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

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• 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.



Almond Lifecycle





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



California State Beekeeping Association

Managed Honey Bee Colony Losses in U.S.



Bee Informed Partnership, Apiary Inspectors of America, USDA

Almond Pollination Fees



Present Honey Bee Migratory Patterns in the U.S.



1.7 million colonies (~70% of all colonies get shipped to CA)



Apiaries – Holding Areas Until Almond Bloom



Honey bee, Apis mellifera



Challenges Viruses Wax Moths Pesticides

Tracheal Mites Poor Nutrition CCD

What can be done to alleviate the honey bee shortage?



Blue Orchard Bees, Osmia lignaria

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- 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





12 almond orchards in southern California Almond orchards in northern California

Almond Orchard Pollinated by Honey Bees





Orchard Supplemented with Osmia lignaria





Orchard Supplemented with Osmia lignaria



2013 Fruit Set







BOB nesting areas



Rows

2013 Fruit Set, Honey Bee Only Orchards





Rows



Honey Bee + BOB Orchards

Honey Bee Only Orchards

Mean percent fruit set





2014 Fruit Set







BOB nesting areas









Honey Bee + BOB Orchards Honey Bee Only Orchards Mean percent fruit set Mean percent fruit set 33.3% 22.3% 0.70 0.70 0.60 0.60 0.50 0.50 0.40 0.40 0.30 0.30 0.20 0.20 0.10 0.10 0.00 0.00 10 30 40 10 30 40 60 90 1 60 90 1 Rows Rows

What about the bees?

Blue Orchard Bee Reproduction











Blue Orchard Bee Reproduction





- Number of nests
- Number of \bigcirc & \bigcirc cells
- Mortality
- Parasites & Disease



Blue Orchard Bee Reproduction

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?







- 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 phenology
- 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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Research Service