



Honey Bees and Avocados

Elina L. Niño
Extension Specialist - Apiculture

UC Davis
Cooperative Extension

A brief pollination review
Honey bees and pollination
Honey bee BMPs for pollination

A brief pollination review
 Honey bees and pollination
 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

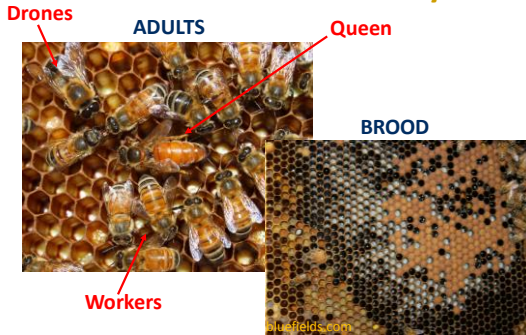
Peter Peterson (1955)



A brief pollination review
Honey bees and pollination
 Honey bee BMPs for pollination

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

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	2,080	\$ 50.00	\$ 35.00	\$ 45.70	\$ 142,300.00	4
ALMONDS						
BERRANDAZCA	82,584	\$ 184.00	\$ 150.00	\$ 181.00	\$ 15,257,850.00	12
BERBERIS SUN JON	25,650	\$ 184.00	\$ 150.00	\$ 179.80	\$ 4,609,700.00	8
BUCKWHEAT/NORTH	3,619	\$ 184.00	\$ 150.00	\$ 184.60	\$ 6,671,620.00	8
TOTAL CA	119,402	\$ 180.00	\$ 135.00	\$ 177.71	\$ 21,229,330.00	28
APPLES	2,329	\$ 50.00	\$ 25.00	\$ 30.22	\$ 70,000.00	3
APRICOTS	2,452	\$ 50.00	\$ 25.00	\$ 27.42	\$ 67,000.00	3
AVOCADO RENT	4,310	\$ 50.00	\$ 25.00	\$ 37.42	\$ 161,000.00	5
AVOCADO/NT	4,310	\$ 50.00	\$ 25.00	\$ 37.42	\$ 161,000.00	5
BILLY BERRIES	3,080	\$ 50.00	\$ 20.00	\$ 29.94	\$ 92,000.00	7
BUSH OF CANE BERRIES	3,080	\$ 50.00	\$ 20.00	\$ 29.94	\$ 92,000.00	7
CHERRIES (SALTY)	3,080	\$ 50.00	\$ 20.00	\$ 29.94	\$ 92,000.00	7
CHERRIES (SWEET)	3,080	\$ 50.00	\$ 20.00	\$ 29.94	\$ 92,000.00	7
CLOVER SEED	435	\$ 30.00	\$ 15.00	\$ 15.80	\$ 6,875.00	2
CUCUMBERS	100	\$ 15.00	\$ 10.00	\$ 12.00	\$ 1,200.00	1
CORRIANDER	100	\$ 15.00	\$ 10.00	\$ 12.00	\$ 1,200.00	1
CYRUS RENT	100	\$ 15.00	\$ 10.00	\$ 12.00	\$ 1,200.00	1
MELONS (WATERMELONS)	100	\$ 15.00	\$ 10.00	\$ 12.00	\$ 1,200.00	1
MELONS (ALL OTHERS)	2,180	\$ 17.00	\$ 11.00	\$ 13.00	\$ 28,360.00	4
ORION SEED	100	\$ 15.00	\$ 10.00	\$ 12.00	\$ 1,200.00	1
PUMPKIN	3,520	\$ 170.00	\$ 15.00	\$ 20.53	\$ 72,200.00	3
RAISINS	8	\$ 50.00	\$ 15.00	\$ 22.00	\$ 176.00	1
PUMPKINS	8	\$ 50.00	\$ 15.00	\$ 22.00	\$ 176.00	1
PRUNES	2,000	\$ 50.00	\$ 15.00	\$ 22.00	\$ 44,000.00	2
PRUNES/NT	2,000	\$ 50.00	\$ 15.00	\$ 22.00	\$ 44,000.00	2
SQUASH	488	\$ 85.00	\$ 35.00	\$ 55.00	\$ 27,075.00	2
SUNFLOWER RENT	3,650	\$ 150.00	\$ 25.00	\$ 44.85	\$ 163,625.00	2
SUNFLOWER/NT	3,650	\$ 150.00	\$ 25.00	\$ 44.85	\$ 163,625.00	2
VEGETABLE SEED (HIVES)	1,301	\$ 150.00	\$ 35.00	\$ 72.51	\$ 95,445.00	3
VEGETABLE SEED (HIVES)	81	\$ 200.00	\$ 100.00	\$ 200.00	\$ 16,000.00	1
TOTAL NUMBER OF LIVE COLONIES SURVEYED	123,389					
AVERAGE WINTER MORTALITY RATE (2013-2014)	20%					
PROJECTED VS ACTUAL ALMOND POLLINATION FEES FROM PREVIOUS SURVEYS						
	YEAR	PROJECTED	ACTUAL	DIFFERENCE		
	2012	\$154.74	\$183.42	-\$13.28		
	2013	\$ 184.03	\$187.51	-\$3.78		
	2014	\$ 188.12	\$177.71	\$9.95		
	2015	\$184.31				

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®

Bee Here®

Bee Here® is an extremely effective control released, all-natural product which lures honey bees to targeted crops. Bee Here® utilizes cutting edge pheromone based technologies that provide a proven means of increasing pollination and boosting crop yields and quality. Targeted crops may include but are not limited to: apples, avocados, berries, citrus, melons, peaches, pears, prunes, nut crops, vegetable seed crops, forage crops and legume crops.

- Increases bee visits to non-pollinated crops such as: softwoods
- Increases bee visits in inclement weather such as early bloom
- Highly concentrated, less containers



- 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

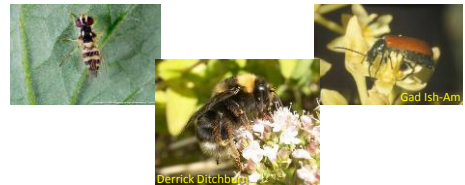


What we study

- 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



Other pollinators in CA orchards?

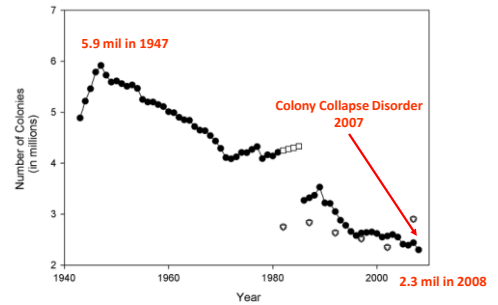


- Gordon Frankie and Ben Faber surveying avocado orchards for native pollinators
 - Develop attractive forage schemes

Help improve breeding protocols and increase success

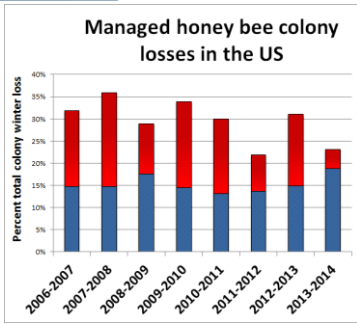
A brief pollination review
 Honey bees and pollination
Honey bee BMPs for pollination

History of honey bee losses in the US

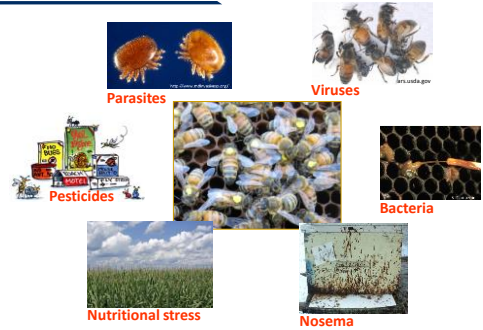


Estimate of the number of honey producing colonies in the US (USDA NASS; vonEngelsdorff and Meixner 2010)

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

THE NEW EPA BEE ADVISORY BOX
On EPA's new and strengthened pesticide label to protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS MUST FOR THE PRODUCT WEIGHED OF USE TO AVOID HARM OTHER POLLINATORS. FOLLOW SPECIFIC RESTRICTIONS FOUND IN THE INSTRUCTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon. In the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This pesticide can kill bees and other insect pollinators. Bees and other insect pollinators will forage on plants when they flower, feed pollen, or drink nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact with their applications or contact with residues on plant surfaces, other plants or water.
- Ingestion of pollen or nectar when the pesticide is applied to a crop or plant.
- Ingestion of water, nectar, or pollen when the pesticide is applied to a crop or plant.
- Ingestion of water, nectar, or pollen when the pesticide is applied to a crop or plant.

When using this Product, take steps to:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging or drinking nectar or pollen on the pesticide.
- Minimize exposure of this product to bees and other insect pollinators when they are foraging or drinking nectar or pollen on the pesticide.
- Minimize exposure of this product to bees and other insect pollinators when they are foraging or drinking nectar or pollen on the pesticide.

Read EPA's new and strengthened label requirements: <http://go.usa.gov/HH4>

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

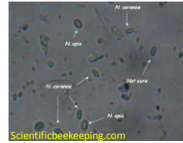
Common name (example trade name)	Mode of action ¹	Selectivity ² (affected groups)	Predatory mites ³	General predators ⁴	Parasites ⁴	Honeybees ⁵	Duration of impact to natural enemies
abamectin (Agri-Mek)	6	moderate (mites, thrips)	M	M7	M/H	II	moderate to predatory mites and long to affected insects
<i>Bacillus thuringiensis</i> ssp. <i>ajizawai</i>	11	narrow (caterpillars)	L	L	L	IV	none
<i>Bacillus thuringiensis</i> ssp. <i>kurstaki</i>	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 (Pittes)	21A	narrow (mites and some insects)	H	L	L	IV	short
imidacloprid (Admiral)	4A	narrow (sucking insects)	—	L	L	I e	long
insecticidal soap (M-Peds)	—	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
metaldelhyde (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	moderate ¹⁰
spinosad (Success, Entrust)	5	narrow (thrips)	M	M9	L/M	III ¹¹	moderate ⁹
spiromeclofen (Envidor)	23	narrow (mites)	L	—	—	I	—
spirotetramat (Movento)	23	narrow (aphids, scales, 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

Department of Entomology and Nematology
 University of California, Davis
 Campus Office: 37D Briggs Hall
 Field Office: 117 Harry H. Laidlaw Jr.
 Honey Bee Research Facility
 Phone: 530-500-APIS
 Email: elnino@ucdavis.edu
 Website: elninobeelab@ucdavis.edu
 Facebook: E.L. Niño Bee Lab

Visit us at the Häagen-Dazs Honey Bee Haven



<http://hbbhgarden.ucdavis.edu>

Thank you!

- Mary Bianchi
- Ben Faber

- CA Avocado Society
- CA Avocado Commission
- Sponsors

