempts

Honey Bee Queen Mating Flight Attempt

What we study

- Queen is the only reproductive female
  - Anything that affects her will affect the colony
  - Factors that regulate mating and reproductive processes in queens

- Behavioral observations
  - Mating flight attempts
- Physiological changes
  - Pheromone production

Honey Bee Queen With Worker Retinue

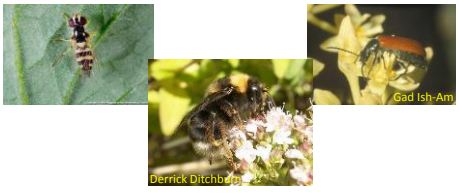
What we study

- Queen is the only reproductive female
  - Anything that affects her will affect the colony
  - Factors that regulate mating and reproductive processes in queens

- Behavioral observations
  - Mating flight attempts
- Physiological changes
  - Pheromone production

Help improve breeding protocols and increase success

Other pollinators in CA orchards?



- Gordon Frankie and Ben Faber surveying avocado orchards for native pollinators
  - Develop attractive forage schemes

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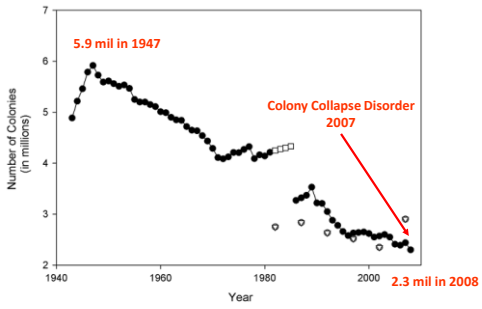
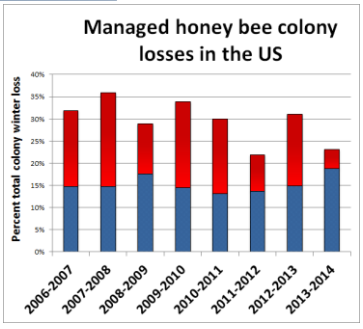
History of honey bee losses in the US

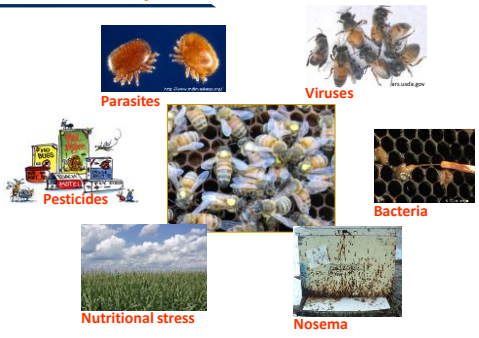


Estimate of the number of honey producing colonies in the US (USDA NASS; *vanEngelsdorp and Meixner 2010*)

Current losses



What ails honey bees?



What are you supposed to do?

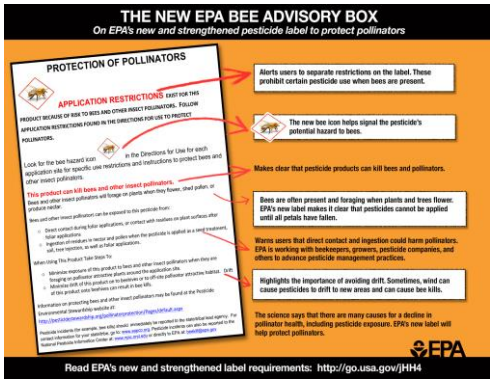
- **Honey Bee Best Management Practices for Pollination**
  - **Almond Board of California**
    http://www.almonds.com/growers/pollination#BeeBMPs
  - **Canadian Pol. Initiative, University of Guelph**
    http://www.pollinator.ca/bestpractices/#

Know your pesticides and read the label

Table 1. Honey bee acute toxicity groups and precautionary statements (from EPA)

Toxicity Group	Precautionary Statement if Extended Residual Toxicity is Displayed	Precautionary Statement if Extended Residual Toxicity is not Displayed
I Product contains any active ingredient with an acute LD50 of 2 micrograms/bee or less	This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.	Product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting treatment area.
II Product contains any active ingredient(s) with acute LD50 of greater than 2 micrograms/bee but less than 11 micrograms/bee.	This product is toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product if bees are visiting the treatment area.	This product is toxic to bees exposed to direct treatment. Do not apply this product while bees are actively visiting the treatment area.
III All others.	No bee caution required.	No bee caution required.

Pesticide effects on pollinators not well understood

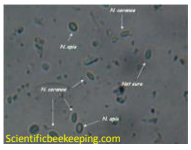


Common name (example trade name)	Mode of action1	Selectivity2 (affected groups)	Predatory mites3	General predators4	Parasites4	Honeybees5	Duration of impact to natural enemies6
abamectin (Agri-Mek)	6	moderate (mites, thrips)	M	M7	M/H	II	moderate to predatory mites and long to affected insects
Bacillus thuringiensis ssp. *aizawai*	11	narrow (caterpillars)	L	L	L	IV	none
Bacillus thuringiensis ssp. *kurstaki*	11	narrow (caterpillars)	L	L	L	IV	none
boric acid bait (Gourmet)	—	narrow (ants)	L	L	L	IV	none
copper sulfate (Bordeaux mixture) trunk spray	—	narrow (snails)	L	L7	L	IV	long as a barrier
etoxazole (Zeal)	10B	narrow (mites)	H12	L	—	IV	short
fenpropathrin (Danitol)	3	broad (insects, mites)	H	H	H	I	—
fenpyroximate (Miteus)	21A	narrow (mites and some insects)	H	L	L	IV	short
imidacloprid (Admire)	4A	narrow (sucking insects)	—	L	L	I 8	long
insecticidal soap (M-Pede)	—	broad (exposed insects, mites)	L	L	L	IV	short
iron phosphate (Sluggo)	—	narrow (snails and slugs)	L	H7	L	IV	short
malathion	1B	broad (insects, mites)	H	H	H	II	moderate
metaldehyde (Deadline)	—	narrow (snails and slugs)	L	H7	L	IV	short
oil, narrow-range	—	broad (exposed insects, mites)	L	L	L	III	short
pyrethrin (PyGanic)	3	moderate (insects)	—	M	M	III	short
pyrethrin/ piperonyl butoxide (Pyrenone)	3/—	moderate (insects)	—	M	M	III	short
sabadilla (Veratran-D)	—	narrow (feeding thrips)	L	L	L	IV	short
spinetoram (Delegate)	5	narrow (thrips)	M	M9	L/M	III	moderate10
spinosad (Success, Entrust)	5	narrow (thrips)	M	M9	L/M	III11	moderate9
spirodiclofen (Envidor)	23	narrow (mites)	L	—	—	I	—
spirotetramat (Movento)	23	narrow (aphids, scale, psyllids, whiteflies)	L	L	L	—	short
sulfur	—	narrow (mites)	L/H	L	H	IV	moderate

Ratings are as follows: I-Do not apply to blooming plants; II-Apply only during late evening; III-Apply only during late evening, night, or early morning; and IV-Apply at any time with reasonable safety to bees. For more information, see *How to Reduce Bee Poisoning From Pesticides* (PDF), Pacific Northwest Extension Publication PNW591.

A word of caution!

Fungicides also a potential hazard to honey bees and other pollinators!



E.g., increased Nosema spore loads in bees exposed to fungicides (Pettis et al. 2013)

Almond Board BMPs

- **COMMUNICATION is the key!**
- **Need to include everyone involved in pest control decisions**
- **Create an agreement with an outlined pesticide application plan**
  - **If trt give 48 hour notice to beekeepers**
  - **Contact Co. Ag commissioner to notify beekeepers with nearby hives**
    - **Required for "toxic to bees"**

Almond Board of CA

Things to avoid

- **Avoid use of INSECTICIDES at any time during the bloom**
  - **Particular concern for brood and sublethal effects**
- **Avoid pesticides highly toxic to bees**
- **Avoid tank mixes**
  - **Synergistic effects**

Timing

- Avoid application of other pesticides (eg., fungicides) when bees are foraging
  - Late afternoon and evening
- Communicate about hive removal from the crop
  - To avoid pesticide exposure

The obvious

- DO NOT spray flying bees
  - Bees can't fly with wet wings
- DO NOT spray hives directly
  - Driver to turn off nozzles near hives
- DO NOT spray when windy

Pesticide bee incident reporting

- Report any pesticide bee kills to the Co Ag commissioners office
  - Need data to inform decisions

How anyone can help (a little more)

- Honey bees need diversity of pollen sources
  - Improves immune/detox response ➡ helps deal with pests, pathogens, PESTICIDES
  - Beekeepers often feed pollen substitute (brewer's yeast, Megabee, etc.), but not as good as pollen
- Plant diverse flower sources!
- Provide a clean water source
  - Cover or empty and refill during spraying

Useful resources

- California Department of Pesticide Regulation
  http://www.cdpr.ca.gov/
- California Dept of Food and Agriculture
  http://www.cdfa.ca.gov/
- UC Cooperative Extension IPM program
  http://www.ipm.ucdavis.edu/
  http://www.ipm.ucdavis.edu/PDF/PMG/pnw591.pdf
- Environmental Protection Agency
  http://www2.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance

Other useful resources

- Project Apis m. http://projectapism.org/?page_id=342
- Pollinator stewardship council
  http://pollinatorstewardship.org/
- Bee Informed Partnership http://beeinformed.org/
- The Xerces Society
  http://www.xerces.org/pollinator-conservation/

Contact information

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Visit us at the Häagen-Dazs Honey Bee Haven

http://hhbhgarden.ucdavis.edu

Thank you!

- Mary Bianchi
- Ben Faber

- CA Avocado Society
- CA Avocado Commission
- Sponsors