Healthy Hives: A Grower’s Role

December 6, 2016
Healthy Hives: A Grower’s Role

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• 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
Longitudinal evaluation of honey bee colonies on different forage regimes

Elina L. Niño, Neal Williams, Quinn McFrederick
Many crops pollinated by honey bees...

but it all starts in the almonds
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 hive 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.
• 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: ____.

   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.
Honey Bee Health

Farmer Practices
- Monoculture
- Field Size

Pesticides
- Application Procedures
- Translocation
- Dust-off

Bee Food Supply
- Less variety
- Less quantity

Climate Weather
- Planting Season
- Spring Timing
- Winter Severity

PATHOGENS
- Viruses, Bacteria, Parasites, Other diseases
  - Varroa
    - Increased transmission of other diseases
    - Resistance development to treatments

Beneficial Microbes
- Susceptible to Disease Control Agents
- Competition with Pathogens

Acaricides & Other Disease Control Agents

Beekeeper Practices
- Attitudes
- Pollination Services
- General Care
- Disease Management

Residues in Bee Products
- Hive Foundations
- Pollen/Wax
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
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
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?

Stronger Hives/Better Pollination

- Increased Foraging
- Increased Brood
- Incoming Pollen
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
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.
Thank you

Find us at:
www.ProjectApism.org
ProjectApis@gmail.com
Danielle Downey, Project Apis m.
Project Apis m. Research & Forage

Bringing You Better Bees!
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)
- Nutrition 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!

3 weeks
2 mil col.

30 weeks
25% ND, 75% 8 state region
PAm is increasing bee forage!

Seeds for Bees

Honey Bee & Monarch Butterfly Partnership
Honey Bee & Monarch Butterfly Partnership
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

<table>
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<tr>
<th>Scenario:</th>
<th>Actual Production - 2013</th>
<th>CRP - 2013</th>
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<tbody>
<tr>
<td>Parameter</td>
<td>Value</td>
<td>Value</td>
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<tr>
<td>Acreage</td>
<td>181.00 acres</td>
<td>181.00 acres</td>
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<tr>
<td>Field Average Yield</td>
<td>145.06 bu/ac</td>
<td>157.66 bu/ac</td>
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<tr>
<td>Profit</td>
<td>$44.18/acre</td>
<td>$86.90/acre</td>
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<tr>
<td>ROI</td>
<td>6.49%</td>
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<tr>
<td>Total Field Expenses</td>
<td>$123,282.72</td>
<td>$112,256.70</td>
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<tr>
<td>Total Field Revenue</td>
<td>$131,279.30</td>
<td>$127,985.72</td>
</tr>
<tr>
<td>Total Field Profit</td>
<td>$7,996.58</td>
<td>$15,729.02</td>
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</table>

+8.7% +96.7% +115.9% - 8.9% - 2.5% + 96.7%
Many Beneficiaries!

Acres of Grassland/Wetlands/Shrub Land Converted to All Crops
By county, 2008-2011

Total Acres: 23,681,611

Calculated using the USDA-NASS Cropland Data Layer for crop years 2008 (56m), 2009(56m), 2010(30m) & 2011(30m).
Many Beneficiaries! Including you!
We’ve got her back!

Thank you!
John Miller,
Miller Honey Farms, Inc.
The Beekeeper, Almond Grower and Forage Partnership

John Miller, Miller Honey Farms
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 Elson 208-680-0736 ryan@millerroneyfarms.com
Chico/Woodland Contact: Jason Miller 408-637-6449 jason@millerroneyfarms.com
California Office: John Miller 916-718-4243 john@millerroneyfarms.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:
Palm Mustard Mix - Contains (35%) Canola Rapini mustard, 15% Braco White Mustard, 15% Nemfix Mustard, 20% Dalkon 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, cutplowed with a ring roller, planted and rolled a second time.
Caution: “Grass killing” herbicides such as Round-up will cause phytotoxicity 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°F
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.ProjectApis.org
6675 Chardonnay Rd., Paso Robles, CA 93446
APM is 501 (c)(3) non-profit organization
The Result
Honey Bee Best Management Practices for California Almonds
Why should all pollination stakeholders care?

- 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

Source: *Scientific American*, September 2013
Honey Bee BMP Resources


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

• 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.

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
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
Hive Shipments for Almond Pollination

Border Station Bee Shipments Entering California, 2008-2015

Number of Bee Shipments


Jan-March
Prior Year (Nov-Dec)
Border Station Bee Shipments Entering California, 2008-2015

- ~890,000 Colonies (~48%)
Colony Strength During Almond Bloom and Winter Mortality Rates

Winter Mortality Rate (Proportion of Colonies Lost) vs. Colony Strength

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
Basics of 2015 Almond Pollination Agreements

**Form(s) of Agreement Used in 2015**
- Oral: 42.1%
- Written: 43%
- N/A: 2.8%
- Both: 12.1%

**Type(s) of Pollination Provider Used in 2015**
- Direct Beekeeper: 52.8%
- Both: 44.3%
- Broker: 2.8%
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

- 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

<table>
<thead>
<tr>
<th>Benchmark Colony Strength: 8-frame average</th>
<th>Bonus/frame above benchmark (Max Bonus=$20)</th>
<th>Penalty/frame below benchmark</th>
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</thead>
<tbody>
<tr>
<td>$175</td>
<td>$10</td>
<td>$15</td>
</tr>
</tbody>
</table>

**Beekeeper Per-Hive Payments**

<table>
<thead>
<tr>
<th>Beekeeper</th>
<th>Average Frame Count</th>
<th>Price/Hive</th>
</tr>
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<tbody>
<tr>
<td>Beekeeper #1</td>
<td>9.5 frames</td>
<td>175+(1.5x10)=$190</td>
</tr>
<tr>
<td>Beekeeper #2</td>
<td>7 frames</td>
<td>175-(15x1)=$160</td>
</tr>
<tr>
<td>Beekeeper #3</td>
<td>11.5 frames</td>
<td>175+Max Bonus=$195</td>
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</table>
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
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
Survey Analysis: Types of Almond Pollination Agreements

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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:

• 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