

Integrated Crop Pollination Project



California Almond Grower Survey Report

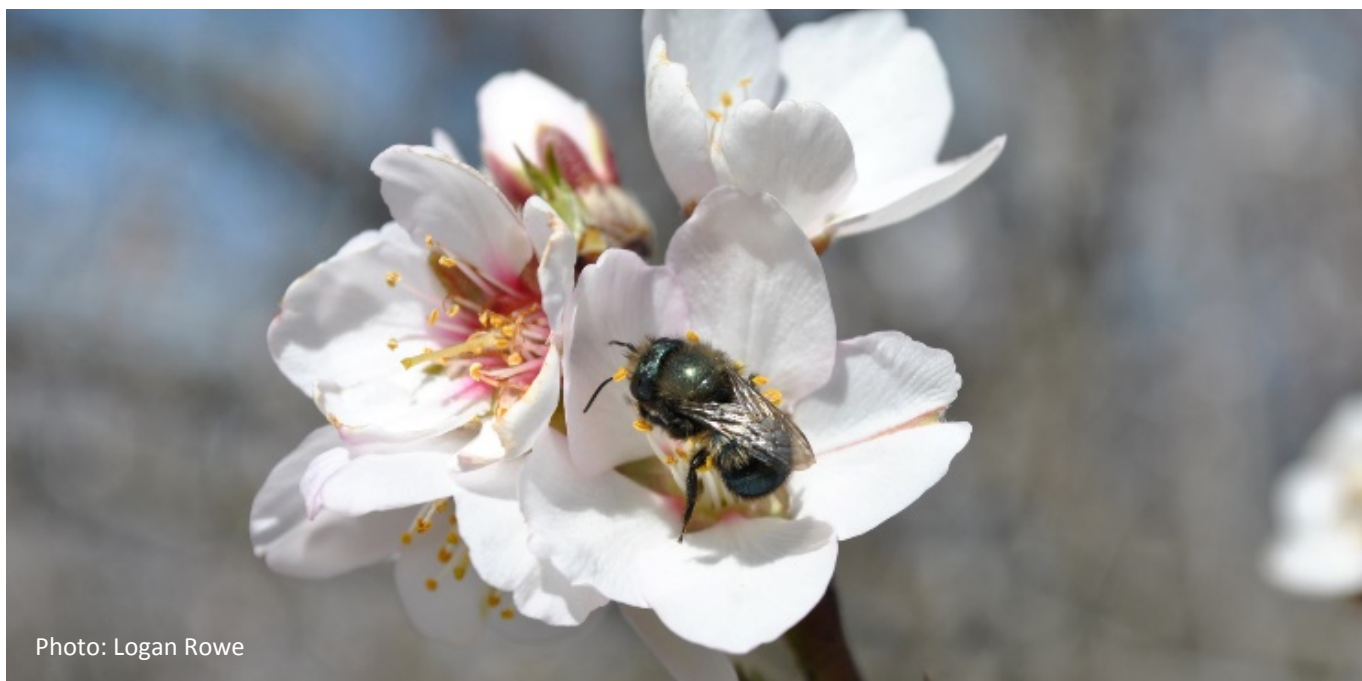


Photo: Logan Rowe

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Survey Overview

California's almonds depend on crop pollinators, which include primarily honey bees, as well as blue orchard bees (BOBs) and at least 19 species of wild bees. The combined use of different pollinator species, habitat augmentation, and farm management practices to provide reliable and economical crop pollination is a new strategy called Integrated Crop Pollination (ICP). In order to better understand the pollination strategies and information sources that growers currently use, the perceived benefits and challenges associated with "pollinator friendly" management practices, we investigated their adoption and use.

In 2014-15, we surveyed 550 almond growers in five counties in California: Fresno, Glenn, Kern, Stanislaus, and Riverside. This survey report summarizes growers' practices, management priorities, and key information sources related to crop pollination.



Photo: Logan Rowe

California Almond Grower Survey Highlights

Information sources: California almond growers get information on crop pollination from a variety of sources. Growers ranked sources in the personal relationships category as most important for their information on pollinator management, including observing their own and neighbors' farms. Pest control advisers were also listed as an important source for pollinator management information. Additionally, beekeepers and extension ranked as important sources for pollination management information.

Pollination Goals: California almond growers' most important goal for crop pollination was achieving consistent, reliable crop pollination.

Managed pollinators: The large majority of California almond growers (93%) reported buying/renting honey bees each year. The average stocking rate for 2014 was 2 hives per acre at a cost of \$154.73 (± 1.71) per hive.

Attracting diverse pollinators: Only a modest number of California almond growers, less than 20%, reported currently using practices that provide floral and nesting resources to attract diverse pollinators (e.g. maintaining natural habitat, using cover crops, and reducing tillage practices). Growers reported that the potential benefits of these practices included enhanced aesthetics, improved industry relationships, and increased property value. Many growers reported uncertainty about the benefits of attracting and retaining diverse pollinators. Addressing uncertainty and reporting data on benefits and concerns may encourage consideration new practices.

One-third of growers reported that they expected practices that attract diverse pollinators to increase crop pollination, crop quality, and economic returns. However, lack of space, weeds, increased investment, and increased regulation were reported as top concerns related to these practices. Extension and outreach work addressing these benefits and concerns is needed to encourage growers' adoption and use of practices that attract diverse pollinators.

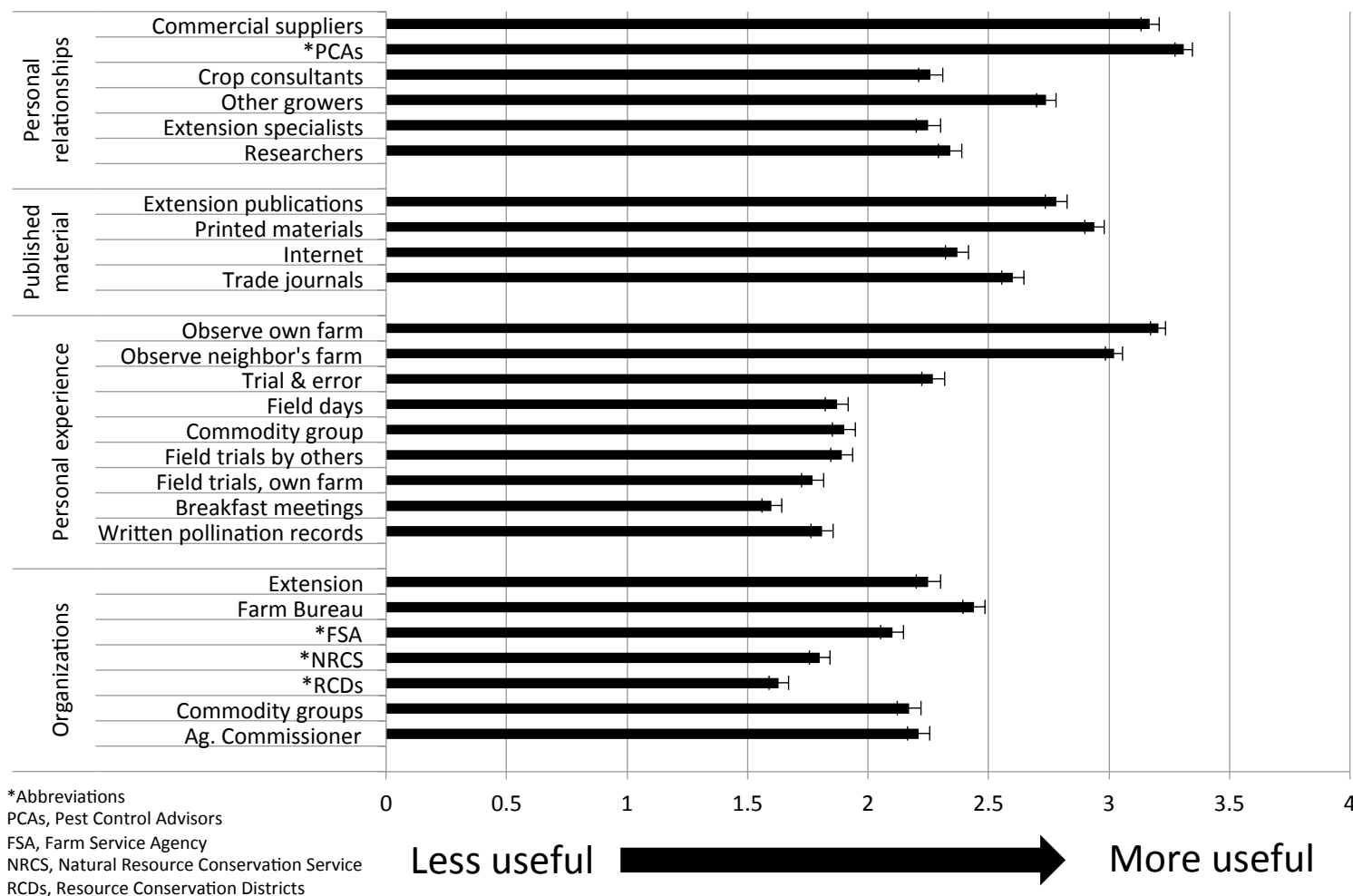
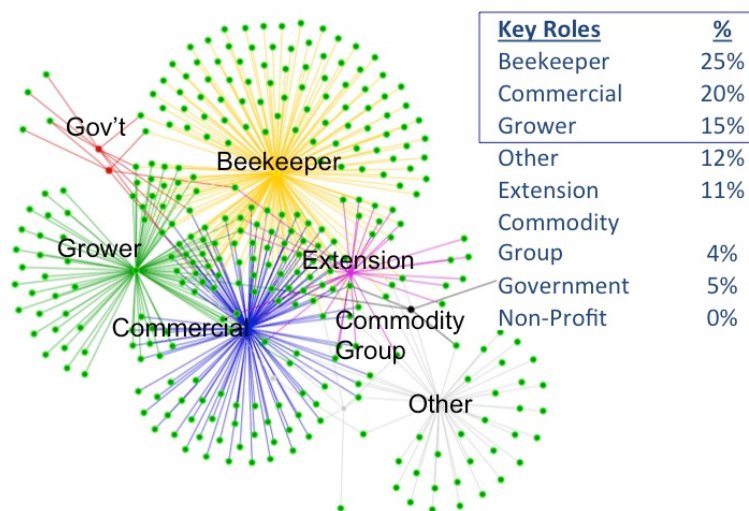
Pesticide management: There is widespread use of pest management practices designed to minimize impacts on bees. These include reducing the amount and modifying the timing of pesticide applications to minimize impacts on bees and making an effort to choose active ingredients that have the least impact on bees. This suggests that pesticide impact messages have been highly visible; extension may reinforce this message and recognize success of wide-spread adoption while emphasizing additional practices to minimize risk to bees.

1. Communication networks for pollination management

We wanted to understand how growers share information about pollination management. Growers reported on the most important people with whom they communicate about pollinators and pollinator management, and the type of job or role their contacts have. The results are presented below, with each dot representing a responding grower and the roles of their contacts grouped together by color.

Beekeepers were an important source of information, represented in 25% of growers' networks. Responses also highlight the importance of **commercial suppliers**, represented in 20% of grower networks and **grower-to-grower communication**, which was reflected in 15% of growers' networks.

Almond growers also rated their sources of information on pollination management on a scale from, *Never Used* to *Most Useful* (0 to 4). Growers rated observation of their own farm, communication with pest control advisors and commercial suppliers, and observing neighbors' farms the most highly. On average, information sources in the "personal relationships" category gained a higher rating than the other categories.

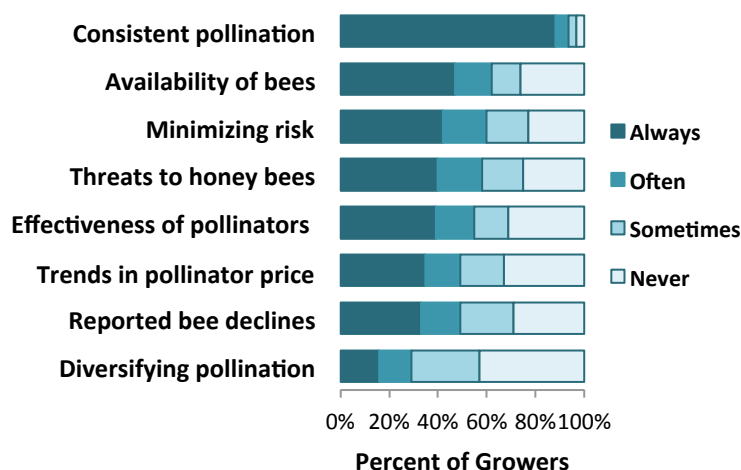




2. Pollination management priorities

We investigated pollination management priorities for almond growers. Respondents categorized a list of priorities as *Always*, *Often*, *Sometimes*, or *Never* a major priority in pollination management decisions (Figure 1).

Figure 1: Pollination management priorities, CA Almond growers



Consistent, reliable crop pollination is a top management priority for 88% of almond growers. Availability of bees was also ranked highly, with 47% responding that it is always a management priority.

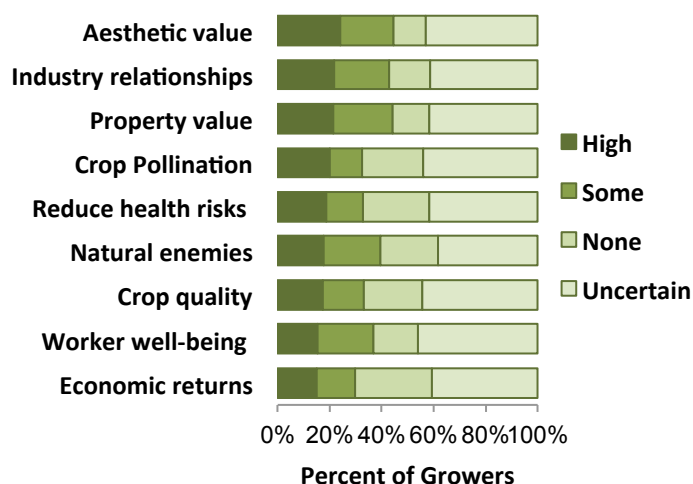
Growers on larger farms tended to report more often than smaller growers that availability of managed pollinators for rental or purchase, and effectiveness of pollinator species, were always or often management priorities.

Taken together, the priorities data suggest three tiers of management priorities for California almond growers: consistent, reliable pollination represented a top tier priority. A second tier of considerations includes availability of bees, minimizing risk and uncertainty, and threats to honey bee populations. Trends in price for pollinator rental or purchase, reported declines in honeybee populations, and diversifying pollination strategies were the lowest rated management priorities.

3. Potential benefits & concerns of practices to attract diverse pollinators

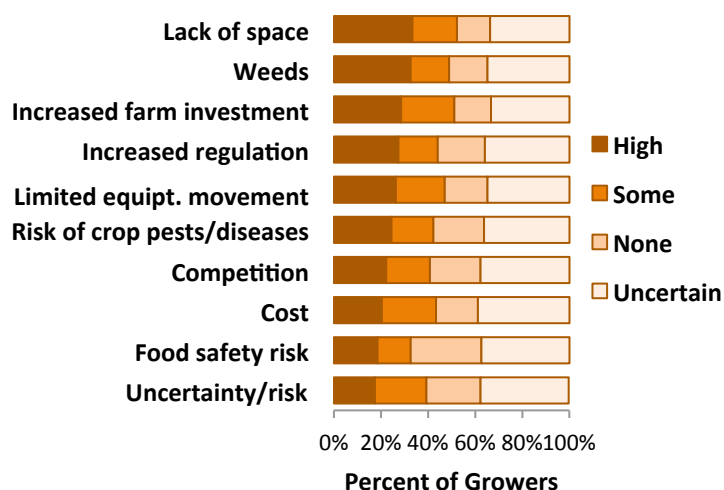
Growers were asked about potential benefits and concerns of practices to attract diverse pollinators (e.g., floral plantings, leaving fallows, establishing pollinator habitat). Respondents ranked benefits and concerns as *High*, *Some*, *None*, or *Uncertain* (Figure 2a, Benefits; Figure 2b, Concerns).

Figure 2a: Benefits of practices to attract & retain diverse pollinators



Benefits rated most highly by California almond growers were aesthetic value, industry relationships, property value, and crop pollination (Figure 2a).

Figure 2b: Concerns of practices to attract & retain diverse pollinators



a



Overall, the ratings of potential benefits were modest. None of the surveyed benefits received a combined rating of more than 50% for *High* benefit and *Some* benefit.

The top rated concerns were lack of space, weeds, increased farm investment, and increased regulation (Figure 2b, previous page). On average, these concerns ranked slightly higher than benefits.

Many growers reported uncertainty about the potential benefits and concerns of attracting and retaining diverse pollinators. Investigating sources of uncertainty and presenting data on benefits and concerns may support consideration of new practices.

4. Pollinator management findings

Buying or renting managed bees

The large majority of California almond growers (93%) reported buying or renting bees annually (Table 1). Among growers that do not buy or rent pollinators, the top strategies are to rely on bees sourced by neighbors (30%), use bees that they own (21%), rely on wild bees (15%), encourage pollinators with habitat enhancements (9%), or use other strategies (24%).

Table 1. Pollinator rental & purchase

County	Number of farms	Buy or Rent	Neither
Fresno	153	95%	5%
Glenn	40	95%	5%
Kern	51	98%	2%
Stanislaus	304	92%	8%
Riverside	2	50%	50%
Total	550	93%	7%

Trends in buying & renting bees by county

Recent increases in average farm size and acreage across all five California counties may be a factor contributing to high rates of honey bee purchase and renting. For example, the average farm size in Glenn county increased 29% between 2007 and 2012, with the number of farms increasing by 37%. Riverside had the lowest number of responding farms ($n = 2$), making it hard to draw widespread conclusions.

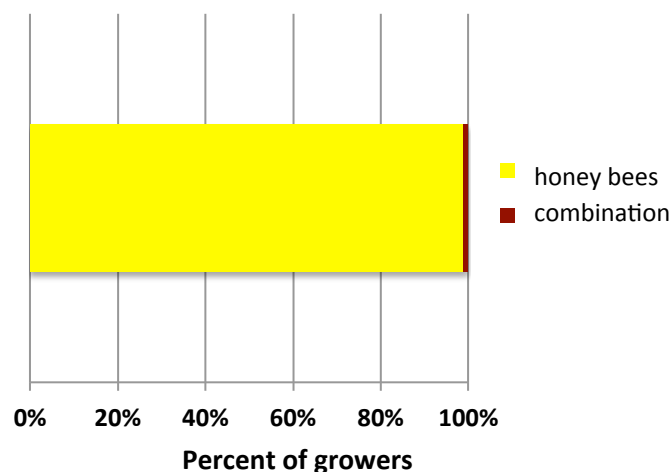
1. NASS 2012, http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/California/cp99026.pdf

The number of farms in Riverside and Kern county, however, decreased while average farm size increased, suggesting trends toward larger, more commercial farming in these counties.¹

5. Perceptions & rental trends

We asked almond growers whether they expected pollinator rental/purchase prices to change in the future. Responses reflected that most growers anticipated prices to change (66%); only 14% of growers expecting prices to stay the same. Many growers (20%) were uncertain about changes in price. All growers that expected pollinator prices to change in the future indicated that prices are expected to increase. This reflects the trend of increased rental prices nationwide.² The average price per honey bee hive was $\$154.73 \pm 1.71$ ($\pm$ se), with growers arranging contracts on average 10 months in advance.

Figure 3. Proportion of CA Almond growers using managed pollinators



Main pollinators used for almonds

Almost all California almond growers that buy or rent pollinators annually use honey bees only (Figure 3); only 1% of these growers reported using a combination of honey bees and wild bees. Other pollinators, such as blue orchard bees, can also be successfully managed for pollination in almond, but these alternative pollinators have not been widely adopted.

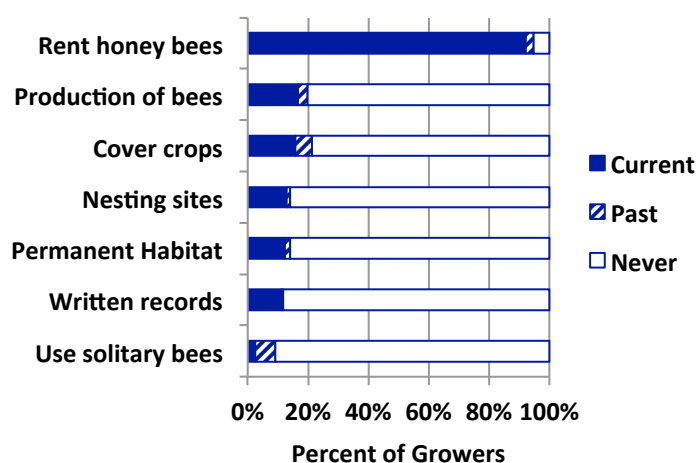
2. USDA ERS, 2012 http://www.ers.usda.gov/media/1679173/special-article-september_-pollinator-service-market-4-.pdf



6. Pollinator & pest management

We asked growers about their current pollinator and pest management practices, those that were tried in the past but discontinued, and practices that had never been used (Figures 4, 5: *Current* practices in solid bars, *Past* practices in striped bars, practices *Never* used in open bars; frequencies across categories sum to 100 for each practice).

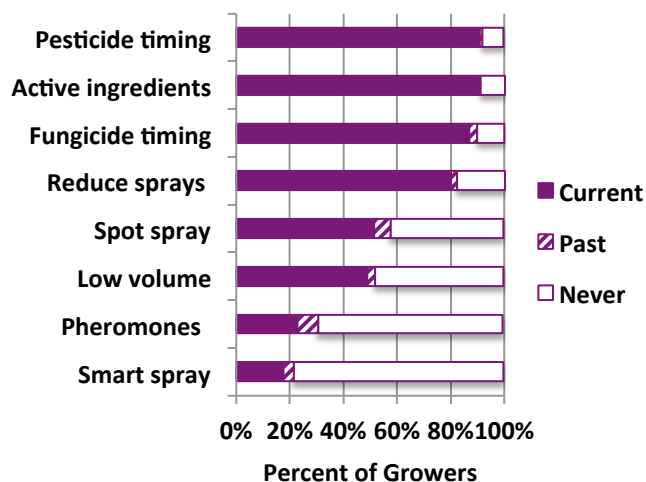
Figure 4: CA almond growers' pollination management practices



Honey bees: Renting managed honeybees is the most frequently reported current management practice (92% of almond growers).

Pollinator habitat: Practices of using habitat to attract and retain diverse pollinators had modest levels of adoption: 16% of growers encouraged pollinators using cover crops, 13% report creating bee nesting sites (e.g., installing bee boxes or maintaining areas of reduced tillage), and 12% of growers report encouraging pollinators with areas of permanent habitat.

Figure 5: CA almond growers' pest management practices



Pest Management Practices: 90% of growers make an effort to select active ingredients that have the least impact on bees in their pest management practices (Figure 5). Most California almond growers make an effort to time application of pesticides (91%) and fungicides (87%) to minimize impacts on bees.

Eighty percent of growers aim to reduce the number of spray applications used. Timing pesticide applications and monitoring active ingredients to protect bees are management practices that have been promoted through extension specialists, beekeepers and suppliers, and the Almond Board of California, which may help to explain their high rate of adoption.

Photo: Katharina Ullmann





7. Overview of California almond farms

The number of almond acres ranged from 156.3 to 537.0 acres, with an average of 235.5 acres. The acreage of counties surveyed is slightly larger than the average reported by the agricultural census (Table 2). However, the acres in almond production per farm is representative of the region.

Median total acres for surveyed counties were as follows: Fresno had a median of 100 acres, Glenn had 132 acres, Kern had 160 acres and Stanislaus had a total median of 57.5 acres. For almond acres alone, Fresno had a median of 95 acres, Glenn had a median of 132 acres, Kern had 167.5 acres and Stanislaus had 57 acres.

Table 2. ICP sample summary

County	Ag. Census 2012 Farm size (mean acres)	ICP Survey 2014-15		
		Farm size acres	Almond acres	Number of farms surveyed
Fresno	194	690.1	238.9	153
Glenn	147	650.7	418.1	40
Kern	144	1224.3	537.0	51
Stanislaus	137	246.8	156.3	304
Riverside	157	1412.0	233.5	2
Average	155.8	500.4	235.5	Total = 550

*Average farm size acreage reported in 2012 Agricultural Census, data available online: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/California

Integrated Crop Pollination is a relatively new strategy in California almond. New research and connections among growers, extension specialists, beekeepers, and are supporting investigation of which strategies are most practical and most profitable in almond orchards.

Integrated Crop Pollination Project

Integrated Crop Pollination (ICP) is the combined use of different pollinator species, habitat augmentation, and farm management practices to provide reliable and economical crop pollination.

For a full copy of the survey, visit:

http://icpbees.org/wp-content/uploads/2016/03/ICP_Survey_11-1-2014.pdf

For more information, visit our website at:

www.projecticp.org or find us on Facebook.

This project is funded by a USDA-NIFA Specialty Crop Research Initiative Grant (Award #2012-51-181-20105). This working paper is document number ICP-CAAL2016.1E.

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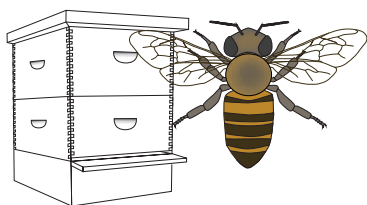
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Overview of Almond Pollination in California

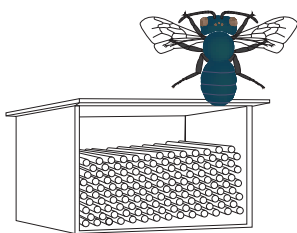
Most almond growers rent or own managed honey bees for almond pollination. Other bee species that can contribute to almond pollination in California include managed blue orchard bees (BOBs) and over 19 species of wild bees, including bumble bees (*Bombus* spp.), sweat bees, and a species of miner bee. Research from Northern California shows that nut set is higher when using a mix of managed BOBs and honey bees than when using honey bees or BOBs alone. In addition, in the presence of wild bees and flies, honey bees move more between varieties, increasing pollination and nut set. Taken together, this research emphasizes that in some orchards combining different pollinator species can help ensure reliable pollination.

Important California Bees



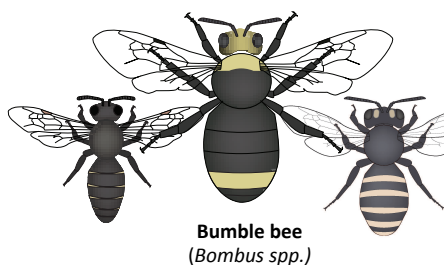
Honey bee
(*Apis mellifera*)

Honey bees are the most common visitor of almond flowers, making them essential for almond production. While honey bees can fly up to 3 miles from their hive, most prefer to forage on nearby flowers, so groups of hives within orchards or along orchard edges placed no more than 0.25 miles apart will help ensure even pollination throughout the orchard. Honey bees are usually removed from the orchards as soon as bloom is complete. The University of California recommends removing hives at 90% petal fall.



Blue Orchard Bees
(*Osmia lignaria*)

Some almond growers use **Blue Orchard Bees (BOBs)**, a managed pollinator that nest in wood or cardboard tunnels and fly under cooler and cloudier conditions than honey bees. BOBs are typically released into orchards at around 20% bloom and nests are removed from orchards 6-8 weeks after bloom finishes, before summer pest management activity. Studies show that planting floral resources near orchards can help increase BOB offspring numbers.



Bumble bee
(*Bombus* spp.)

Sweat bee
(*Lasioglossum* spp.)

Miner bee
(*Andrena* spp.)

Wild bees and flies visit almond flowers in many orchards, especially near riparian areas or other natural habitat. The more species of wild bees an orchard has, the better the nut set. Researchers found that 3 in 10 insects visiting almond flowers in Northern California orchards near natural habitat were non-honey bees. Wild pollinators were more common in organic orchards and orchards with flowering plants. Researchers found 19 species of wild bees, including a mining bee, sweat bees, bumble bees, a number of hover flies, and other insects pollinating almond.