Mixing It Up: Using Blue Orchard Bees as Supplemental Pollinators to Honey Bees for Almond Pollination

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Global food supply and pollinators

- Bees are the predominant and most economically important group of pollinators.

- Honey bees are the primary agricultural pollinators for many worldwide crops.

- Out of some 100 crop species which provide 90% of food worldwide, 71 of these are bee pollinated.
Almonds

- California’s top agricultural export
- Largest tree nut crop in total value & acreage
- 30 different varieties of almonds
- 30% sold in U.S., 70% shipped internationally
- Largest U.S. specialty crop export
Almond Orchards in CA (860,000 acres or 1,344 square miles)

Area of Rhode Island is 1,214 sq miles
Almond Pollination in CA

- Almonds are grown throughout CA’s Central Valley
- Bloom occurs in mid-February
- World’s largest pollination event
- Our studies in southern Central Valley Lost Hills, CA at Paramount Farming Co.
In early to mid-February, almond trees begin to bloom *en masse.*
In early to mid-March, blossoms fall and pollinated flowers begin to develop fruits.
Many almond trees are not self-pollinating so honey bees are brought in.
From March to June, almonds continue to mature, with the kernel forming.
In July and August, hulls split open exposing the shell and allowing it to dry.
From August through October, mechanical tree “shakers” harvest the almonds.
After harvest, almonds go to a huller/sheller to remove debris.
Almond Bearing Acreage

Thousands of Acres


California State Beekeeping Association
Managed Honey Bee Colony Losses in U.S.

Percent Total Colony Winter Loss

- 2006-2007
- 2007-2008
- 2008-2009
- 2009-2010
- 2010-2011
- 2011-2012
- 2012-2013
- 2013-2014

Bee Informed Partnership, Apiary Inspectors of America, USDA
Almond Pollination Fees

Price per hive


California State Beekeeping Association
Present Honey Bee Migratory Patterns in the U.S.

860,000 acres of almond × 2 colonies per acre

1.7 million colonies (~70% of all colonies get shipped to CA)
Apiaries – Holding Areas Until Almond Bloom
Honey bee, *Apis mellifera*

**Challenges**

- Varroa Mites
- Viruses
- Tracheal Mites
- Hive Beetles
- Wax Moths
- Poor Nutrition
- American Foulbrood
- Pesticides
- CCD
What can be done to alleviate the honey bee shortage?
Blue Orchard Bees, *Osmia lignaria*

- Native to the U.S.
- Overwinter as adults
- Emerge from cocoons in spring
- Active in cool, cloudy weather
- Pollinators of fruit and nut trees
Blue Orchard Bee, *Osmia lignaria*

- Cavity-nesting species
- Nest in old beetle borings in wood
- Accept artificial nesting substrates
- Females nest gregariously
- Mud plugs and cell partitions
Project ICP: Almond Experimental Design

Sites
- Almond orchards in northern California
- 12 almond orchards in southern California

Plot design
- Transects

Measurements
- Pollinator observations
- Pollination treatments
- Fruit quality & quantity
Almond Orchard Pollinated by Honey Bees
Orchard Supplemented with *Osmia lignaria*

- 160 acre almond orchard
- 3 almond varieties
- Each block = 10 acres
- 48 nest boxes per block
- 4,000 ♀ per block
Orchard Supplemented with *Osmia lignaria*

- Nest boxes in both blocks
- 30 tagged trees
- Record pollinator visits to flowers
- Assess fruit set

**Block 1**

**Block 2**

**= tagged trees**
2013 Fruit Set

Mean percent fruit set

24.6%

24.5%

Percent fruit set

HB + BOB  HB + BOB  HB + BOB  HB + BOB  HB + BOB  HB + BOB  HB only  HB only  HB only
Mean percent fruit set 29.8%
2013 Fruit Set, Honey Bee Only Orchards

Mean percent fruit set
23.1%

Percent fruit set

Orchard
- 385
- 398
- 399

Rows

1 10 30 40 60 90
2013 Fruit Set

Honey Bee + BOB Orchards

Mean percent fruit set
29.8%

Honey Bee Only Orchards

Mean percent fruit set
23.1%
2014 Fruit Set

Mean percent fruit set

- **33.3%**

Mean percent fruit set

- **24.0%**

Percent fruit set

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2014 Fruit Set, Honey Bee + BOB Orchards

BOB nesting areas

Mean percent fruit set
33.3%

Percent fruit set

Orchard
- 335
- 337
- 341
- 358
- 358
- 385
- 399

Rows
- 1
- 10
- 30
- 40
- 60
- 90

Percent fruit set
2014 Fruit Set, Honey Bee Only Orchards

Mean percent fruit set
22.3%

Percent fruit set

Rows

Orchard

- 307
- 339
- 340
- 354
- 398
2014 Fruit Set

**Honey Bee + BOB Orchards**
Mean percent fruit set
33.3%

**Honey Bee Only Orchards**
Mean percent fruit set
22.3%
What about the bees?
Blue Orchard Bee Reproduction

- Number of nests
- Number of ♀ & ♂ cells
- Mortality
- Parasites & Disease
### 2013 Reproduction
- Released 48,000 females
- Return of 16,211 females
  - ~34% return

### 2014 Reproduction
- Released 48,000 females
- Return of 13,106 females
  - ~27% return

Strategies for better retention and reproduction of blue orchard bees released in orchard—**nest attractant**

How to place blue orchard bees in orchards for efficient pollination—**distribution and density of nest boxes**
What other ways can we help the bees?
How can we help the bees?

• Almond bloom – abundant resources for a short period

• Plant wildflowers to extend the foraging season for blue orchard bees and honey bees

• Potentially allow for greater bee survival, reproduction, and almond pollination
Experimental Wildflower Plantings

- Tailor wildflower mixes for almonds with plants attractive to blue orchard bees
- Monitor plant growth and establishment success
- Assess flower phenomenology
- Record bee visitation
Cost-benefit analyses – assess the economics of using blue orchard bees as supplemental pollinators in almonds

• Cost of the bees
• Management of the bees
• Cost of the nesting materials
• Labor costs
• Wintering and incubation costs
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