



Proof of a successful pollination job is a good crop set. Almonds here are silhouetted against a full frame of pollinator honeybees. Almond growers and beekeepers both may profit by adopting a multiple rental price structure for almond pollination based upon colony strength.

Assuming that the amount of almond pollen collected by bees, and the number of blossoms pollinated have a direct correlation, meaningful grades can be established for honeybee colonies with active laying queens for use in almond pollination. Pollen collection records for two years in five almond orchards in Fresno County indicate that colonies can be graded into five strength groups for almond pollination. Grading can be done visually by determining the number of frames covered on both sides with bees in each colony. These grades can be useful in defining bee colony strengths in almond pollination agreements. Grading of colonies for strength could lead to a multiple rental price structure for almond pollination.

**F**OR THIS STUDY of the value of colony strength, 143 colonies of honeybees were placed in two almond orchards on the east side of Fresno County in 1970. The number of frames covered with bees on both sides was used to subjectively determine colony populations. Each colony was graded four times under similar conditions to assure reasonable accuracy of its strength prior to the beginning of pollen trapping. Pollen was collected from each of the 143 colonies twice during a period of seven days from February 18 to 24, 1970. An additional three days' collection of pollen was made with 99 of the colonies, resulting in 10 days of pollen collection.

TABLE 1. POLLEN AND COLONY COLLECTION DATA

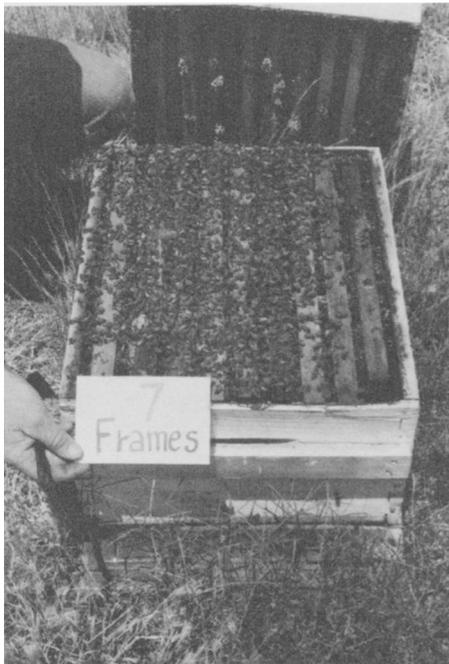
Frames of bees per colony	Seven-day collection period			Ten-day collection period		
	Colonies	Pollen per colony	Per cent of 4-frame colony collection	Colonies	Pollen per colony	Per cent of 4-frame colony collection
No. 1	No. 5	Av. grams 1.7	% 2	No. 1	Av. grams 14.0	% 6
2	4	12.1	10	2	51.2	22
3	19	51.8	44	11	131.6	58
4	19	116.9	100	13	228.5	100
5	22	126.4	108	11	261.1	114
6	11	211.3	181	9	369.0	161
7	8	186.7	160	7	353.6	155
8	14	278.5	238	12	529.6	232
9	4	276.1	236	4	730.3	320
10	3	273.0	234	3	680.4	298
11	3	310.4	266	2	844.7	370
12	4	363.9	311	3	1,074.3	470
13	5	246.2	211	4	560.4	245
14	1	410.8	351	1	863.0	378
15	5	437.0	374	3	936.4	410
16	6	517.2	443	5	910.7	399
17	3	379.1	324	3	760.6	333
18	7	477.0	408	5	906.9	397

TABLE 2  
ALMOND ORCHARDS 1, 2, & 3 COMBINED—1969

Frames of bees per colony	Colonies	Six-day collection pollen per colony	Per cent of 4-frame colony collection
No. 1	No. 8	av. grams 3.7	% 2
2	5	35.4	15
3	18	164.5	71
4	28	230.9	100
5	16	303.9	132
6	16	532.2	231
7	13	488.3	212
8	4	773.2	335
9	4	616.0	267
11	1	1,091.4	—

# STRONG HONEYBEE COLONIES PROVE VALUE IN ALMOND POLLINATION

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The minimum standard colony for almond pollination has four frames covered with bees and an actively-laying queen.

The combined almond pollen collection results for colonies with different strengths used in 1970 are listed in table 1. Results are expressed as average grams of almond pollen collected per colony during the seven-day and ten-day collection periods and as a percentage of pollen collected by four-frame colonies. (A *minimum* standard colony of honeybees for almond pollination was defined in 1968 by the California Beekeepers Association as having an actively laying queen and four frames completely covered with bees at the beginning of almond bloom.)

### Comparable results

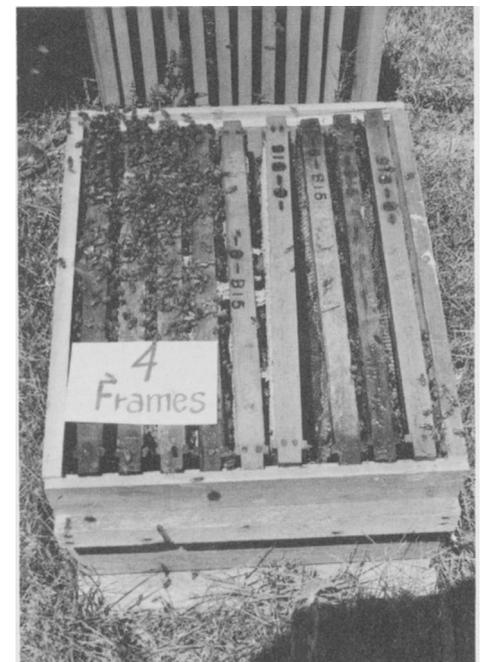
The 1970 results compare favorably with those obtained in 1969 in the same geographical area, although, different weather conditions existed during these two years. Table 2 lists the combined almond pollen collection results from the 113 colonies and three almond orchards used in 1969.

Pollen collection records from the five orchards during 1969 and 1970 included 256 honeybee colonies with population strengths ranging from one frame to 18 frames covered with bees on both sides. All colonies had active laying queens during the pollen collection periods. Pollen collection data from colonies without brood and laying queens were eliminated

from the experiment results. During both years colonies without queens or brood collected far less pollen than queen-right colonies with brood.

Results of these experiments over a two year period indicate that queen-right honeybee colonies can be classified into five strength groups for almond pollination. These groups include colonies with: (1) less than three frames covered on both sides with bees, (2) three frames of bees, (3) four and five frames of bees, (4) six and seven frames of bees, and (5) colonies with eight or more frames of bees.

Group 1 appears to be of no practical value to almond growers for pollination



The number of frames covered with bees in a queen-right colony can be used to visually establish colony-strength grades for almond pollination.

TABLE 3. AVERAGE WEIGHT OF POLLEN COLLECTED BY COLONIES OF FIVE POPULATION STRENGTH GROUPS, EXPRESSED AS PER CENT OF GROUP 3

Experimental colony group	Group 1 (0-2 frames)*	Group 2 (3 frames)	Group 3 (4-5 frames)	Group 4 (6-7 frames)	Group 5 (8 or more frames)
	%	%	%	%	%
1969 (6 Days Collection from 113 Colonies)	6.2	63.9	100	199.1	286.9
1970 (7 Days Collection from 143 Colonies)	5.2	42.4	100	164.7	292.4
1970 (10 Days Collection from 99 Colonies)	16.0	54.1	100	148.8	305.9

\* The equivalent number of frames covered on both sides with bees.



Pollen was collected in front entrance traps after all cracks in the hive body were sealed shut with masking tape, allowing entrance only through the pollen trap.

purposes. Group 2 collected about one-half the weight of pollen collected by group 3 during 1969 and 1970. Group 4 collected more than one and one-half times the pollen collected by group 3; and group 5 collected almost three times the weight of pollen collected by group 3. Table 3 lists the comparative relationships of pollen collection results for these five colony strength groups during 1969 and 1970. Results are expressed as a percentage of the pollen collected by colonies in strength group 3.

#### Colony strength survey

To accompany the "pollen collection, versus colony strength" study, a survey was conducted in Fresno County during both 1969 and 1970 to determine the strengths of bee colonies used to pollinate the county's almond crop. Written permission was obtained from beekeepers for the purpose of inspecting their colonies at random for strength. It was agreed that specific results would be reported to the beekeeper only, and that only a summary of the county survey results would be made public.

Up to 36 colonies were inspected at random in each of 28 orchards in 1969, and in 22 orchards in 1970. This represented bee colonies from 37 beekeepers. Beekeepers were not notified which orchards would be included in the survey. Results of the two surveys are summarized in table 4.

TABLE 4  
PER CENT OF SURVEYED COLONIES IN EACH  
STRENGTH GROUP IN FRESNO COUNTY  
FOR 1969 AND 1970 ALMOND POLLINATION

Strength Group	1969	1970
	%	%
1 (0-2 frames)*	21.6	1.4
2 (3 frames)	14.9	1.6
3 (4-5 frames)	24.6	6.8
4 (6-7 frames)	15.1	11.3
5 (8 or more frames)	23.8	78.9

\* The equivalent number of frames covered on both sides with bees.

Colonies were much stronger for almond pollination during 1970 than in 1969. A combination of three factors can be credited for this difference. Many beekeepers fed their colonies during the fall and late winter of 1969 to build colony populations for almond pollination. The late spring rains of 1969 in Fresno County provided more than the normal weed and range plant pollen and nectar sources. This allowed beekeepers to enter the 1969 winter with much stronger colonies than in the previous year. An awareness of the minimum colony strength standards adopted in 1968 in California may have encouraged the combining or culling of some colonies prior to the 1970 almond bloom period.

The 1970 survey strength average of 11.2 frames of bees per colony during almond bloom is far greater than that which can be expected following an average or below average rainfall year. The 1969 survey strength average of 5.3 frames of bees per colony is less than should be expected following an average rainfall year.

If beekeepers are to provide strong colonies for almond pollination in California, both feeding and grading of colonies are tools that may be used to advantage. Both of these procedures can help almond growers improve their crop pollination and increase subsequent yields. Beekeepers who provide strong pollinating colonies need to be paid for the additional management expenses involved. Almond growers and beekeepers both can profit by adopting a multiple rental price structure for almond pollination based upon colony strength. It seems logical that written almond pollination agreements in the future should financially encourage the use of strong honeybee colonies.

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# Effects

## performance

Under mild winter conditions in California's Central Valley (mean temperature about 50°F) moderate amounts of artificial wind had no effect on beef cattle performance. Artificial rainfall reduced performance somewhat, depending on the amount of "rain." Muddy pens seriously affected production, reducing the rate of gain by about 35 per cent and increasing the amount of feed required per lb of gain by about 25 per cent.

CATTLE FEEDERS in the Central Valley of California have reported higher production costs in winter compared with other times of the year—costs which presumably are due to slower rates of gain and poorer feed conversion. Winter temperatures in the Valley are well above those usually considered detrimental to beef cattle. However, other factors associated with winter such as wind, rain and mud were considered as possible causes of reduced performance. These factors were studied in controlled experiments for three years at Davis. Tests were conducted from January 17 to June 5, 1967 (139 days); from February 18 to April 15, 1969 (84 days); and from December 2, 1969 to March 27, 1970 (112 days). Eight animals initially weighing 500 to 600 lbs were used in each treatment, and were fed a high-energy feedlot ration.