

# Pollinating Almonds with Blue Orchard Bees: Impacts on yield and insight into sustainable bee production

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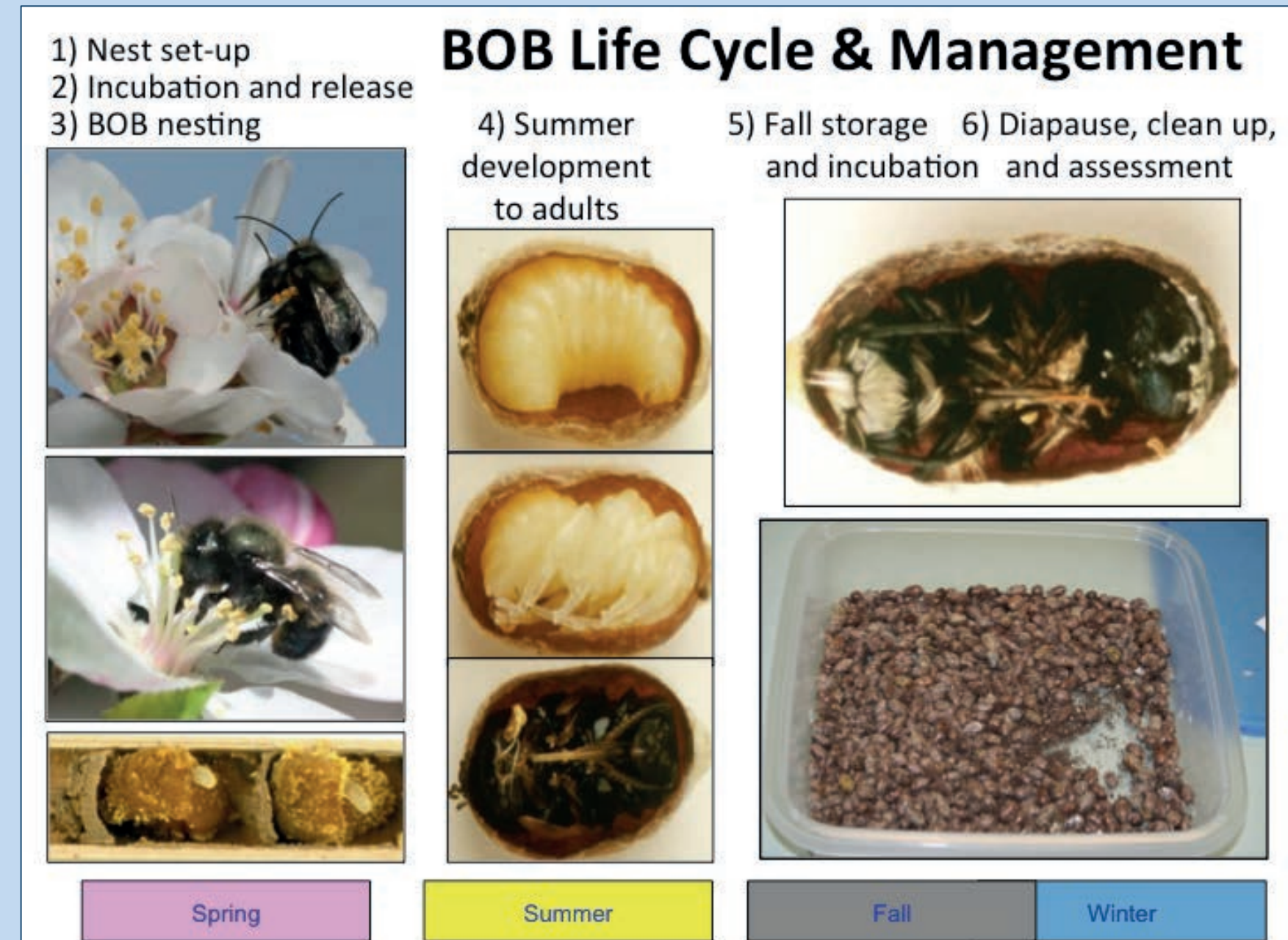


## Who is the Blue Orchard Bee?



Blue Orchard Bee (BOB), *Osmia lignaria*

- Managed native bee
- Tree fruit pollinator
- Phenology can be synchronized to align with onset of bloom



## What Makes the Blue Orchard Bee Effective?



## Overcoming Limited Supply

- BOB has been supplied through wild trapping for commercial application
- Wild trapping may have negative consequences on native populations
- Need for alternative propagation



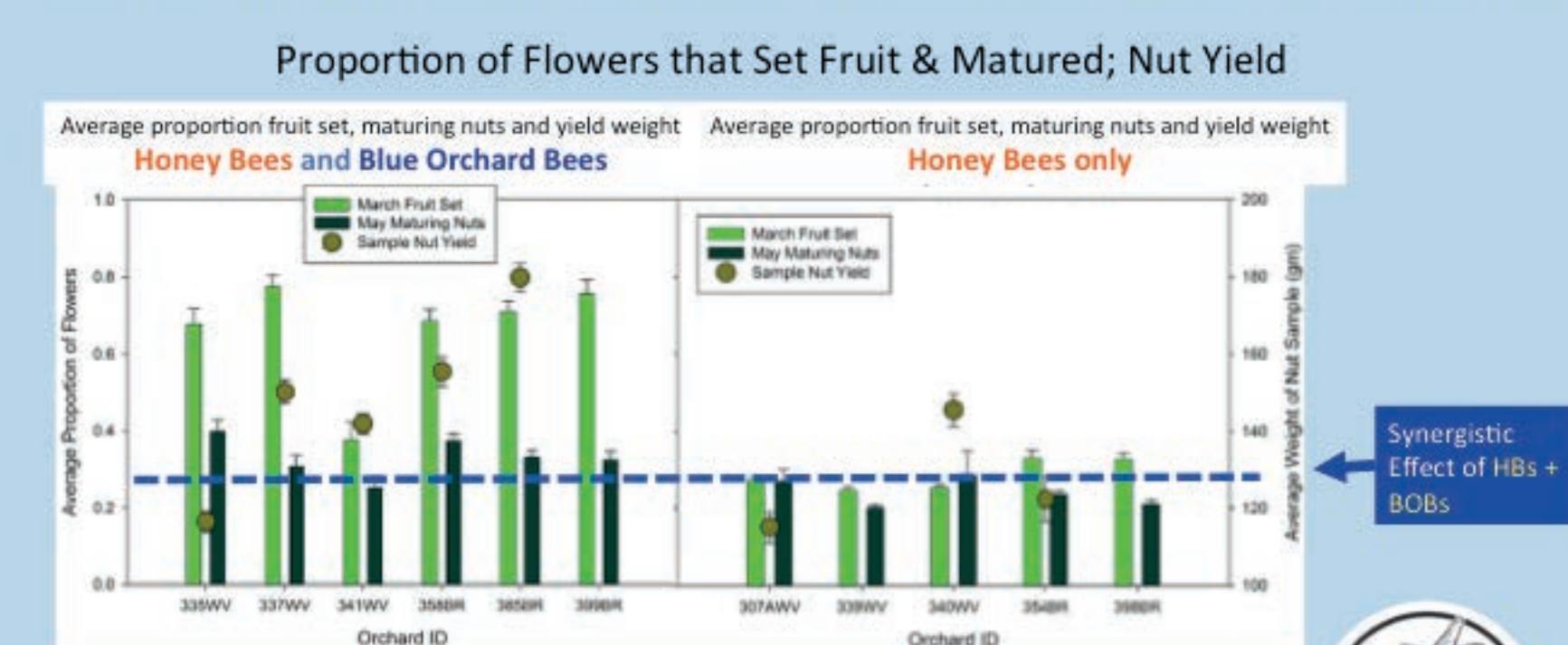
## BOBs synergize with honey bees in almond pollination!

### 2013-2014 Research in Almonds in Wonderful Orchards by ARS - (publication in preparation)

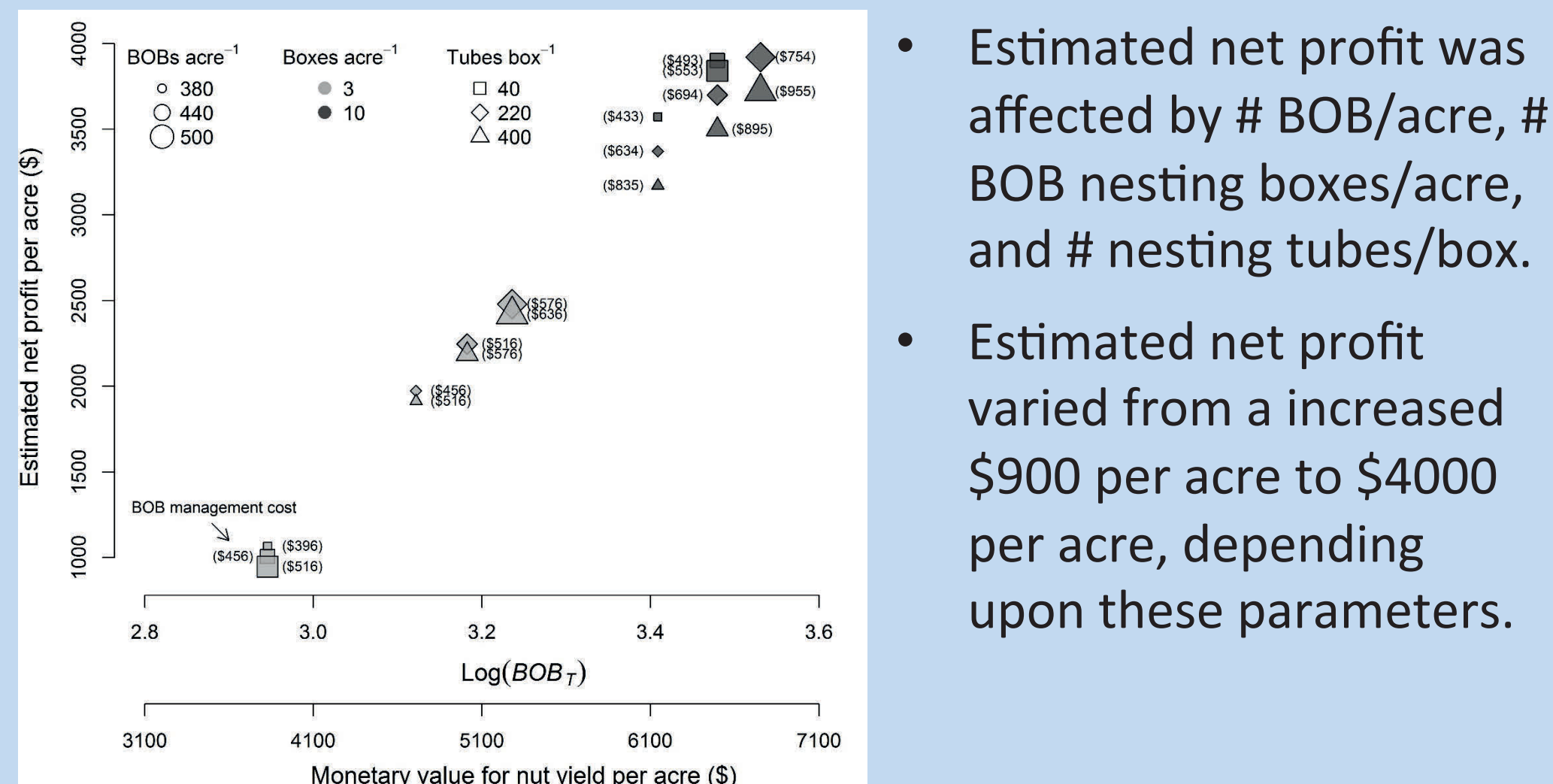
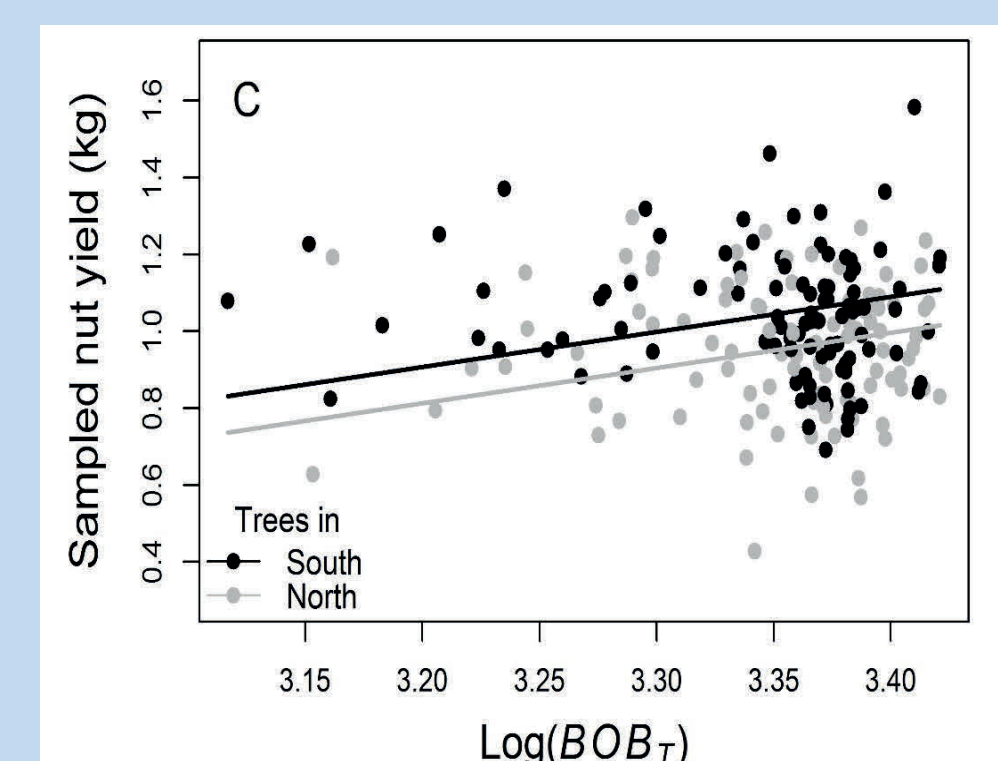
- Research was performed to ask how BOBs impact yield when used in combination with honey bees (2 hives per 0.4 ha) with BOBs (at 400 females per 0.2 ha) versus honey bees only (2 hives per 0.4 ha).
- We used orchards in both Northern (n = 8) and Southern (n = 12) ends of the San Joaquin Valley to evaluate how location, climate and management style influence BOB pollination efficacy.
- Efficacy was evaluated by measuring BOB reproduction, fruit set and nut yield within each orchard. By evaluating fruit set and nut yield resulting from orchards co-pollinated by both honey bees and BOBs, we evaluated the **direct** impacts that BOB pollination has on overall almond production.
- Northern valley fungicide sprays during bloom likely impacted overall BOB (and maybe HB?) pollination efficacy in these areas.

Synergism between BOBs and HBs was also found by Steve Peterson from AgPollen in 2014 in northern almond orchards and by Brittain, Williams, Kremen, and Klein (Proc. R. Soc. B (2013) 280: 20122767) in cage studies.

### Wonderful Orchards: 2014 Blue Orchard Bee Effect on Almonds



A model has been constructed to examine the impact of BOBs and Honey bees on almond yield and economics of BOB use (Insu Koh, Eric Lonsdorf, Derek Artz, Theresa Pitts-Singer, Taylor Ricketts, in preparation). The best-fit regression model uses the following variables: density of foraging BOBs and honey bees [ $BOB_T$  and  $HB_T$ ] on individual tree, block effects [ $Block$ ], and distance to boundary [ $Dist_{bound}$ ] for each distance decay parameters of BOB ( $P_{BOB}$  = decreasing likelihood of foraging from nest  $i$  to tree  $T$ ) and honey bees.



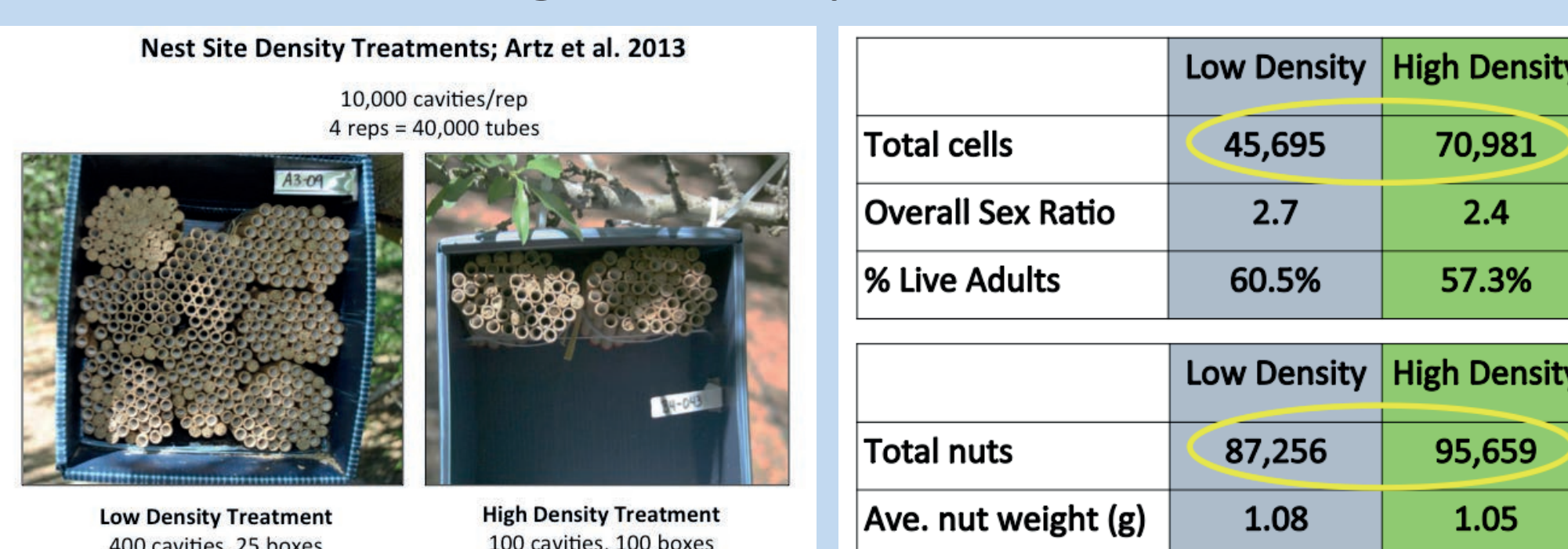
- The sampled nut yield varied by the density of BOB ( $BOB_T$ )
- Model included additional costs to grower such as one HB hive rental and other production costs.
- Estimated net profit was affected by # BOB/acre, # BOB nesting boxes/acre, and # nesting tubes/box.
- Estimated net profit varied from a increased \$900 per acre to \$4000 per acre, depending upon these parameters.

## How to maximize the use of BOB in Almond Pollination

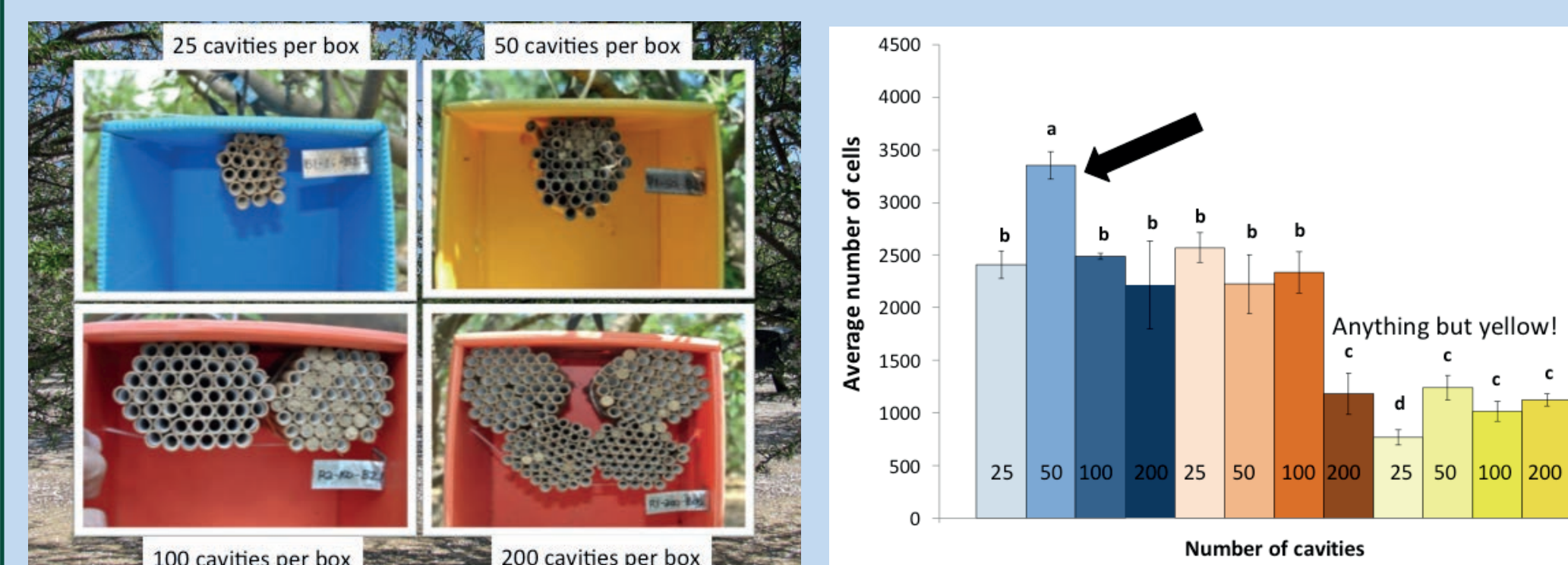
### Pollination by BOBs depends upon several factors:

- Incubation of BOB cocoons for release of adults into field
- Nests (size of boxes, color of boxes, placement of boxes)
- Nesting tubes (number per box)
- Attraction of nest tubes to female BOBs
- Availability of mud for construction of nest cell partitions
- Available pollen supplies (overcoming limited almond pollen if short bloom period or high-level competition with other bees)

BOB cocoons with diapausing bees are purchased and require incubation at warmer temps; chilling the bees at night causes problems.



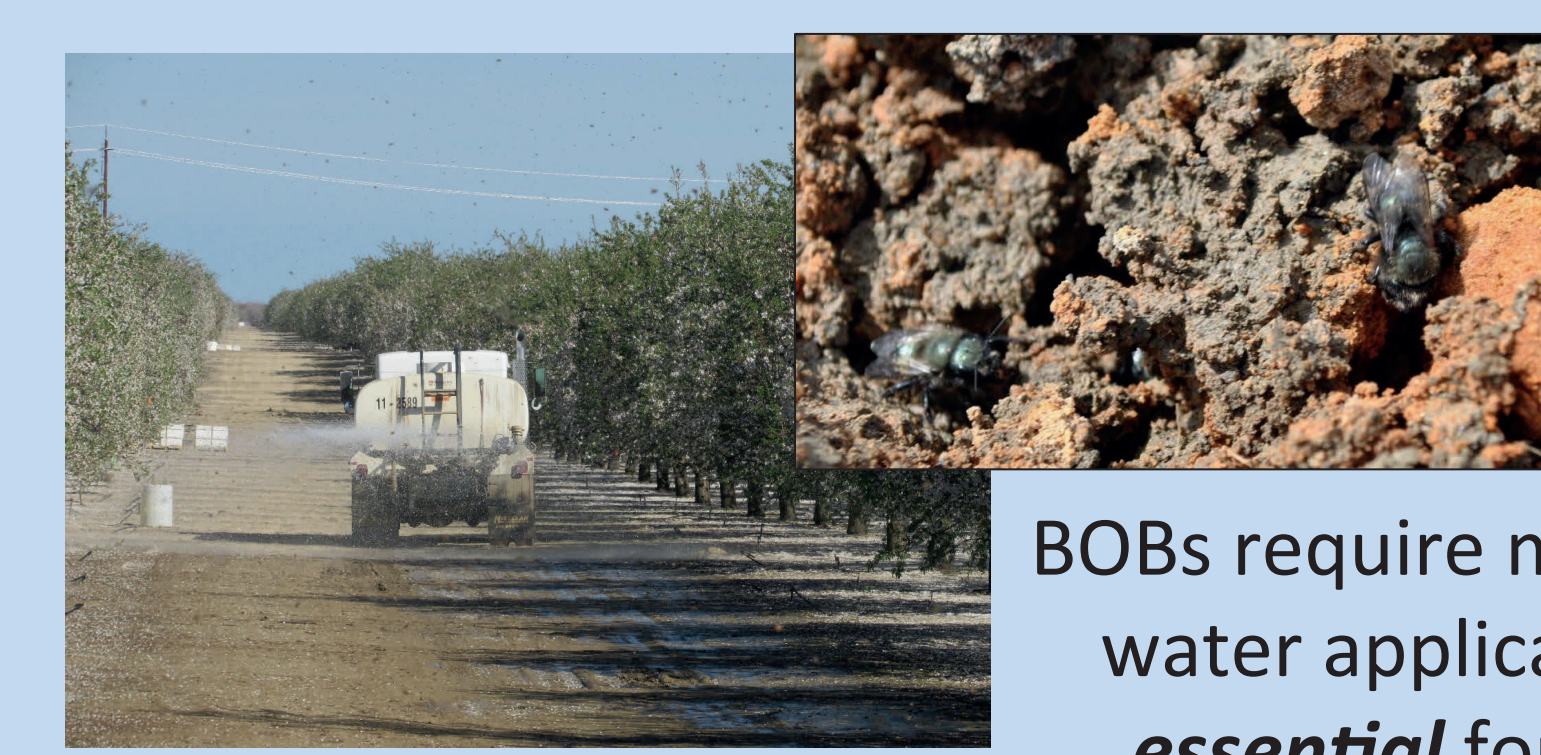
Almond yield and BOBs nesting are increased when the nest boxes have fewer tubes and are placed at a higher density in the orchards. (**More nests=More pollination**)



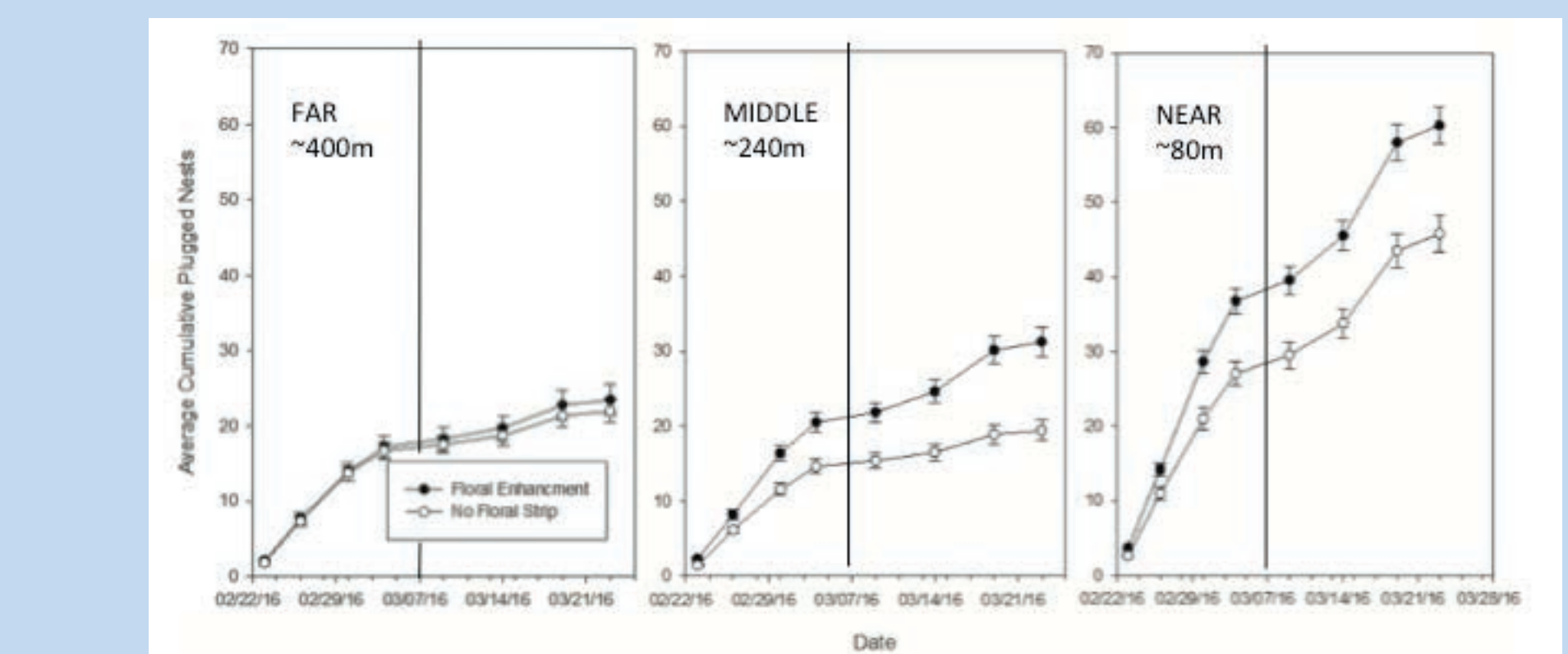
BOBs prefer to nest in **BLUE** boxes that have about 50-100 nest tubes or cavities per box.



A chemical attractant has been defined by ARS researchers and patented. **Use of the attractant increases the nesting of BOBs and keeps them where released** (in tests by Steve Peterson and by ARS).

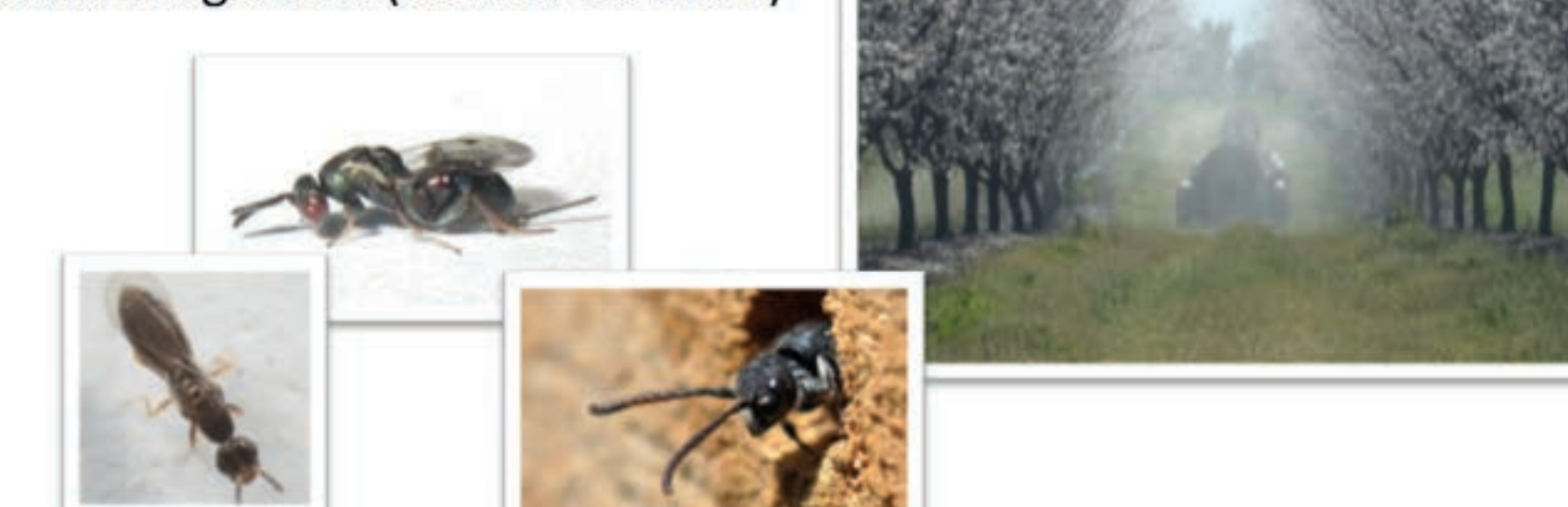


## How to get sustainable BOB supply for pollination



BOB nesting is increased by floral enhancements and extended past almond bloom, resulting in increased # of bees available for the next pollination season. Floral enhancements did not interfere with almond pollination and may also benefit honey bee health.

- Fungicide sprays during bloom are common in many almond orchards and can disrupt BOB nest recognition (Artz et al. 2016)



- Parasites can be problematic year round
  - During nesting: *Stelis* and *Sapyga*
  - During nesting and storage: *Monodontomerus*, *Melittobia*, *Pteromalus*, pollen mites
  - Trapping and monitoring techniques are currently under development

Like honey bees, BOBs are impacted by pathogens, parasites, and pesticides. Current research at PIRU is focused on these factors and asking how they interact to impact BOB health. The goal is to enable BOB use in pollination while promoting pollination and crop yields.

