Healthy Hives: A Grower's Role

December 6, 2016

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Healthy Hives: A Grower's Role

- Bob Curtis, Almond Board of California (Moderator)
- Elina Nino, University of CA, Davis UCCE
- Billy Synk, Project Apis m.
- Danielle Downey, Project Apis m.
- John Miller, Miller Honey Farms, Inc.
- Bob Curtis, Almond Board of California
- Brittney Goodrich, UC Davis-Agricultural and Resource Economics

Elina Nino,
University of California, Davis UCCE

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Longitudinal evaluation of honey bee colonies on different forage regimes

Elina L. Niño, Neal Williams, Quinn McFrederick

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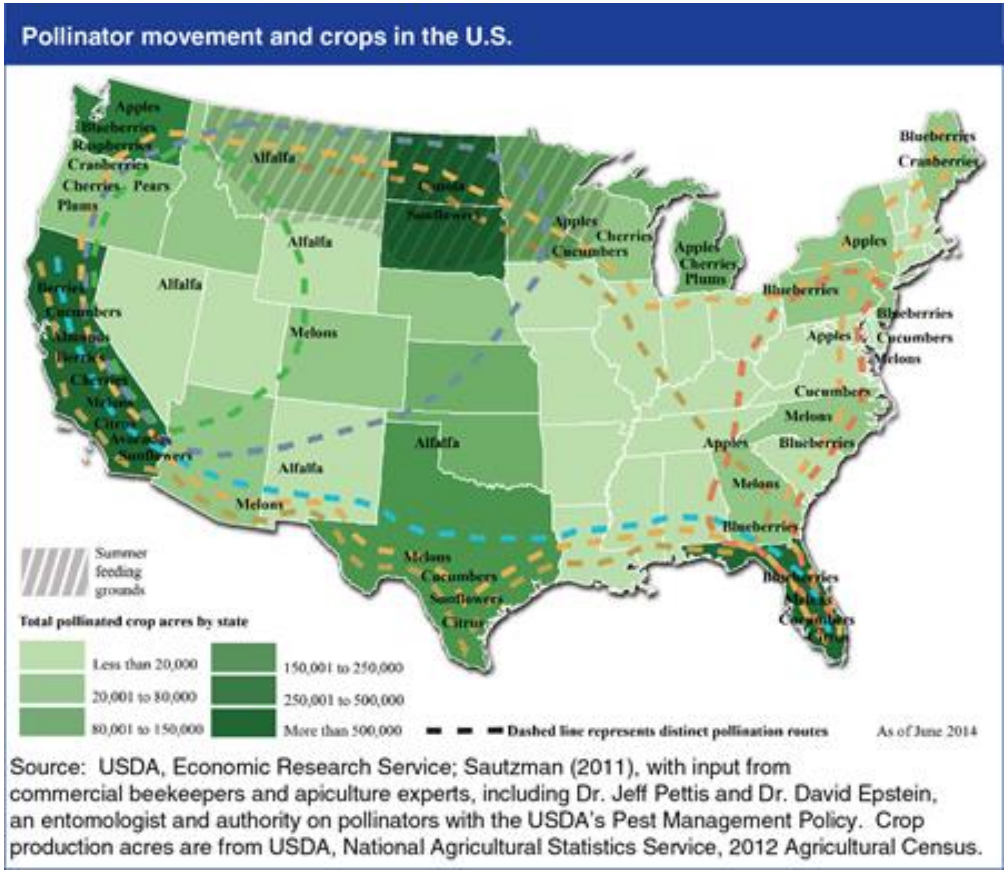
Many crops pollinated by honey bees…

but it all starts in the almonds



Source: USDA, Economic Research Service; Sautzman (2011), with input from commercial beekeepers and apiculture experts, including Dr. Jeff Pettis and Dr. David Epstein, an entomologist and authority on pollinators with the USDA's Pest Management Policy. Crop production acres are from USDA, National Agricultural Statistics Service, 2012 Agricultural Census.

Bee Culture
The Magazine of American Beekeeping

NOVEMBER 8, 2016

CATCH THE BUZZ - BEST MANAGEMENT PRACTICES FOR ALMOND POLLINATION, HONEY BEE HEALTH, AND THE SEASON STARTS NOW

The Almond Board of California has directed significant resources toward understanding the issues surrounding honey bee health and communicating to growers the steps to take to avoid contributing to hives losses.

It has published "Honey Bee Best Management Practices for California Almonds" and related quick guides that outline bee best management practices for growers. To access these vital documents, go to www.Almonds.com/BeeBMPs.

The Almond Board will continue to work to get the word out on honey bee health and related best management practices through workshops, communication vehicles, and presentations at the annual Almond Conference, Dec. 6–8, in Sacramento, Calif.

NOVEMBER 2016 PHOTO CONTEST

- **Beekeepers have prepared colonies for overwintering**
- **Some colonies are already in California**
- **Beekeepers will keep an eye on their colonies and manage as needed**

Current pollination recommendations

- **Recommendation: two colonies per acre**
  - **May require fewer if younger orchards**
  - **Pollination success depends on number of hives but also strength of the colonies**

Have a contract in place!

1. BEEKEEPER'S RESPONSIBILITIES

a. The beekeeper shall supply the grower with_____ colonies of bees to be delivered to the _____ as specified below:
(crop: apple orchard, squash field, etc.)

Projected date of delivery:_____. Beekeeper will notify grower at least ____ days in advance of any change in projected delivery date.

Name of location:_____

Directions to location:_____

Placement Instructions: _____

b. The beekeeper will provide colonies with the following minimum standards:

A laying queen with _____ frames of adult bees and _____ frames of brood.

The _____ story colony will have adequate surplus honey or equivalent feed.

The beekeeper will maintain all colonies at the standards above for the entire contract duration.

The grower may request inspection of any colony after notifying the beekeeper_____ days in advance.

c. The beekeeper will leave the bees on the crop until notified by grower at least _____ days prior to desired removal date. Beekeeper will remove hives within _____ days of notification date.

Projected date of removal:_____.

Total projected duration of placement:_____days.

d. The beekeeper will not be responsible for personal injury caused by unauthorized hive manipulation, abuse of hives or careless behavior in the immediate vicinity of the hives during the contract duration.

2. GROWER'S RESPONSIBILITIES

a. The grower shall provide a location for the colonies that is accessible to the beekeeper and associated vehicles whenever it is necessary to work with the bees, including access to locked property if hives are placed therein.

b. The grower shall provide a source of water for the bees, if none is available within one-half mile from the colonies as follows:_____.

c. The grower agrees to inform the beekeeper within not less than ____ hours if materials hazardous to bees are to be applied to the crop during the duration of the contract. The grower agrees to not apply the following pesticides/fungicides to the target crop for the duration of the contract or within ___ __days prior to the placement of the hives: *none specified*.

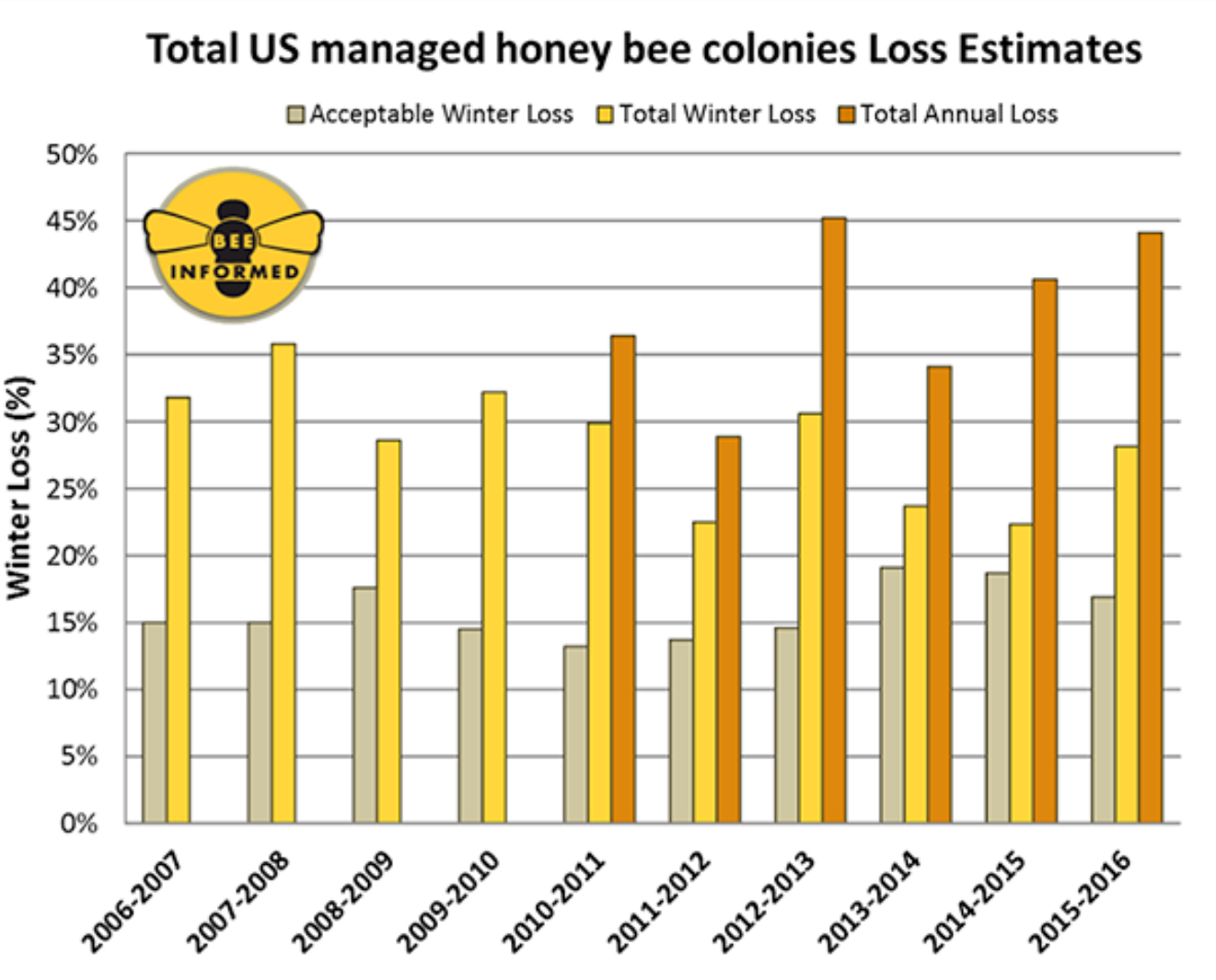
d. The grower agrees to pay $_____ per colony per set for _____colonies of bees. Total payment to the beekeeper shall be $_____.

Payment to the beekeeper shall be made as follows: $ _____ within ___days_ of hive delivery, with the balance due within _____ days of hive removal or as follows: _____ _____.

e. The grower agrees to pay the beekeeper an additional $_____ per hive for each additional hive requested beyond the number of hives and after the dates of placement specified in this contract.

The grower agrees to pay the beekeeper an additional $_____ per hive for changes in hive placement during the contract duration unless such changes are agreed to as follows:_____ _____.

f. Loss of bee colony populations due to application of farm chemicals in violation of this contract shall be reimbursed to the beekeeper at the rate of $ _____per hive. Payment of said reimbursement shall be made no less than _____days subsequent to the date of said application. Loss of bee colony population shall be defined as the death of 50% or more of the adult bees in a given hive as a direct result of the application.


Total US managed honey bee colonies Loss Estimates
Acceptable Winter Loss
Total Winter Loss
Total Annual Loss
BEE INFORMED
Winter Loss (%)
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2006-2007
2007-2008
2008-2009
2009-2010
2010-2011
2011-2012
2012-2013
2013-2014
2014-2015
2015-2016

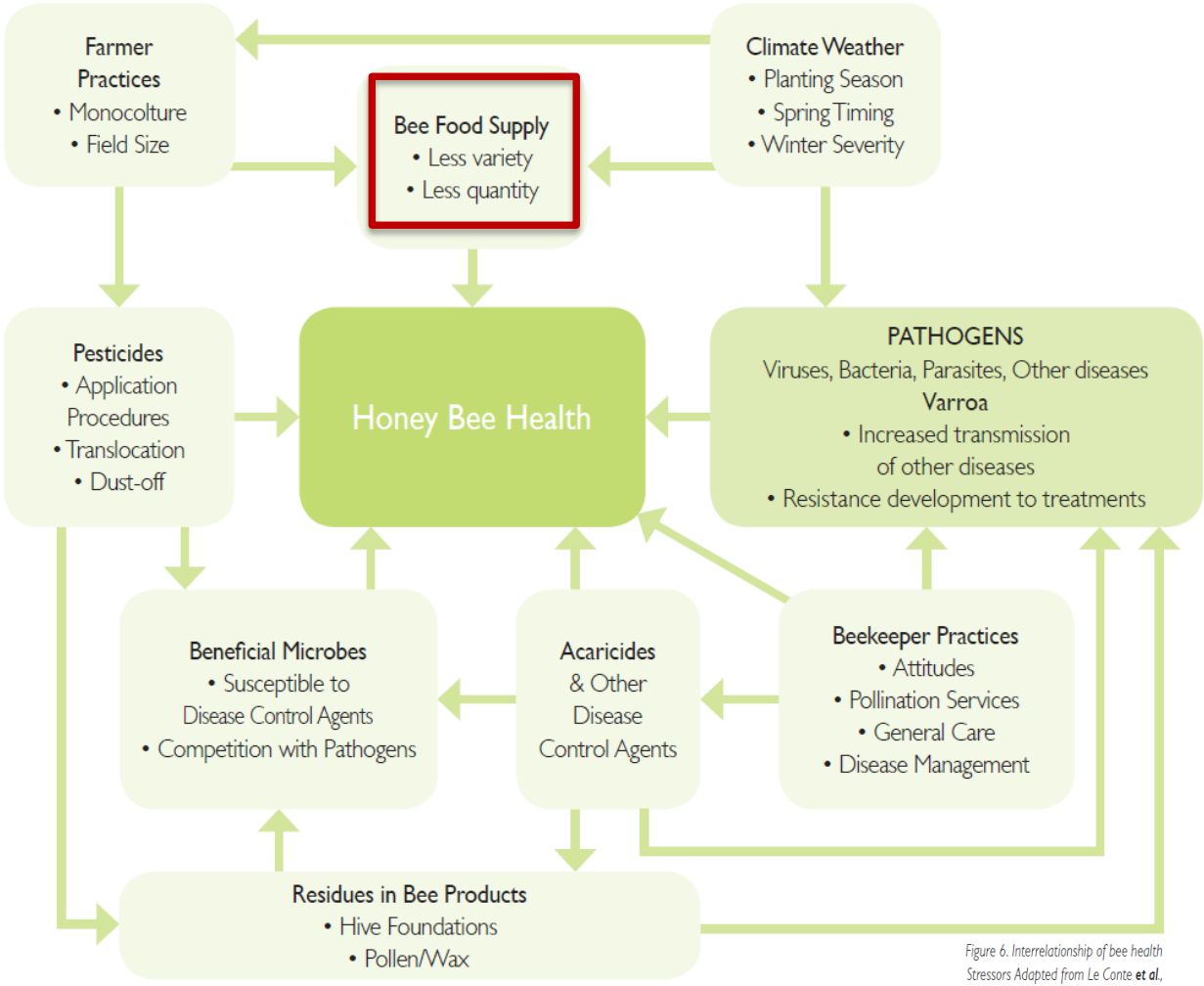


Figure 6. Interrelationship of bee health Stressors Adapted from Le Conte ***et al.****, 2010,*

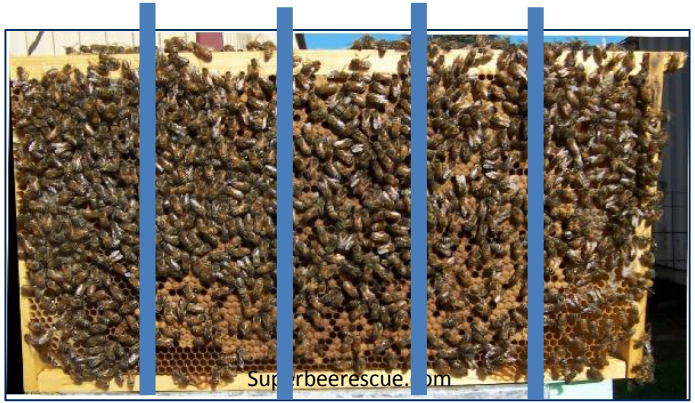
Longitudinal assessment of forage sources on honey bee health and survival

- Research on forage mixes best for supporting pollinators in ag areas (Williams Lab, UC Davis)
- Longitudinal evaluation of forage mixes on honey bee colony growth and survivorship (E. L. Niño Bee Lab, UC Davis)
- Evaluation of various forage mixes on gut microbiome and immunity (McFrederick Lab, UC Riverside)

Longitudinal assessment of forage sources on honey bee health and survival

- **Testing the effect of two different forage plantings (rapini and native) in the vicinity of almond orchards**

- **Longitudinal monitoring of:**
  - **Colony growth = adults and brood, weight**
  - **Varroa mite and pathogen load**
  - **Immune competence**
  - **Bee gut flora**



Longitudinal assessment of forage sources on honey bee health and survival

- Colonies will be tracked before, during and after almond bloom
- After bloom colonies will be moved to a stationary site and monitoring will continue to assess possible long-term benefits
- Colonies will be followed for survival

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

Billy Synk,
Project Apis m.

Forage Opportunities in Orchards

An Overview of Seeds for Bees and Hedgerows

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Almond Board of California

Project Apis m.

Seeds for Bees

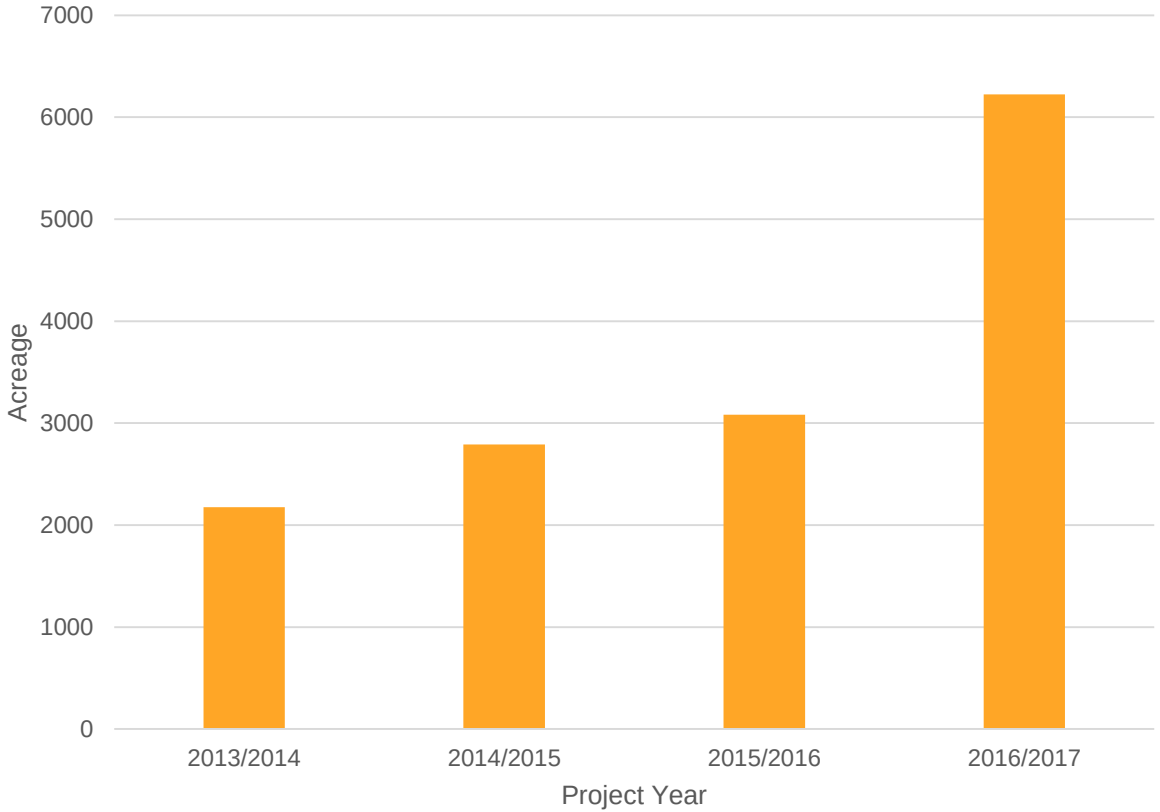
- Seed mixes extend diversity, duration and density of bloom before and after almonds in California
  - PAm Mustard mix
  - PAm Clover mix
  - Lana Vetch
  - All almond growers are eligible

- Free seed! Free shipping!
- Enough seed to cover 50-250 acres

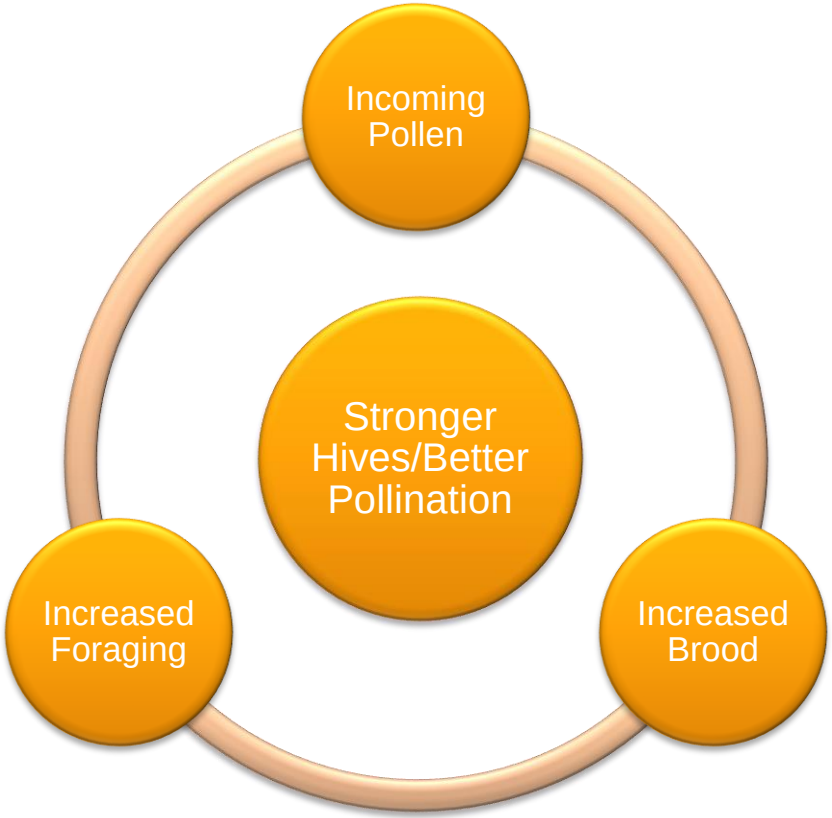
Seeds for Bees Acres

Seed for Bees is a valued program growers appreciate

- 3,082 acres in 2015
- 6,225 acres in 2016



Why Should You Plant Bee Forage?



In addition to stronger colonies, bee forage benefits include:

- Increased organic matter
- Prevents erosion
- Increase water infiltration
- Increase nitrogen
- Suppress weeds
- Suppress nematodes
- Decomposition of mummy nuts
- Support soil fertility
- Many pollinators benefit

Seeds for Bees options

1. PAm Mustard Mix

35% Canola
15% Bracco White Mustard
15% Nemfix Mustard
20% Daikon Radish
15% Common Yellow Mustard

2. PAm Clover Mix

15% Annual Medic
17% Balansa Clover
25% Persian Clover
10% Crimson Clover
25% Berseem Clover
8% Hykon Rose Clover

3. Lana Vetch

100% Lana Vetch

PAm Mustard Mix

Check out this Daikon!

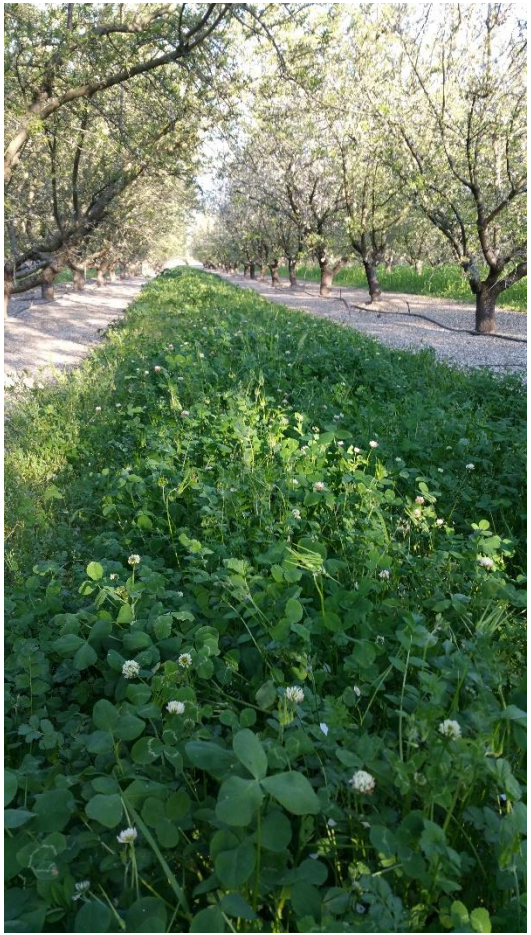
PAm Clover Mix

Lana Vetch

Vetch

Mustard

1% organic matter = 19,000 gallons per acre of water holding capacity!



Hedgerows

- Intended goal of your hedgerow will determine composition of species
  - Habitat restoration
    - Wildlife
    - Pollinators
      - Bees
      - Butterflies
  - Soil erosion reduction and windbreaks
  - Water and air quality protection
  - Attract beneficials (pest control/IPM)
  - We need financial support!

Site Selection

- Roadsides, agricultural drains, fences, canals, field borders, and gullies are all appropriate for hedgerows
- Consider topography, hydrology, and soil quality
  - Many drought tolerant plants will be negatively affected by standing water in the summer months
- Hedgerows are perennial and have season long bloom and soil amending qualities

Plant Selection

- Shrubs
- Forbs
- Grasses

A hedgerow can have one or all three. If a wind break is desired trees can be incorporated too.

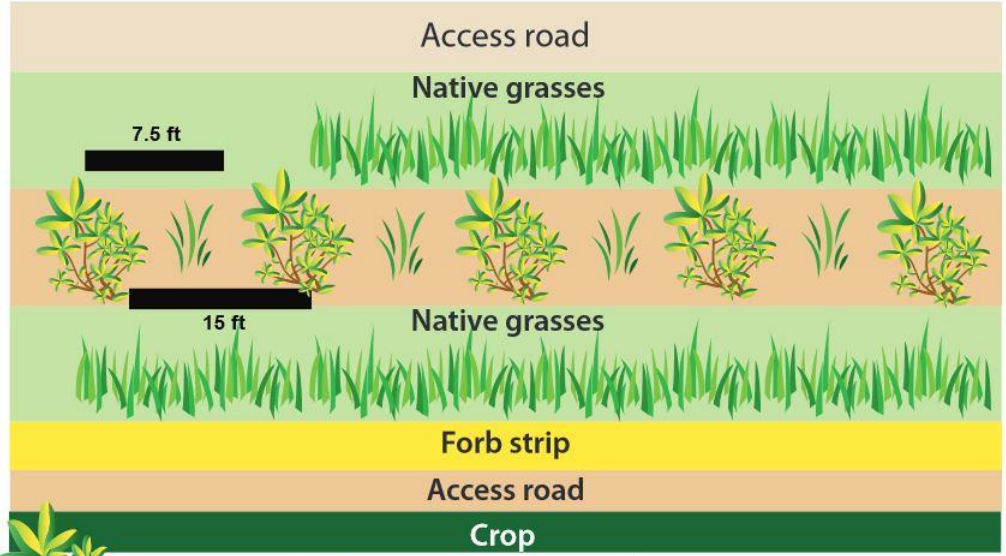


Figure 1. Hedgerow design that is well integrated into farming systems with a single row of shrubs and/or trees bordered by strips of native perennial grasses, or sedges or rushes if riparian.

Large shrubs (15 ft spacing)
Toyon
Western redbud
Coyote brush
Ceanothus
Elderberry
Coffeeberry

Smaller shrubs and forbs and plugs (7.5 ft spacing)
California buckwheat
Yarrow
Milkweed
Aster
Goldenrod
Mugwort
Phacelia
Gum plant

Native grass mix
Purple needlegrass
Nodding needlegrass
California oniongrass
Squirrel tail
One-sided bluegrass
Blue wildrye
Creeping wildrye
Slender wheatgrass
Meadow barley

Forb strip seed mix
Lupine
Clovers
Tarweed
Vinegar weed
California poppy
Gum plant
Phacelia

Courtesy of UC ANR

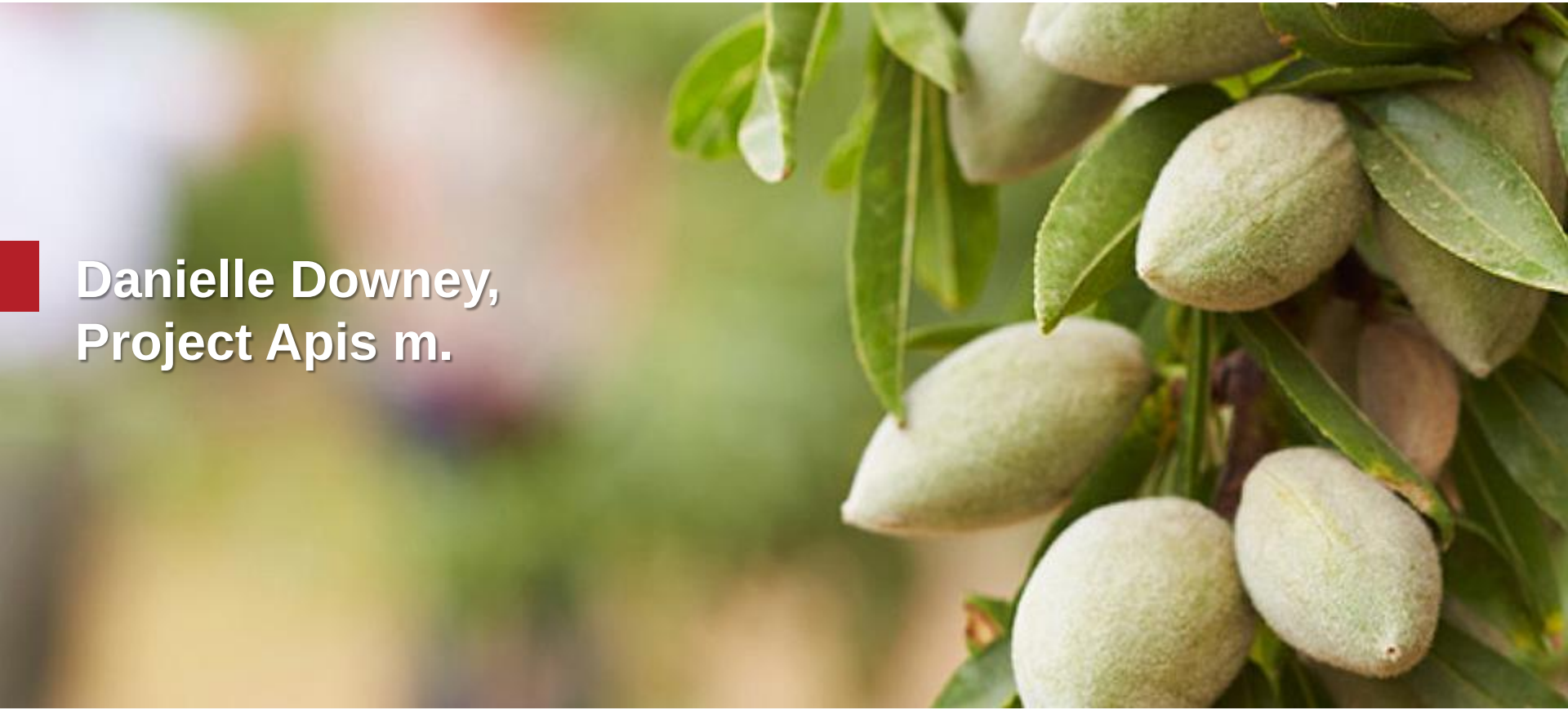
Thank you

Project Apis m.

Find us at:

www.ProjectApism.org

ProjectApis@gmail.com



Danielle Downey, Project Apis m.

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Project Apis m. Research & Forage

Bringing You Better Bees!

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Almond Board of California

Danielle Downey, Executive Director, Project Apis m.

PAM Research, Seeds for Bees, Honey Bee & Monarch Partnership

We know bees face many stressors!

1. Varroa mite- Honey Bee Enemy #1!
2. Pathogens
   - Virus, gut parasites, bacteria, fungus
3. Pesticides
4. Environmental stress
   - Nutrition
   - Habitat/forage loss

PAm Projects to study Varroa

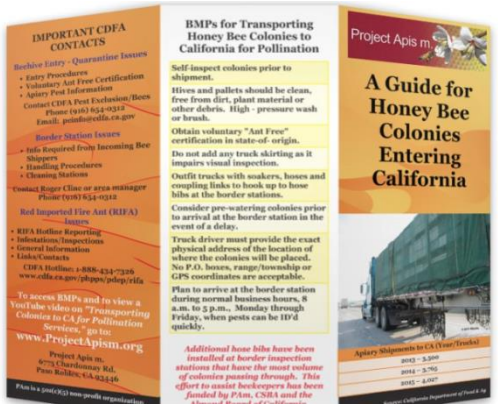
- Do Varroa feed on blood or fat? (vanEngelsdorp, MDSU)
- Compounds trigger Hygienic Behavior (Wagoner, NCSU)
- Breeding Varroa Resistant Bees (Danka, USDA)
- In vitro Varroa rearing (Jack, UFL)
- Mite Resistance Proteome (Foster, UBC)
- Seminal Fluid/Queen Quality effects of Varroa (Nino, UCD)
- Viruses (Martin- Salford, Flenniken, Brutscher- MSU)

PAm Projects to control Varroa

- Spider venom toxins! Dr. Frank Bosmans, Johns Hopkins
- Botanicals! Dr. Elina Niño, UC Davis
- Insect predators! Dr. Jonathan Lundgren, USDA
- Pheromone disruption, Dr. Kirk Hillier, Acadia U.
- Organic acid new applications, Dr. Patrick Smith, Michigan State
- Orphaned chemicals/potential, Dr. Jody Johnson, USDA

PAm Projects on Nutrition, Bee Health, Forage, BMPs, etc.

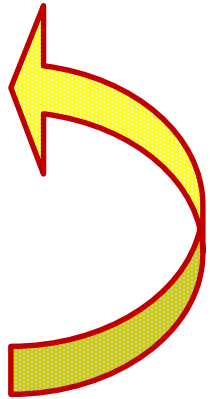
- Nosema, gut microbes, probiotics, nutrition (McFrederick, Giovenazzo)
- Sperm Quality effects on Queens (Guarna, AAFC)
- Immune function, phytochemicals and hemocytes (Seshadri, Richardson)
- Nutrtion benefits of specific plants or communities (Cartar, Williams, Carr-Markell)
- Dimilin effect on queens and workers (Johnson,with Almond Board of California)
- Tech Transfer, Field Guide for Beekeepers (BIP)
- Smart Hive Technology (Cazier, Hopkins)
- Scholarship, beekeeper development, equipment purchases for labs
- Hose bibs and guidance brochures at border crossings



Solve the Problems, & Until Then Mitigate Them!

1. Varroa mite- Honey Bee Enemy #1!
2. Pathogens
   - Virus, gut parasites, bacteria, fungus
3. Pesticides
4. **Environmental stress**
   - **Nutrition**
   - **Habitat/forage loss**

mitigation

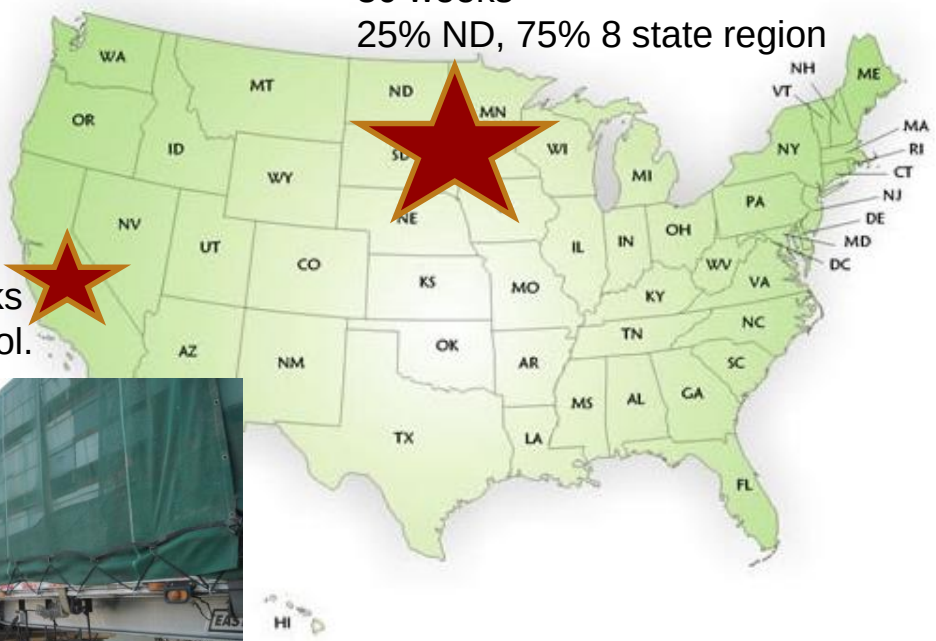


Habitat and Forage = Honey Bee Nutrition

- Crops are grown intensively, large monocrops don’t support bees after bloom
- Land is being converted for urbanization, soy and corn at staggering rates
- Scraps of habitat in-between are shrinking, and of marginal value
- Planting for bees can make a BIG difference, and benefits many species
- You can do this anywhere, but its not all equal to bees.

For pollination of ag crops, it's clear where our efforts are needed!

30 weeks
25% ND, 75% 8 state region



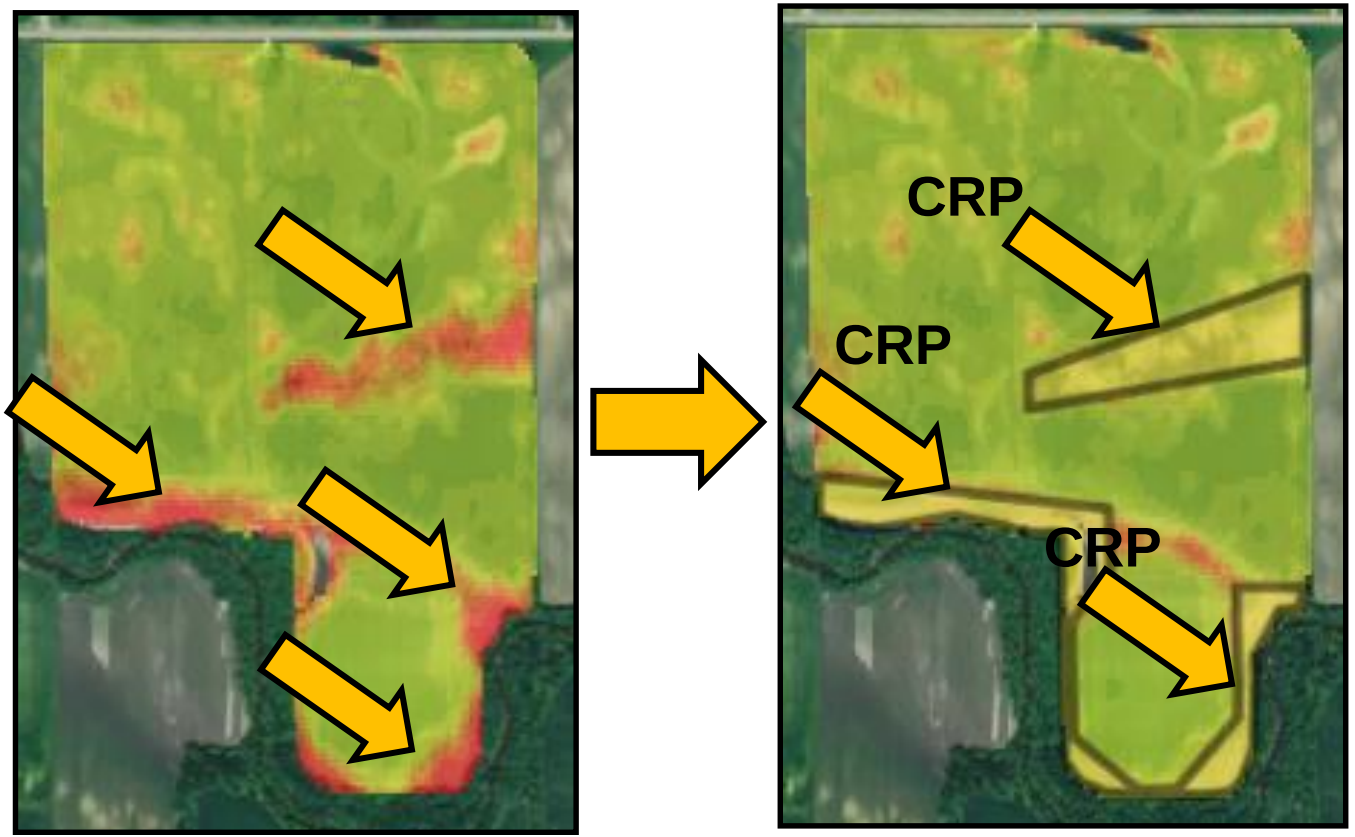
3 weeks
2 mil col.

PAm is increasing bee forage!

Honey Bee & Monarch Butterfly Partnership: A Strategic Approach

- Beekeepers help enlist participation with landowners
- Target agricultural landscapes that no longer support healthy bees
- Maximize the potential of every acre by delivering:
    1. Appropriate floral **diversity**
    2. Maximum seeding **density for success**
    3. Season long foraging **duration** (bloom)
    4. Out competing weeds
    5. Cost effective mixtures that use both native and introduced species in 2 practices on each project.
- *This is conservation that works with agriculture!*

A Real Example- Corn in MN

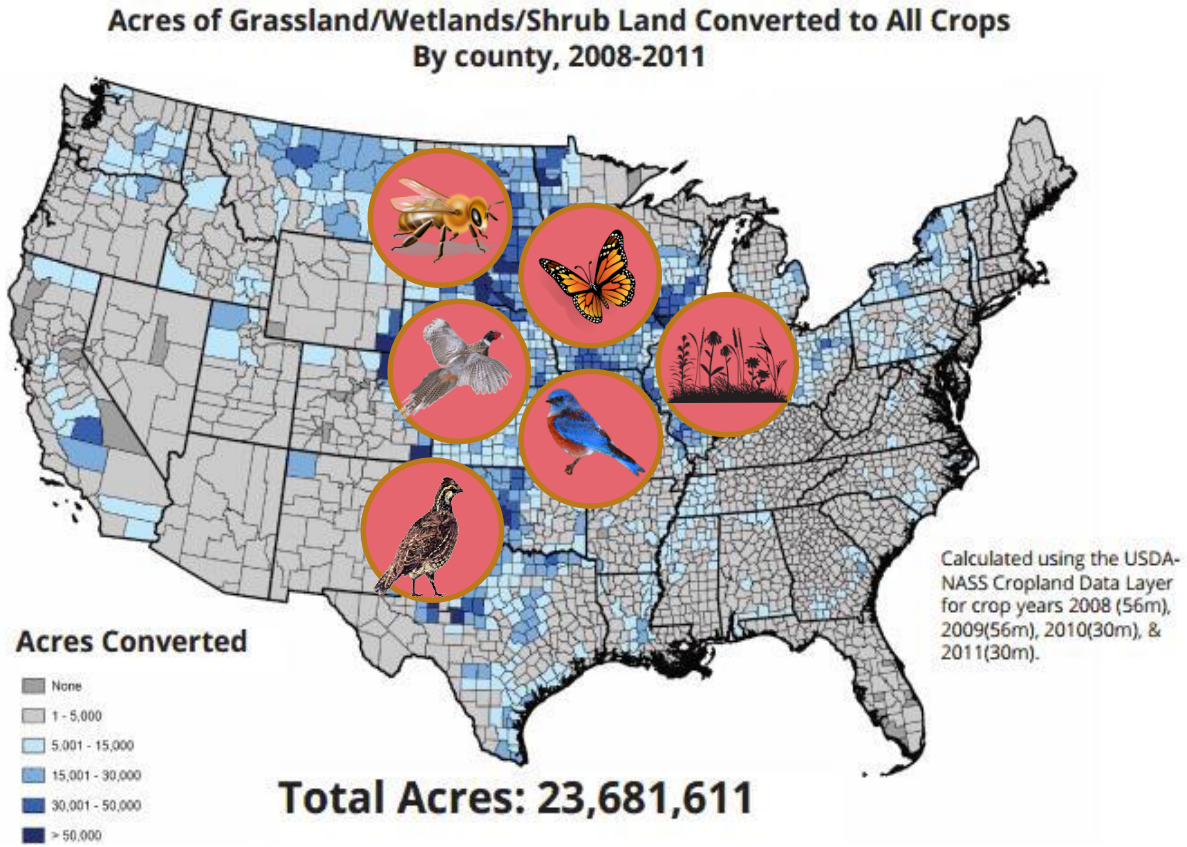


A Real Example- Corn in MN

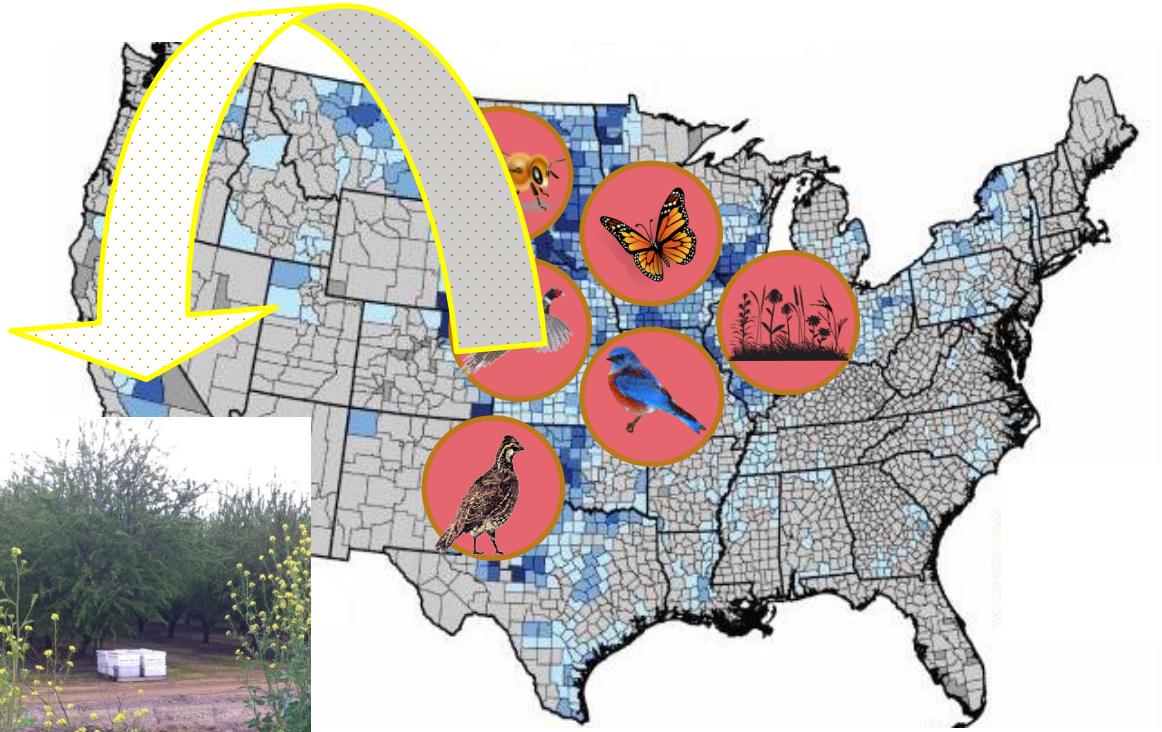
Scenario: Actual Production - 2013 CRP - 2013

Parameter	Value	Value	
Acreage	181.00 acres	181.00 acres	
Field Average Yield	145.06 bu/ac	157.66 bu/ac	+8.7%
Profit	$44.18/acre	$86.90/acre	+96.7%
ROI	6.49 %	14.01 %	+115.9%
Total Field Expenses	$123,282.72	$112,256.70	- 8.9%
Total Field Revenue	$131,279.30	$127,985.72	- 2.5%
Total Field Profit	$7,996.58	$15,729.02	+ 96.7%

Many Beneficiaries!



Many Beneficiaries! Including you!



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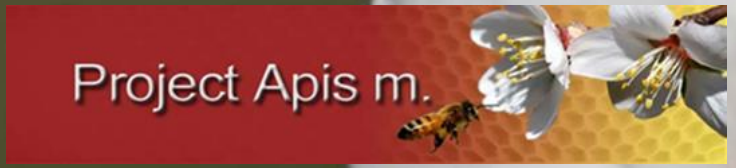


WE'VE GOT HER BACK!

John Miller,
Miller Honey Farms, Inc.

The Beekeeper, Almond Grower and Forage Partnership

John Miller, Miller Honey Farms

california almonds®
Almond Board of California

The Agreement

Almond Pollination Agreement

Miller Honey Farms, Inc. agrees to supply _____beehives to

_____, **Grower**, for Almond pollination services. Delivery date and location will be mutually agreed upon. Beehive removal will be prompt after notification by Grower. Beehives will not be moved except by Miller, and not at all during bloom, unless extreme conditions exist or are imminent.

CA Dept. of Pesticide Regulation and the Environmental Protection Agency require labeling on materials **toxic** to honeybees. Harmful materials will not be applied while beehives are in pollination location. Grower is responsible for loss or damage to beehives; including **theft, vandalism, and poisoning** while beehives are on pollination location. Miller reserves the right to remove beehives when toxic-labeled materials application is imminent, or after notice has been given from adjacent growers or applicators. **Involuntary removal** of beehives will not affect collection of fees for this pollination agreement.

Strength of Beehives. Beehives are to have an average strength of **Eight** frames of bees. Each of the eight frames at least one-half covered with bees when the outside temperature is **Sixty** degrees, and bees are flying. **Any Party** may perform an inspection. The requesting party pays the cost of inspection. Miller reserves the right to be present during hive inspections. Grower gives Miller permission to enter properties to care for hives during pollination period. Miller will **distribute** hives in lots of not less than 24 hives. Hives will be attended to as needed by Miller.

Security. Miller and Grower agree that orchard security and property theft is a problem. Miller will cooperate with Grower-installed security systems. Miller may install security equipment on Grower property to monitor hives while on Grower owned/managed property.

Default. Should Grower default on this agreement, Grower agrees to pay attorney fees and court costs in the satisfaction of the agreement terms.

Communication. Miller recognizes the importance of Grower/Pollinator communications.

San Joaquin Valley Contact: Ryan Elison 208-680-0736 ryan@millerhoneyfarms.com

Chico/Woodland Contact: Jason Miller 408-637-6449 jason@millerhoneyfarms.com

California Office: John Miller 916-718-4243 john@millerhoneyfarms.com

Field Name:_____

Number of Hives Rented:_____

Base Rental Price Per Hive:$_____

Discounts per hive:

_____$ 3 - Bee forage planted in tree rows, contact us for planting requirements

_____$.50 - Weather accessible roads throughout orchard (i.e. gravel or raised compacted)

_____$.50 - Locked orchard or onsite resident manager

Surcharges per hive:

_____$ 2 - Hives placed inside tree rows rather than on perimeter of orchard blocks

Adjusted Rental Price Per Hive:$_____

Total Pollination Fee:$_____

Due and Payable in Full April 1, 2017.

Grower/Agent Signature :_____

Phone:_____

Email:_____

Address:_____

_____

_____

Miller Signature:_____

Address:

Miller Honey Farms, Inc.
P.O. Box 911
Blackfoot, ID 83221

Please remit contract and payment to Blackfoot, ID office. Phone/Fax 208 785 2348. Please return this completed agreement within Fifteen days to assure hives are reserved for your operation. Thank-you for your business.

The Agreement - Discount for Bee Forage

Discounts per hive:

_____$ 3 - Bee forage planted in tree rows, contact us for planting requirements

Planting Instructions

Almond Forage Mustard Mix Planting Instructions

Seed Vendors:
Wilbur Ellis - (209) 982-5400
AgSeeds - (530) 666-3361
Mid Valley Ag - (209) 931-7600
Crop Protection Services - (209) 551-1424

Approved Seed Mix:
PAm Mustard Mix - Contains (35% Canola Rapini mustard, 15% Braco White Mustard, 15% Nemfix Mustard, 20% Daikon Radish, 15% Common Yellow Mustard

Seed Cost and Rates:
Seed cost: approx $2.25/lb + shipping

Required Seed Coverage:
Minimum of .1 acre per beehive

Seed Rate:
10 lbs/acre via Broadcast Spreader
8 lbs/ acre via No-Till Drill

Ground Prep:
A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time.
Caution: 'Grass killing' herbicides such as Round-Up will cause phytotoxitcy in Rapini mustard.

Planting Methods:
Use a grain drill, no-till drill, broadcaster, or even a hand-held broadcaster to evenly distribute the seed.

Planting Date:
After Sept. 10th but **BEFORE Oct 10th**, it is important the planting takes place no later than Oct 10 for the forage to be in bloom before the almond bloom. Plant while soil is still warm - above 55°
Sow before first rains. Plant no more than 1/8" to 1/4" deep. Plant in fallow areas, where trees are being taken out of production, between young non-bearing trees, in tree rows, and in orchard margins.
Emergence/Visible: 6 - 8 days

Bloom Period:
December - February
90 days - Canola will be the first to bloom

Post Bloom Management:
If concerned about almond bloom competition, mow, disk and kill at time of almond bloom. If not, after bloom, disk under.

Planting Questions:
Tom Johnson - Agronomist Kamprath Seeds
Telephone: 209-823-6242
Email: tom@kamprathseed.com

This Information Provided by:
www.ProjectApism.org
6675 Chardonnay Rd., Paso Robles, CA 93446
PAm is 501 (c)(5) non-profit organization

The Result

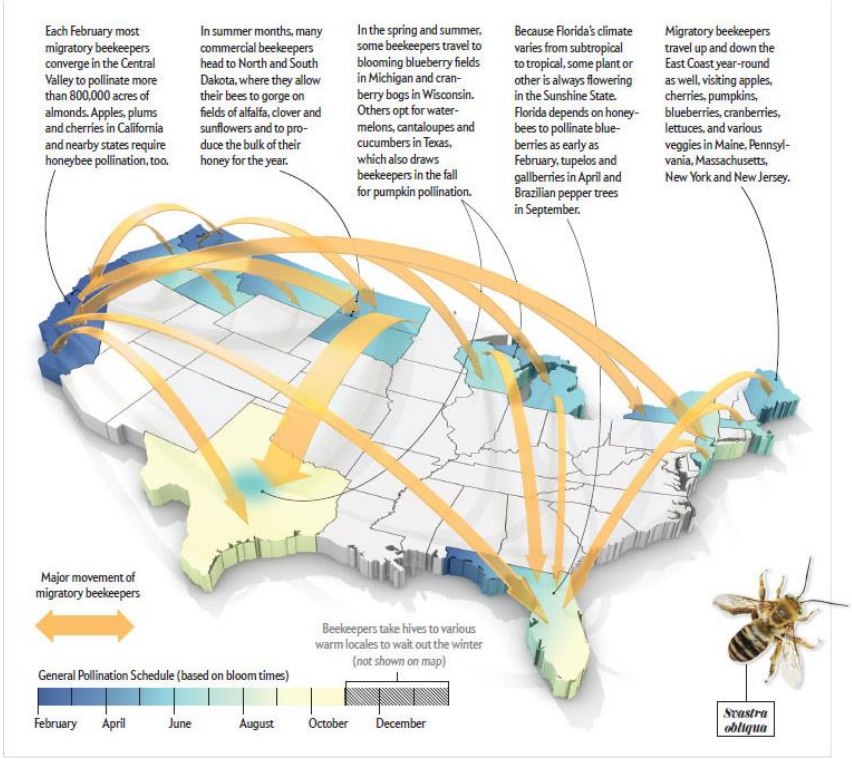
Bob Curtis,
Almond Board of California

california almonds
Almond Board of California

Honey Bee Best Management Practices for California Almonds

california almonds®
Almond Board of California

Why should all pollination stakeholders care?



Source: *Scientific American*, September 2013

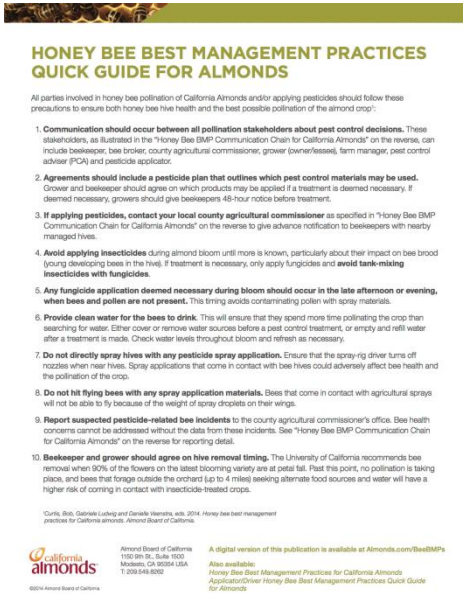
The Pollination Partnership

- Almonds need honey bees and honey bees benefit from almonds
- Bees are a valuable resource and almond production input
- The time bees spend in almonds impacts hive health throughout the year until they return the next season

Honey Bee BMP Resources

"Honey Bee Best Management Practices for California Almonds"
Comprehensive Guide

General/Decision Maker
Quick Guide



HONEY BEE BEST MANAGEMENT PRACTICES QUICK GUIDE FOR ALMONDS

All parties involved in honey bee pollination of California Almonds and/or applying pesticides should follow these precautions to ensure both honey bee hive health and the best possible pollination of the almond crop[1]:

1. **Communication should occur between all pollination stakeholders about pest control decisions.** These stakeholders, as illustrated in the "Honey Bee BMP Communication Chain for California Almonds" on the reverse, can include beekeeper, bee broker, county agricultural commissioner, grower (owner/lessee), farm manager, pest control adviser (PCA) and pesticide applicator.
2. **Agreements should include a pesticide plan that outlines which pest control materials may be used.** Grower and beekeeper should agree on which products may be applied if a treatment is deemed necessary. If deemed necessary, growers should give beekeepers 48-hour notice before treatment.
3. **If applying pesticides, contact your local county agricultural commissioner** as specified in "Honey Bee BMP Communication Chain for California Almonds" on the reverse to give advance notification to beekeepers with nearby managed hives.
4. **Avoid applying insecticides** during almond bloom until more is known, particularly about their impact on bee brood (young developing bees in the hive). If treatment is necessary, only apply fungicides and **avoid tank-mixing insecticides with fungicides**.
5. **Any fungicide application deemed necessary during bloom should occur in the late afternoon or evening, when bees and pollen are not present.** This timing avoids contaminating pollen with spray materials.
6. **Provide clean water for the bees to drink.** This will ensure that they spend more time pollinating the crop than searching for water. Either cover or remove water sources before a pest control treatment, or empty and refill water after a treatment is made. Check water levels throughout bloom and refresh as necessary.
7. **Do not directly spray hives with any pesticide spray application.** Ensure that the spray-rig driver turns off nozzles when near hives. Spray applications that come in contact with bee hives could adversely affect bee health and the pollination of the crop.
8. **Do not hit flying bees with any spray application materials.** Bees that come in contact with agricultural sprays will not be able to fly because of the weight of spray droplets on their wings.
9. **Report suspected pesticide-related bee incidents** to the county agricultural commissioner's office. Bee health concerns cannot be addressed without the data from these incidents. See "Honey Bee BMP Communication Chain for California Almonds" on the reverse for reporting detail.
10. **Beekeeper and grower should agree on hive removal timing.** The University of California recommends bee removal when 90% of the flowers on the latest blooming variety are at petal fall. Past this point, no pollination is taking place, and bees that forage outside the orchard (up to 4 miles) seeking alternate food sources and water will have a higher risk of coming in contact with insecticide-treated crops.

[1]Curtis, Bob, Gabriela Ludwig and Daniela Veerstra, eds. 2014. *Honey bee best management practices for California almonds.* Almond Board of California.

Almond Board of California
1150 9th St., Suite 1500
Modesto, CA 95354 USA
T: 209.549.8262

A digital version of this publication is available at Almonds.com/BeeBMPs

Also available:
Honey Bee Best Management Practices for California Almonds
Application/Driver Honey Bee Best Management Practices Quick Guide for Almonds

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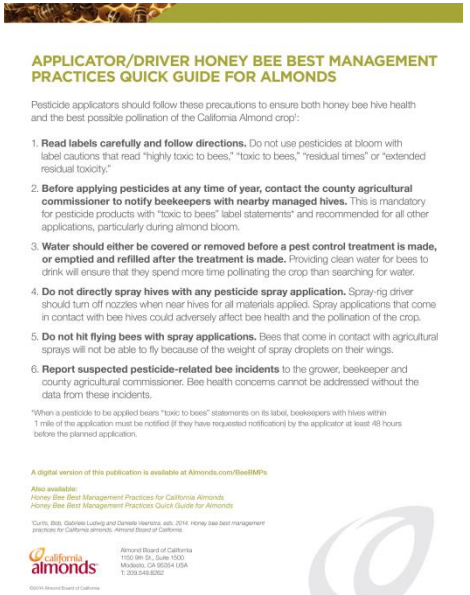
Applicator/Driver
Quick Guide



APPLICATOR/DRIVER HONEY BEE BEST MANAGEMENT PRACTICES QUICK GUIDE FOR ALMONDS

Pesticide applicators should follow these precautions to ensure both honey bee hive health and the best possible pollination of the California Almond crop[1]:

1. **Read labels carefully and follow directions.** Do not use pesticides at bloom with label cautions that read "highly toxic to bees," "toxic to bees," "residual times" or "extended residual toxicity."
2. **Before applying pesticides at any time of year, contact the county agricultural commissioner to notify beekeepers with nearby managed hives.** This is mandatory for pesticide products with "toxic to bees" label statements* and recommended for all other applications, particularly during almond bloom.
3. **Water should either be covered or removed before a pest control treatment is made, or emptied and refilled after the treatment is made.** Providing clean water for bees to drink will ensure that they spend more time pollinating the crop than searching for water.
4. **Do not directly spray hives with any pesticide spray application.** Spray-rig driver should turn off nozzles when near hives for all materials applied. Spray applications that come in contact with bee hives could adversely affect bee health and the pollination of the crop.
5. **Do not hit flying bees with spray applications.** Bees that come in contact with agricultural sprays will not be able to fly because of the weight of spray droplets on their wings.
6. **Report suspected pesticide-related bee incidents** to the grower, beekeeper and county agricultural commissioner. Bee health concerns cannot be addressed without the data from these incidents.

*When a pesticide to be applied bears "toxic to bees" statements on its label, beekeepers with hives within 1 mile of the application must be notified (if they have requested notification) by the applicator at least 48 hours before the planned application.

A digital version of this publication is available at Almonds.com/BeeBMPs

Also available:
Honey Bee Best Management Practices for California Almonds
Honey Bee Best Management Practices Quick Guide for Almonds

[1]Curtis, Bob, Gabriela Ludwig and Daniela Veerstra, eds. 2014. *Honey bee best management practices for California almonds.* Almond Board of California.

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Available downstairs at ABC Booth (#625) or online at Almonds.com/BeeBMPs

california almonds
Almond Board of California

HONEY BEE BMP COMMUNICATION CHAIN

- Engage in agreements with growers.
- Register hives with county agricultural commissioner by Jan. 1 each year or upon arrival in California.
- Request optional notification from county agricultural commissioner each year upon registration and with any hive movement.
- Immediately report any suspected pesticide-related bee incidents to owner-lessee/ county agricultural commissioner at almond bloom and throughout the year.

- Communicate details and specifications of pesticide application agreement to the PCA and applicator.
- Follow the *Honey Bee Best Management Practices Quick Guide for Almonds* and, if applying pesticides, follow the *Applicator/Driver Honey Bee Best Management Practices Quick Guide for Almonds*.
- If applying pesticides, contact local county agricultural commissioner to notify beekeepers with nearby managed hives before making applications any time of year. This is mandatory for "toxic to bees" label statements* and recommended for other applications, particularly during almond bloom.
- Immediately report suspected pesticide-related bee incidents to beekeeper/county agricultural commissioner at almond bloom and throughout the year.

- Follow the *Applicator/Driver Honey Bee Best Management Practices Quick Guide for Almonds* and relay messages to the spray-rig driver.
- Before applying pesticides, contact local county agricultural commissioner to notify beekeepers with nearby managed hives before making applications any time of year. This is mandatory for "toxic to bees" label statements* and recommended for other applications, particularly during bloom.
- Immediately report suspected pesticide-related bee incidents to farm manager/owner-lessee/beekeeper/county agricultural commissioner.

- Engage in agreements with beekeepers/bee brokers.
- Communicate details and specifications of agreements to stakeholders down the chain (farm manager, PCA, applicator).
- Follow the *Honey Bee Best Management Practices Quick Guide for Almonds* and, if applying pesticides, follow the *Applicator/Driver Honey Bee Best Management Practices Quick Guide for Almonds*.
- If applying pesticides, contact local county agricultural commissioner to notify beekeepers with nearby managed hives before making applications any time of year. This is mandatory for "toxic to bees" label statements* and recommended for other applications, particularly during almond bloom.
- Immediately report any suspected pesticide-related bee incidents to beekeeper/county agricultural commissioner at almond bloom and throughout the year.

- Communicate details and specifications of pesticide application agreement to applicator.
- Follow the *Honey Bee Best Management Practices Quick Guide for Almonds*.
- Immediately report suspected pesticide-related bee incidents to grower/beekeeper/county agricultural commissioner at almond bloom and throughout the year.

- Collect and map locations of managed bees throughout the county based on information provided by registered beekeepers.
- Provide pesticide applicators the contact information for beekeepers with hives within a 1-mile radius of the application location.
- Investigate reports of suspected pesticide-related bee incidents.

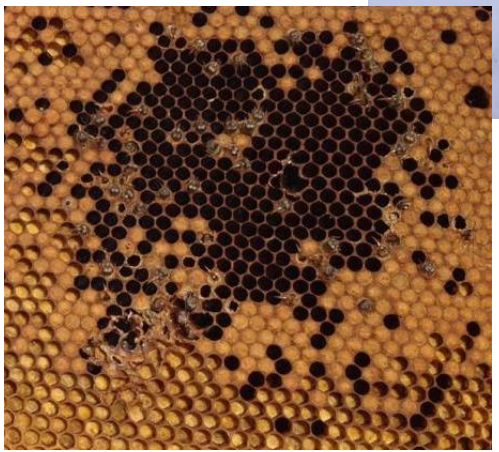
Key BMP: Communication should occur between all pollination stakeholders about pest control decisions

- Agreements/contracts should include a pesticide plan that outlines which pest control materials may be used.
- If treatment is deemed necessary, growers/PCAs/applicators should contact their beekeepers as well as contact county ag commissioners so that beekeepers with near by managed hives are notified 48 hours in advance.
- As well, beekeepers should register their hives with county agricultural commissioner offices and request notifications for pesticide applications.
- Report suspected pesticide related incidences to county ag commissioners. Bee health concerns cannot be addressed without data from potential incidents.

Key BMP: Avoid applying insecticides during bloom

- Avoid applying insecticides at bloom until more is known, particularly about their impact on bee brood (immature bees) and avoid tank mixing insecticides with fungicides.
  - Bee losses have occurred as a result of tank mixing insecticides with bloom time fungicides.
  - The term ‘insecticide’ includes insect growth regulators, also known as IGRs.
  - Currently most bee label warnings are only based on acute adult toxicity.
- There are alternative IPM insecticide timings.
  - See http://www.ipm.ucdavis.edu/ > Agricultural Pests > Almonds

Impact on immature bees



Newly emerged, wingless bees pulled from the combs by other bees, and empty cells of brood that failed in their attempts to

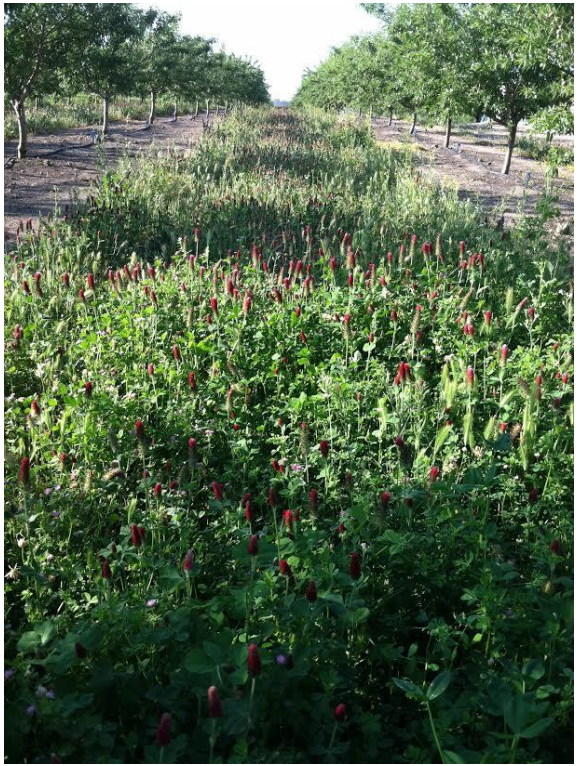
Key BMP: Spray fungicides when bees and pollen are not present

- Any fungicide application deemed necessary during bloom should occur in the late afternoon or evening, when bees and pollen are not present.
  - Avoids contaminating pollen with spray materials
  - But, don't spray so late that fungicides do not have time to dry before bees begin foraging
  - Spraying while bees are foraging can degrade floral scent chemicals that the bees "home in on"
- In general, spray applications should not directly hit hives or flying bees.

Provide Clean Water for the Bees to Drink

6. **Provide clean water for the bees to drink.** This will ensure that more time is spent pollinating the crop than searching for water. Either cover or remove water sources before a pest control application or supply clean water after an application is made. Check water levels throughout bloom and refresh as necessary.

Plant Supplemental Forage



Overall Objective:

Ensure that almonds continue to be a good and safe place for bees

Brittney Goodrich,
UC Davis-Agricultural and Resource Economics

2015 Almond Pollination Contract Survey Results

Brittney Goodrich and Rachael Goodhue
Agricultural and Resource Economics, UC Davis

california almonds
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UCDAVIS
AGRICULTURAL AND RESOURCE ECONOMICS

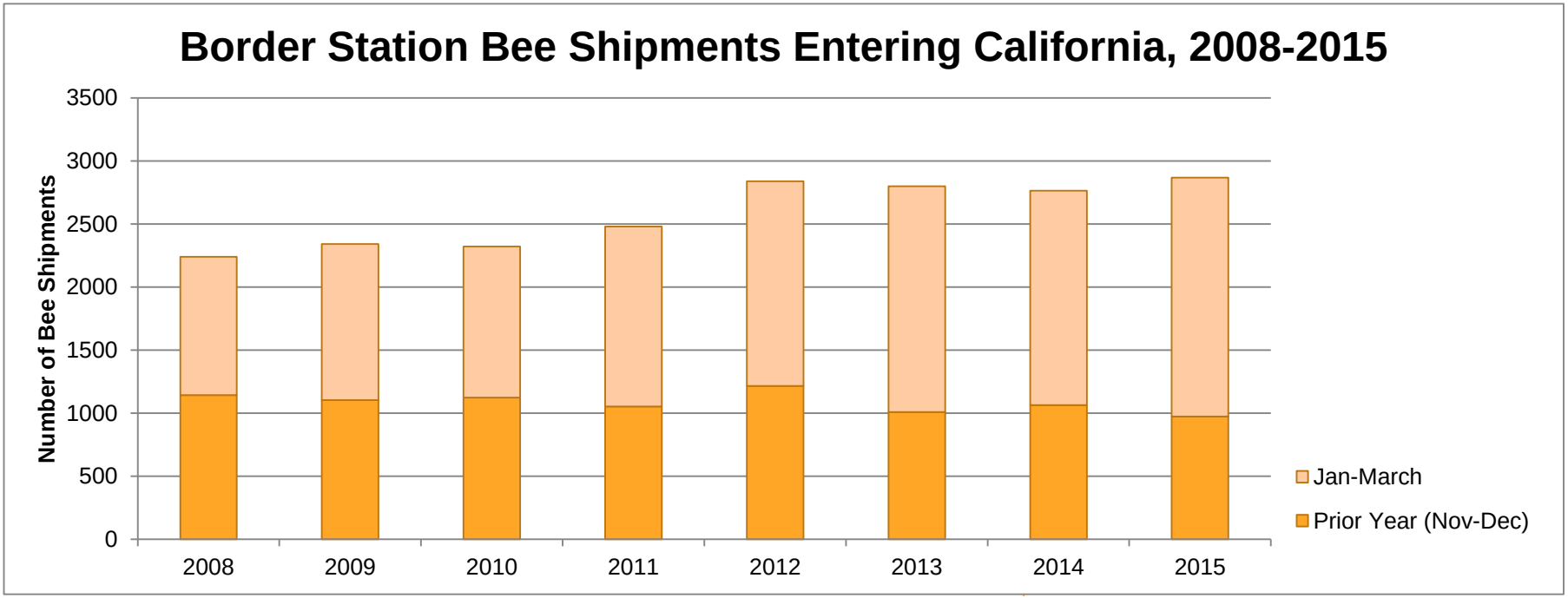
Almond Pollination Contracts

- Pollination decisions made under uncertainty
  - Weather during bloom
  - Colony strength
  - Availability of colonies
- Pollination Costs: 9-17% total operating expenses
- 2016 CSBA average per-colony fee: $189

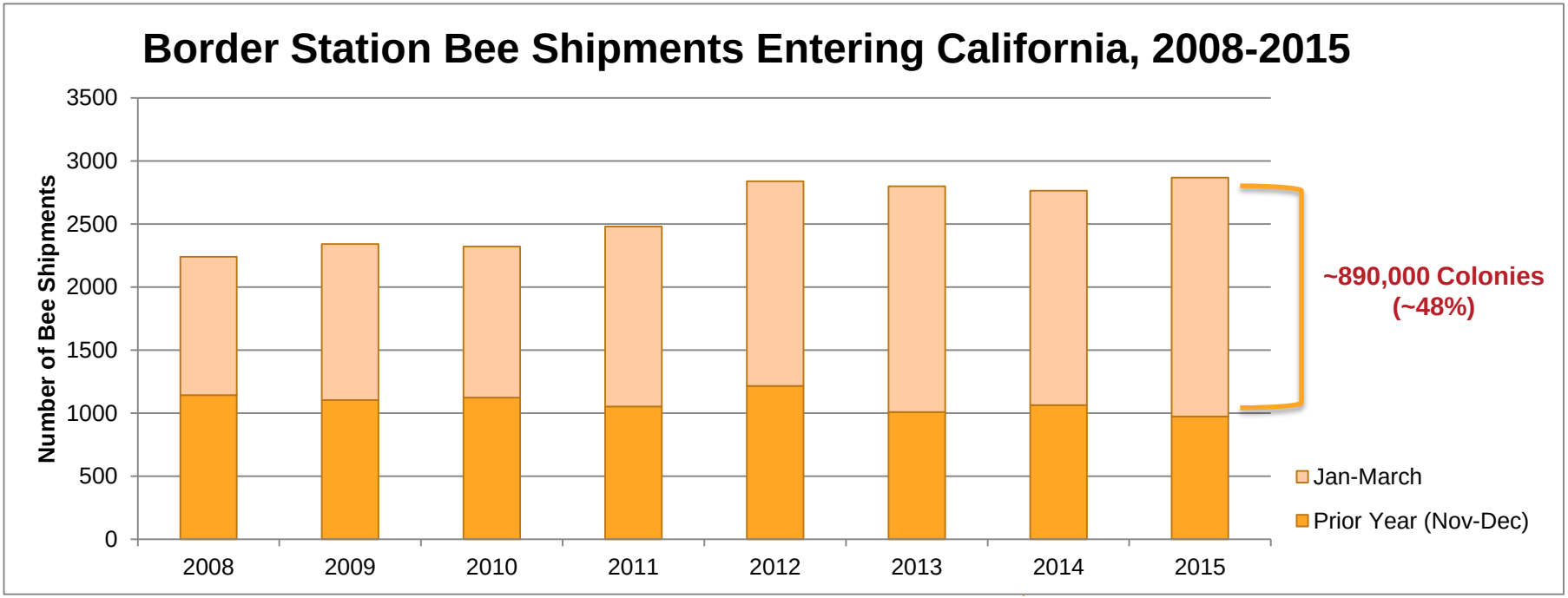
Almond Grower View

Beekeeper View

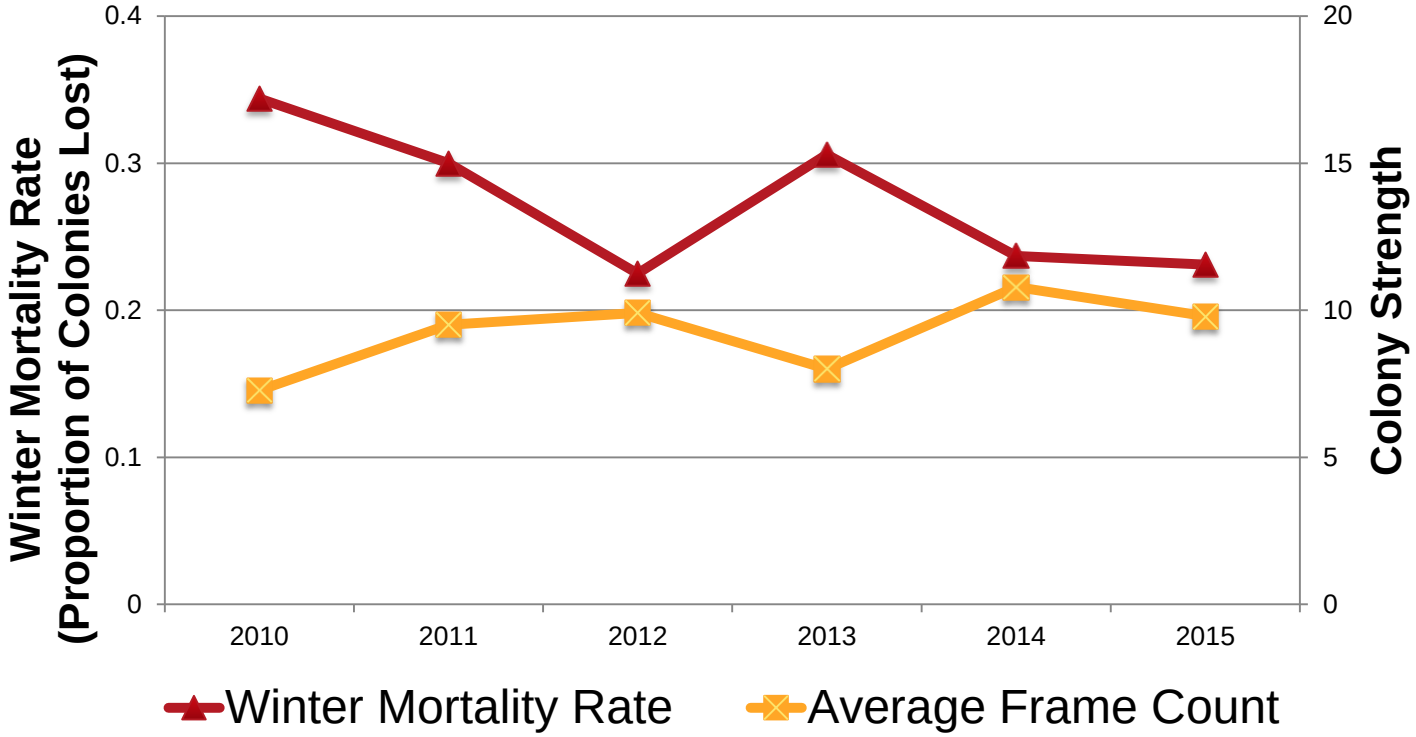
Hive Shipments for Almond Pollination



Hive Shipments for Almond Pollination

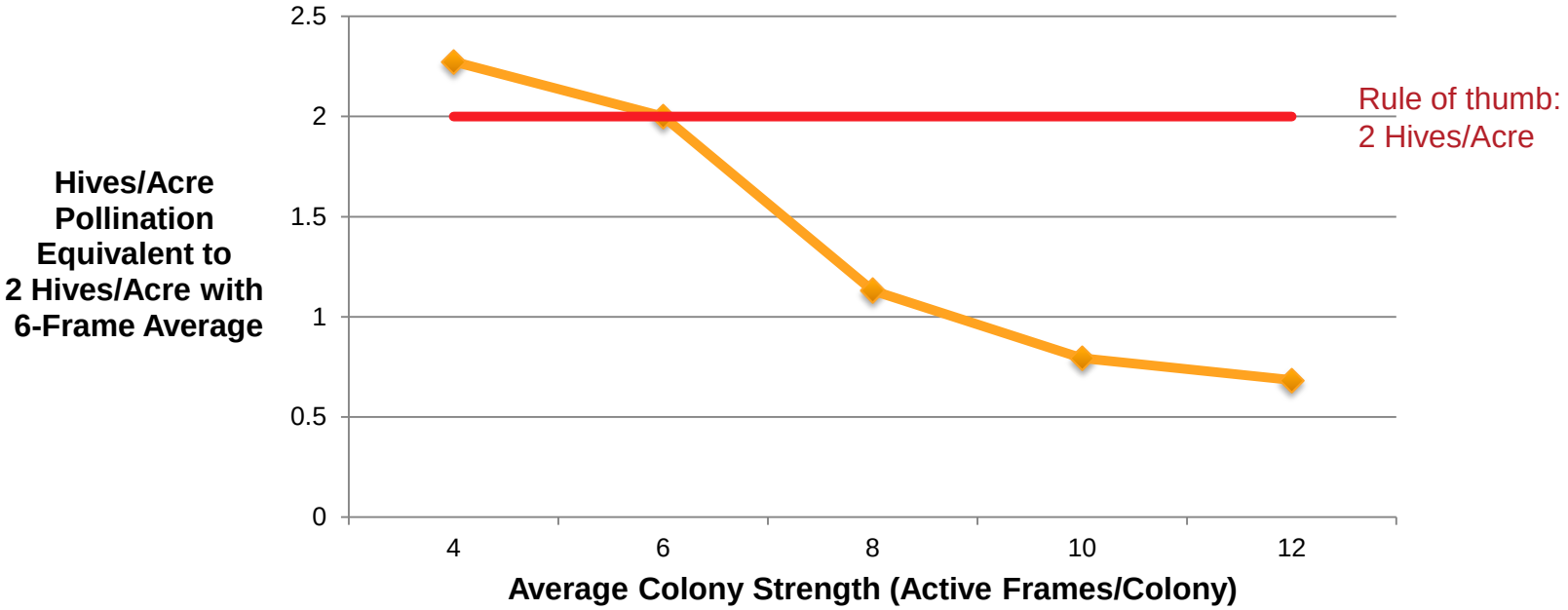


Colony Strength During Almond Bloom and Winter Mortality Rates



Sources: U.S. Average Winter Mortality Rate: Bee Informed Partnership; Average Frame Count: The Pollination Connection

Colony Strength and Hives/Acre



Data Source: Eischen et al. (2007) Effect of Colony Size and Composition on Almond Pollen Collection

Note: This graph represents equivalence in weight of pollen collected, not almond yield. Should **not** be interpreted as a measure of optimal stocking density!

2015 Almond Pollination Contract Survey Results

california almonds
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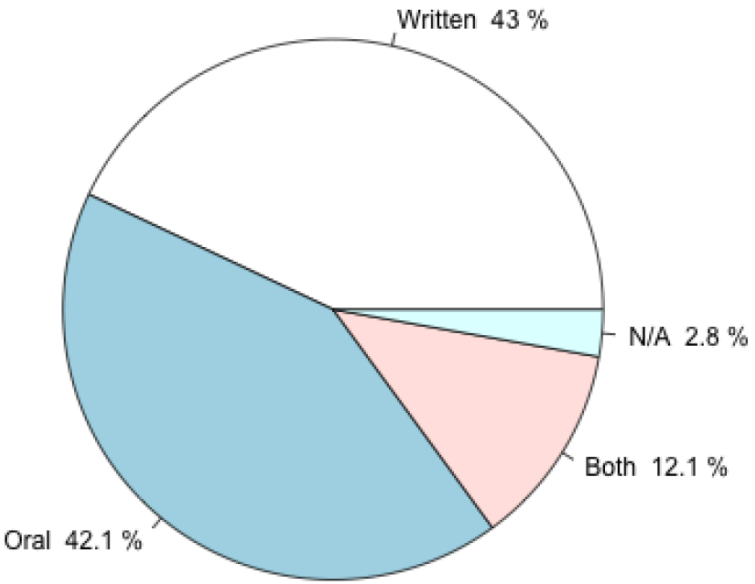
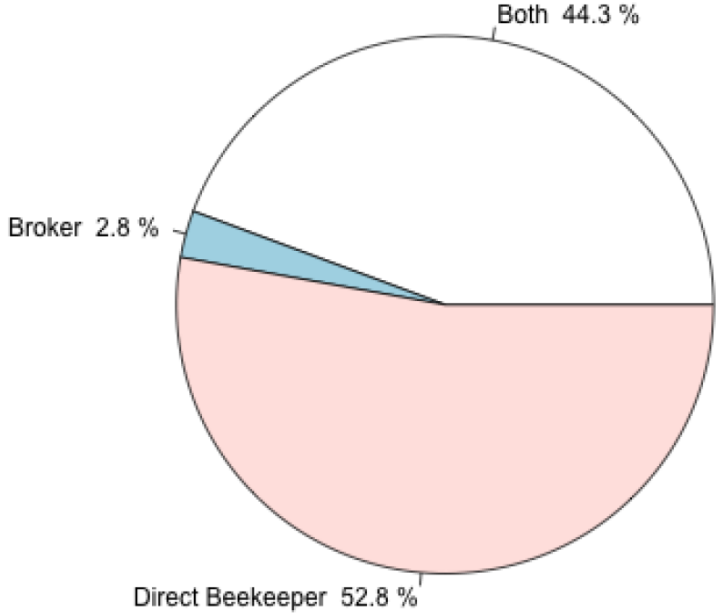
Basics of 2015 Almond Pollination Agreements

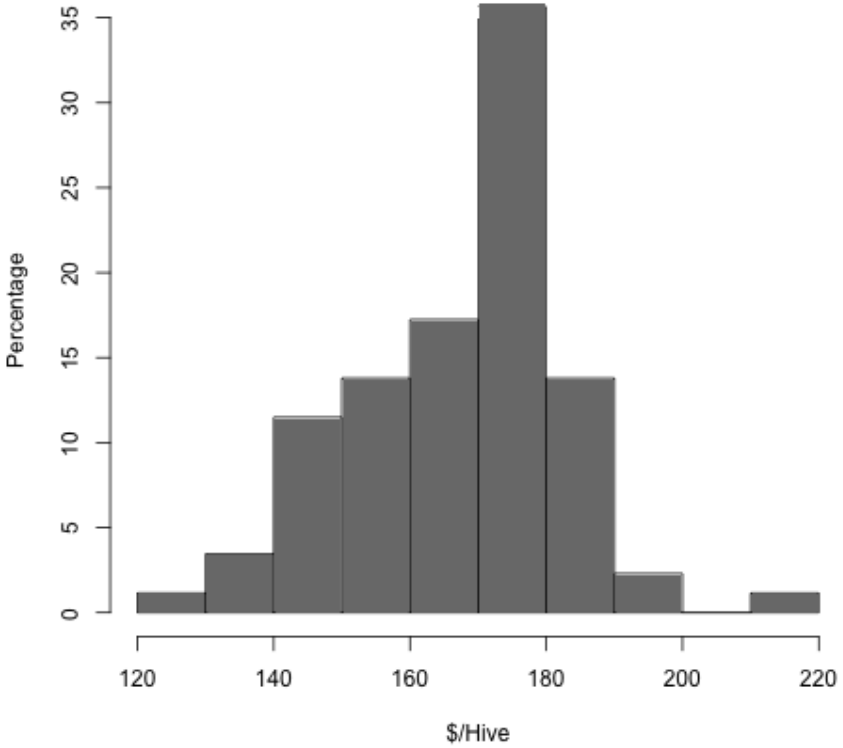
Form(s) of Agreement Used in 2015



Type(s) of Pollination Provider Used in 2015

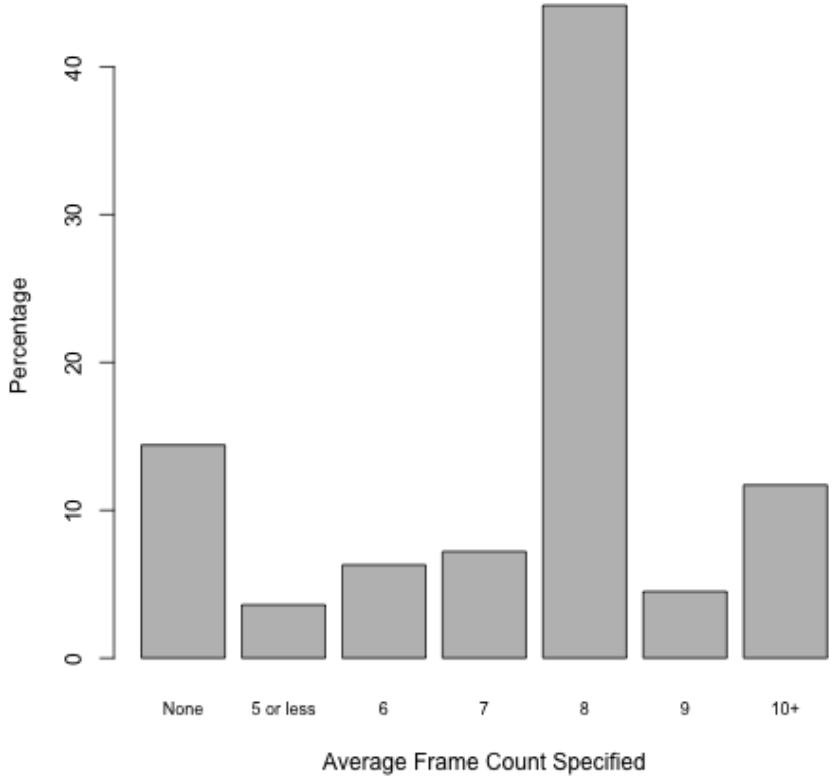


2015 Contract Provisions: Per-Colony Fees



- Minimum: $120/Colony
- Average: $170/Colony
- Maximum: $215/Colony

2015 Contract Provisions: Minimum Average Frame Count

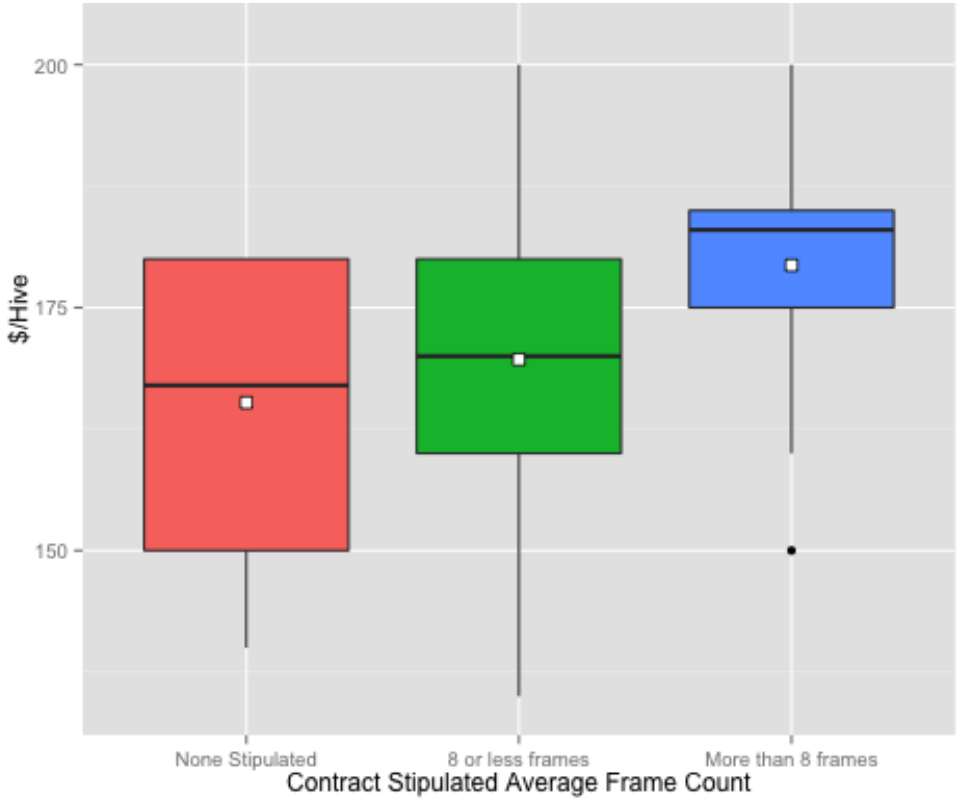


- ~78% of respondents' agreements required a minimum average colony strength
- 45% required 8 frames

Relationship Between Minimum Average Colony Strength and Fees

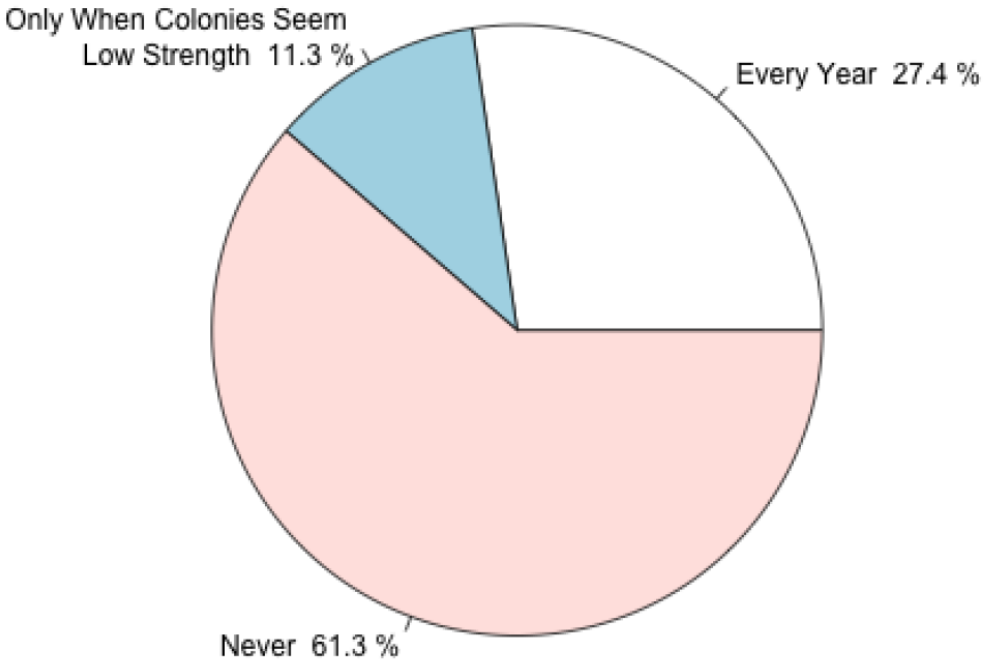
Average Per-Colony Fees by Minimum Average Frame Count Category:

- High Colony Strength Requirement: $180
- Standard Requirement: $170
- No Colony Strength Requirement: $165



2015 Contract Provisions: Colony Strength Inspections

Frequency of Paying Third Party for Colony Strength Inspection:



- Most (78%) almond growers require minimum colony strength
- 39% verify that the requirement has been met
- Inspection cost: $1.50-2.00 per inspected hive

2015 Contract Provisions: Response to Low Delivered Colony Strength

Response	Allowed by Agreement (N=105)	Employed in 2015 † (N=100)
No Response	1%	2%
Communicate with Beekeeper to Bring More Colonies	74%	12%
Impose Per-Frame Penalty (For # Frames Below Min Avg)	22%	6%
Impose Monetary Penalty (% Pollination Expense or Fixed)	28%	3%
Remove Colonies and Replace with Others	8%	4%
No Longer Contract With in Future	41%	9%
Impose Another Penalty	3%	3%

- 39% have at least one monetary penalty included as possible response in agreements
- 62% received high strength colonies in 2015 (no response required)
  - 10% implemented a monetary penalty

2015 Contract Provisions: Per-Frame Bonus

- 21% offered per-frame bonus incentives for high strength colonies
- 86% of those offering per-frame bonuses paid them to at least half their beekeepers

Table 1: Sample Almond Pollination Incentive-Based Contract

Almond Pollination Pricing Schedule		
Benchmark Colony Strength: 8-frame average	Bonus/frame above benchmark *(Max Bonus=$20)*	Penalty/frame below benchmark
$175	$10	$15
Beekeeper Per-Hive Payments		
Beekeeper	Average Frame Count	Price/Hive
Beekeeper #1	9.5 frames	175+(1.5x10)=$190
Beekeeper #2	7 frames	175-(15x1)=$160
Beekeeper #3	11.5 frames	175+Max Bonus=$195

Survey Analysis: Types of Almond Pollination Agreements

1. Per-Frame Bonus Contract (21% of growers)

- Provide per-frame bonus for high colony strength
- Require minimum colony strength
- Pay for colony strength inspection every year

2. Strictly-Enforced Contract (10% of growers)

- Require minimum colony strength
- Pay for colony strength inspection every year
- Highest average fee of all types: $186/colony

3. Standard Oral Agreement (29% of growers)

- Use oral agreements only
- Require minimum colony strength
- Unlikely to pay for colony strength inspection
- Average fee: $169/colony

4. Standard Written Contract (29% of growers)

- Use written contracts
- Require minimum colony strength
- Unlikely to pay for colony strength inspection
- Average fee: $171/colony

5. Informal Agreement (11% of growers)

- No minimum colony strength requirement
- Never pay for colony strength inspection
- Lowest average fee of all types: $165/colony

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Conclusions

- Colony strength and inspection requirements interact to impact pollination fees

- If requiring high colony strength (>8 frames) and inspection, expect to pay the beekeeper more per-colony. Why?
  - Inspections costly to beekeeper: May result in killed queen
  - High colony strength requires more beekeeping inputs

- “Field run” hives (or low colony strength requirements) priced much lower per colony
  - Know what you are paying for!
    - Possibility of decreased yields
      - Especially with cold/rainy weather
      - May require more hives/acre
    - Communication with beekeeper is key

Thank you!

- Want more info?
  - More results in Poster Session (#98 on Map)
  - Check out:

  http://giannini.ucop.edu/publications/are-update/issues/2016/19/4/honey-bee-colony-strength-in-the-california-almond/

- Contact:
  - Brittney Goodrich
  - Phone: (415)-310-0350
  - E-mail: goodrich@primal.ucdavis.edu

- Thank you to the survey participants and the Almond Board of California for making this survey possible!

SAVE THE DATE

Almond Board of California
“In-the-Orchard”
Bee Health and Pollination Workshops

Jan 16 | Fresno
Jan 17 | Livingston
Jan 18 | Woodland