Going Nuts for More Bees: Factors Influencing California Almond Pollination Fees

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Due to low almond prices, 2021 pollination expenses will be scrutinized. Using grower survey data, we find the following were associated with higher pollination fees and potential benefits for growers: contracting with a pollination broker compared to a beekeeper, an out-of-state beekeeper compared to one in California, and high colony strength compared to low-strength requirements.

Over the past two decades, expanding almond acreage and the corresponding demand for pollination services has increased almond pollination fees. Pollination costs now represent a substantial share of annual operating expenses for almond operations, rivaling both harvest and irrigation costs.

Currently, almond prices are roughly 30% below their 5-year average of $2.90/lb, while almond pollination fees are 7% above their 5-year average of $183/colony. Tight profit margins mean almond operations will closely scrutinize their pollination expenses as they establish contracts in the coming months. In this article, we investigate the factors that influence almond pollination fees using 2019 survey data collected from over 300 almond growers.

Background

Most almond varieties require cross-pollination for commercial production, so orchards contain multiple varieties. When almond trees begin blooming in mid-February, honey bee colonies are brought in to facilitate the transfer of pollen between varieties. Almond growers have traditionally relied on two colonies per acre to guarantee sufficient pollen transfer. In recent years, self-fertile varieties have been put into production. These varieties do not require cross-pollination, so an entire orchard can be planted with one variety. Self-fertile varieties still require bees to transfer pollen, but fewer colonies per acre can be used.

As almond acreage has increased over time, so has the demand for honey bee colonies (Figure 1). The demand far exceeds the supply of colonies within California, so colonies are shipped from all over the U.S. to pollinate almonds each February. Almond pollination fees have risen in response to this increasing demand to attract additional colonies. Beekeepers not already participating in California almond pollination may have relatively high transportation costs or the potential for honey production in their home state during almond bloom, thus requiring increased fees to ship their bees to California.

For the 2020 almond bloom, roughly 1.2 million almond acres required an estimated 2.4 million honey bee colonies for pollination; 1.9 million colonies these colonies were shipped into California from other states (Figure 1). In February 2021, an estimated 2.5 million colonies will be required for almond pollination, approximately 88% of the total colonies in the United States.

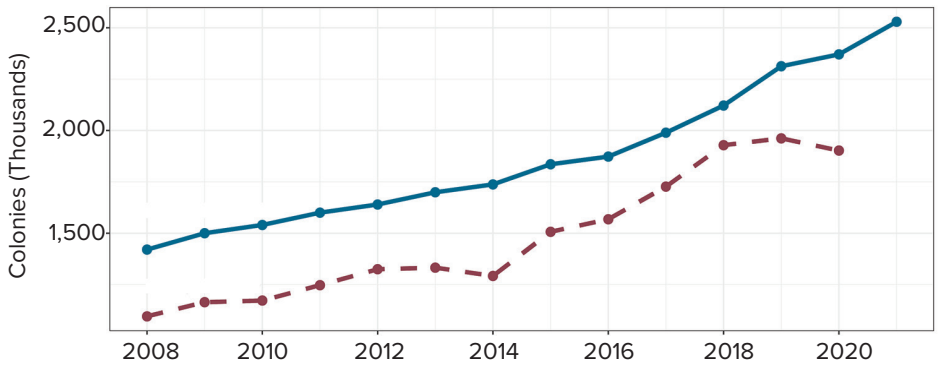
Colony Strength in Almond Pollination Contracts

A honey bee colony with a large population is able to provide more pollination services than a colony with a small population. Consequently, many growers provide incentives in almond pollination agreements for beekeepers to provide large colonies.

Almond bloom occurs in mid-February, when honey bee colonies are naturally at their smallest population due to the lack of pollen and nectar from flowering plants. Normally, a colony would begin increasing its population as flowers bloom in early spring. However, to deliver a colony with a large population at the beginning of almond bloom, a beekeeper must supplement a colony with pollen or a pollen substitute to stimulate population expansion weeks before bloom begins.

Due to the clustering nature of the honey bee colony within a hive (the physical box containing the colony), industry participants use a standard of

Figure 1. Estimated Demand for Almond Pollination Services and Colony Shipments into California, 2008-2021



Sources: Apiary Shipments through California Border Protection Stations, CDFA Plant Health and Pest Prevention Services; USDA NASS 2008–2019 Almond Acreage Reports

Note: Estimated demand calculated as 2 colonies/acre for traditional almond varieties and 1 colony/acre for self-fertile varieties.

Table 1. Average Almond Pollination Fees by Average Colony Strength Requirement, 2015 and 2019

Minimum Average Colony Strength Requirement	2015 Survey (N=74)			2019 Survey (N=205)			
	Percentage of Responses	Average Pollination Fee	Premium/Discount compared to 8-frame	Percentage of Responses	Average Pollination Fee	Premium/ Discount compared to 8-frame	Percentage Change in Real Pollination Fees 2015-2019
No. of Frames	Percent	2019 U.S. Dollars	Percent	Percent	$US Dollars	Percent	Percent
<6-frame	5	$179.73	-1.9	10	187.25	-3.1	4.2
6-frame	7	$177.05	-3.4	24	189.96	-1.7	7.3
7-frame	7	178.12	-2.8	8	191.41	-1.0	7.5
8-frame	61	183.27	-	48	193.30	-	5.5
>8-frame	20	187.57	2.3	10	205.28	6.2	9.4
Average		183.17			192.78		5.2

Sources: 2015 Almond Pollination Contract Survey, B. Goodrich and R. Goodhue, 2015;
2019 Survey on Bee-Friendly Practices in Almond Orchards, J. Durant and E. McNamara, 2020
Note: 2015 fees adjusted to 2019 dollars using U.S. Bureau of Economic Analysis GDP Implicit Price Deflator.

measurement to estimate the size of a colony: counting the number of active frames within a hive. An active frame meets one of two criteria: 1) bees cover at least 75% of both sides of a standard frame of comb within the hive, or 2) at least four bees per square inch of comb are present.

Almond pollination contracts can contain many types of colony strength requirements, but the most commonly used is the minimum average (active) frame count. To determine the average frame count for the colonies in an orchard, typically 10–25% of the colonies are inspected to determine the number of active frames in each colony. The inspector averages the active frame counts across the sample. If the average frame count across the sample does not meet the minimum specified in the contract, the grower may request an increase in the number of colonies brought in to make up for the shortfall or may impose monetary penalties.

Almond Pollination Fees

In December 2019–February 2020, researchers at UC Davis and Duke University conducted an online survey of over 300 almond growers to better understand pollination decisions. The sample represented roughly 14% of almond acreage in 2019. Of the 321 growers who participated in the survey, 273 rented some or all of their honey bee colonies for almond pollination in 2019, 18 had almond orchards not mature enough for pollination, and 28 were integrated beekeeping/almond operations that supplied all of their own bees for pollination.

Colony Strength Requirements

Among the growers who rented colonies, 75% of the respondents received the minimum colony strength requirements associated with their largest almond pollination contract. The remaining 25% may have not known or not required a minimum colony strength.

Table 1 shows the average almond pollination fee by the minimum average frame count requirement for growers' largest pollination contracts in 2015 and 2019. Pollination fees in 2015 were converted to 2019 dollars to adjust for inflation. The 2015 data come from a survey conducted at the 2015 Almond Conference. The 2015 survey has a smaller sample size than the more recent survey. However, paired together these surveys provide the first documentation of how fees have changed across colony strength categories over time.

Across both surveys, the 8-frame minimum average frame count was the most frequently used colony strength requirement. It is clear across both surveys that pollination fees increase as the colony strength requirement increases. This reflects both the value of increased pollination services from larger colonies, as well as increased inputs from the beekeeper.

Across all colony strength requirements, inflation-adjusted pollination fees increased by 5% between 2015 and 2019. This varied by category: the highest colony strength requirement of a minimum average above 8 frames increased by 9% on average, while the smallest colony strength requirement of less than 6 frames increased by 4%. The premiums associated with the highest colony strength category went from 2% to 6% above the 8-frame minimum average. This increase in premium could reflect either increased costs associated with beekeepers supplying high-strength colonies, and/or an increase in the demand for high-strength colonies relative to 8-frame colonies.

Pollination Provider

Approximately 28% of respondents said an independent almond pollination broker supplied some or all of their colonies in 2019. Typically, a pollination

broker will contract with multiple beekeepers and multiple growers and act as a middleman, coordinating colony placement and payments with beekeepers and growers individually.

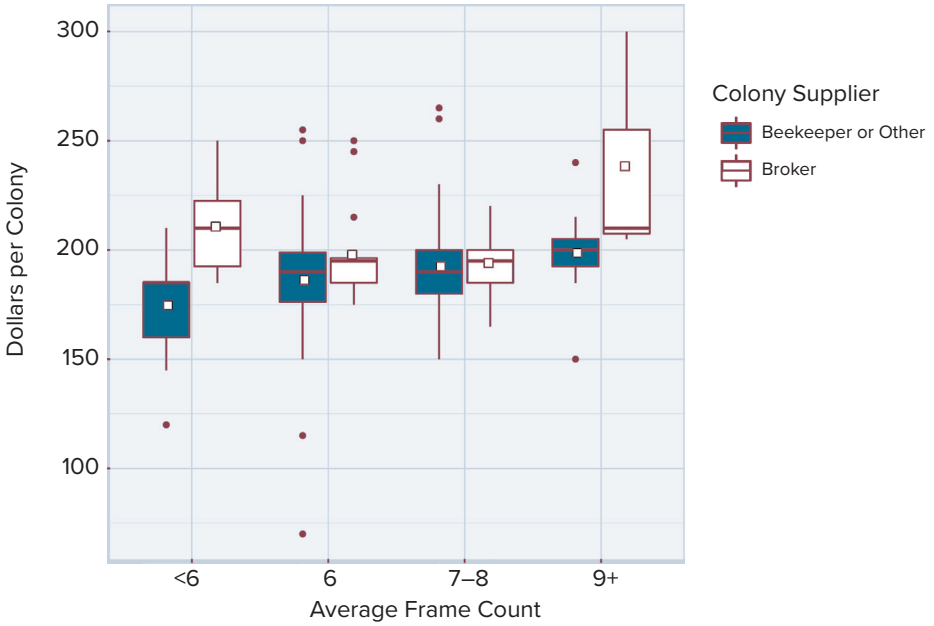
Brokers provide a service by taking on risks on both sides of almond pollination agreements. Brokers can guarantee timely payments to beekeepers, guaranteeing little to no risk the beekeeper will not be paid. Brokers also ensure growers receive the number and strength of colonies desired. For example, if a beekeeper comes up short on the contracted number (or strength) of colonies due to adverse colony health issues, the broker will find additional colonies to fill the grower's contract.

To take on risk from the contracting parties, pollination brokers charge the grower more money than they pay out to the beekeeper, taking the difference as the brokerage fee. Figure 2 shows box plots of almond pollination fees separated by colony strength category and whether the grower contracted with a broker or another pollination provider (direct with beekeeper, another grower, or other). The white squares in Figure 2 display the average fee for each group. Within each colony strength category, colonies contracted through a broker were more expensive on average than those contracted through another supplier. On average, growers paid $9.50 more per colony when contracting through a pollination broker compared to other sources.

Origin of Colonies: Within California or Out of State

Out-of-state colonies are shipped into California by the semi-truckload, typically in amounts of 400–450 colonies per truck. Shipment costs vary based on the distance traveled. Costs to ship colonies from the Pacific Northwest range from $10 to $14/colony, while shipment from the Northeast can cost up to $50/colony. Thus, higher fees are necessary to get participation from beekeepers further away. On average, growers paid $7 more per colony for colonies originating outside of California compared with colonies from within.

Figure 2. Box Plots of Almond Pollination Fees by Colony Strength Category and Pollination Provider, 2019



Source: Survey on Bee-Friendly Practices in Almond Orchards, J. Durant and E. McNamara, 2020

Note: Box plots represent the distribution of fees within each group where groups are separated by colony strength category and whether the grower obtained colonies through a broker or beekeeper. The lower and upper sides of each rectangle are the 25th and 75th percentiles of each group's fee distribution. The horizontal line in each rectangle represents the group median, white squares represent the group average, and red circles represent outliers in each group. Within each colony strength category, on average brokers charged more than beekeepers.

Regional Variation in Almond Pollination Markets

There are three regions of almond production in California: Sacramento Valley (SV), Northern San Joaquin Valley (NSJV) and Southern San Joaquin Valley (SSJV). Due to differences in almond production conditions, e.g., irrigation water availability and microclimates, one would expect pollination markets to vary regionally as well. For example, the SV is home to many queen and packaged bee producers who keep colonies in California year-round, while NSJV and SSJV have much more almond acreage requiring pollination than the SV.

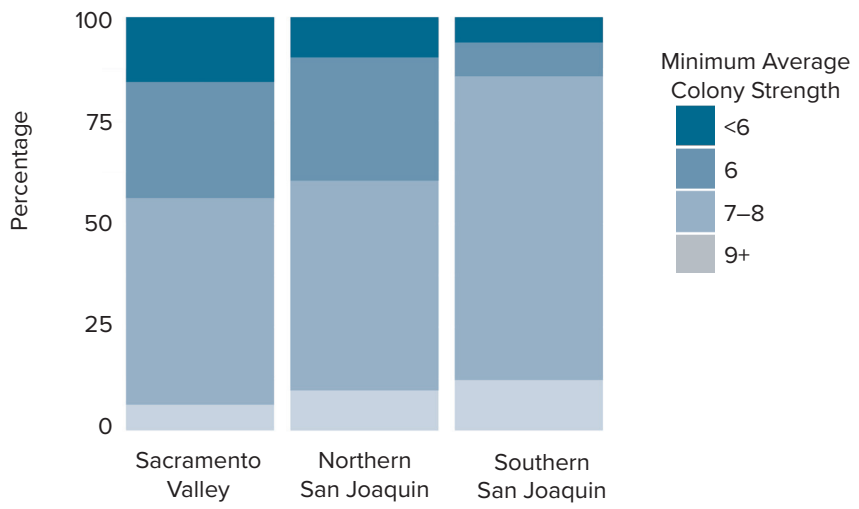
Table 2 shows regional variation in characteristics of almond pollination markets, and Figure 3 shows the percentage of each colony strength category required for each region. As discussed in the previous sections, one would expect that markets with a higher percentage of brokered colonies, a higher percentage of out-of-state beekeepers, and higher colony-strength requirements on average would result in higher average pollination fees.

Table 2. Regional Almond Pollination Market Characteristics, 2019

Region	Average 2019 Pollination Fee	Respondents with Out-of-State Beekeepers	Respondents Using Broker
	($/Colony)	Percent	
Sacramento Valley (SV)	200.86	33	23
Northern San Joaquin Valley (NSJV)	190.41	55	28
Southern San Joaquin Valley (SSJV)	196.34	40	32

Source: Survey on Bee-Friendly Practices in Almond Orchards, J. Durant and E. McNamara, 2020

Figure 3. Percentage Minimum Average Colony Strength Requirement by Region, 2019



Source: Survey on Bee-Friendly Practices in Almond Orchards, J. Durant and E. McNamara, 2020

The NSJV and SSJV regions were relatively similar in most characteristics, except for colony strength requirements. Over half of the respondents in the NSJV region received colonies from out of state, compared to 40% in the SSJV. The percentage of respondents who contracted through an independent pollination broker was similar across the two regions: 28% in the northern region and 32% in the southern region. Roughly 86% of SSJV respondents reported colony strength requirements of 7 frames or higher, compared to 60% in the NSJV. Corresponding with these higher colony strength requirements, pollination fees in the southern region were on average $6/colony higher than that of the northern region.

The SV was an outlier with respect to the previously discussed fee determinants. It had the lowest percentage of respondents receiving colonies from out of state, the lowest percentage of respondents contracting through a broker, and the lowest percentage of colony strength requirements above 7-frames, yet it had the highest average fee. One explanation is that the SV growers in the sample may have smaller orchards compared to the NSJV and SSJV. Logistically, it is less costly for beekeepers to drop many colonies at once. If a beekeeper must make many colony placements in a large number of small orchards, the grower may have to pay the beekeeper more per colony to cover those costs.

Another potential explanation is that many queen bee producers in the SV have an effect on the market. Queen bee operations depend heavily on the health of their managed colonies at the beginning of the year so that they can supply other beekeepers with bees in the spring. Outside colonies coming within 3 miles of the queen producers' colonies may result in the spread of pests and diseases. Because many growers and beekeepers have worked together for many years, it is possible that a queen producer might insist that any outside colonies brought into the area go through extensive pest and disease health checks. The expense of this may require higher pollination fees.

Conclusions

Growers need to consider the value associated with pollination decisions in addition to the cost. Contracting for colonies through a pollination broker, from an out of state beekeeper, or above the 8-frame colony strength were associated with higher fees. However, each of these may provide benefits to the grower in excess of the premiums paid. Using a pollination broker or contracting from a portfolio of beekeepers from in and out-of-state will likely decrease risks associated with colony health. Contracting higher-strength colonies may allow growers to employ fewer colonies per acre.

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For additional information, the authors recommend:

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