Winter Conditions in Commercial Colonies in Louisiana[1,2]

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Introduction

IN the early 1960's, beekeepers in the southeastern United States, primarily Louisiana and Texas, complained of large-scale losses of colonies of honey bees, *Apis mellifera* L. Colonies in some apiaries dwindled severely or even died without apparent cause while other apiaries within a mile or two were unaffected. Few dead bees were found on the bottom boards or in front of the entrances, even when only a handful of worker bees and a queen remained. Also, no dead brood was observed. Oertel (1965) reported that several thousand colonies were lost in south-central Louisiana and northeast Texas within 3 months in the autumn of 1963. He suggested that "fall dwindling" more properly described the malady, but beekeepers of the area referred to it as "disappearing disease." In California, beekeepers lost approximately 10,000 colonies during the fall of 1964 to an apparently similar problem which was given the name "autumn collapse" (Foote 1966).

The heavy losses of honey-bee colonies during the autumn of 1963 in the southeast and in California in 1964, prompted research and regulatory personnel to monitor a number of affected apiaries in these areas and to conduct laboratory tests in hope of determining the cause(s) of such unusual losses. Oertel (1965) concluded that no transmissible disease (e.g., acarine disease, Nosema disease, paralysis, septicemia), pesticide, or naturally poisonous honey or poisonous pollen was the cause of the disappearing bee problem in the southeast. Foote (1966), after extensive studies of the California problem, ruled out the same possibilities considered by Oertel. However, Foote suggested that the California problem might be caused by a fungal toxin (aflatoxin) produced by an interaction between the mold *Aspergillus flavus* Link, ex Fries, and the honeydew available to bees in some of the problem areas; he also stated that feedings of sugar syrup containing a small amount of pollen or the transfer of colonies to blossoming, ladino clover were the only treatments among many, including the addition of bees, that brought about substantial improvement in severely affected colonies. (Whether the disappearing bee problems in California and in the southeastern United States had the same cause is still unclear.)

In Indiana, Kentucky, and Tennessee the "disease of 1868" appeared during the months of September and November and caused wide-spread losses of entire apiaries. Symptoms reported consisted of few or no bees, some honey, and little or no pollen or brood. (Anon., 1869.) Beekeepers with many years of experience had seen nothing similar. However, the problem of "disappearing" bees has appeared sporadically from 1965 to the present in some areas of some southern states. One operator in southern Louisiana who had verified losses of several hundred colonies in the fall of 1963 reported a similar loss of more than 100 colonies in a queen yard from January to February 1969. Thus, the large losses of colonies can apparently take place later in the winter season of some years. Also, the problem in Louisiana appears to occur only after extended dry periods (Dr. W. C. Roberts, formerly Investigations Leader, Bee Stock Center, Baton Rouge, ARS, USDA, personal communication.)

Inadequate pollen supplies from plants affected by unusually dry weather could prevent or drastically restrict brood rearing during late summer and autumn. Following such pollen dearths, the death of old bees with few or no emerging bees available for replacement and overwintering would result in a rapid decrease in the populations like those observed in Louisiana and California. The severity of the reduction of the populations of individual colonies might be expected to vary somewhat according to such factors as initial colony strength, pollen reserves at the beginning of the dearth, types and quantity of pollen plants, nutritive value of pollens available to each apiary, and weather conditions following the dearth period.

We decided to study 3 commercial apiaries in Louisiana to obtain a better picture of colony conditions through the fall and winter months. Because the incidence and infection levels of Nosema disease are considerably higher in the southeastern and south central states than in California (Foote, 1971; Doull and Eckert, 1962; Oertel, 1964) and since Nosema increases substantially during the autumn in some years (Oertel, 1964), we monitored the amount of Nosema infection in the test colonies to determine whether the disease might contribute to abnormal reductions in the populations of the study colonies.

Methods and Materials

Colony Treatments

Four apiaries containing approximately 40 colonies each were selected for the test. A USDA laboratory apiary (Ben Hur) in the Baton Rouge area was a check and was operated by USDA personnel throughout the test. The three other apiaries, designated Dow 1, Dow 2 (Plaquemine, Louisiana), and the Home Yard (Donaldsonville, Louisiana) were operated by a commercial beekeeper who allowed us to use the colonies for this test.

After we had inspected and equalized the colonies in the 4 apiaries, 20 in each apiary (total of 80) were chosen, cleaned, and marked. Thereafter, 10 of the 20 in each apiary were fed a ½-lb cake of 40% soybean flour (expeller processed) and 60% Drivert® every 2 weeks; the others did not receive any supplementary feeding.

Other data taken consisted of measurements of square inches of brood, pollen, and honey. The soybean + Drivert cakes were weighed at 2-week intervals to determine the rates of consumption and then replaced with fresh cakes.

The amounts of floral nectar and pollen available to the colonies were not equal in each of the 4 apiaries. However, goldenrod (bloomed September 15 — November 15, 1971) and red maple (bloomed December 20 — January 17, 1971) were available at all four localities and were the primary sources of nectar and pollen.

Table 1. Longevity of caged forager bees[1] from four different apiaries (maintained on a liquid sucrose diet at 88° plus or minus 4° F).

Apiary	History of disappearing problem	Average number of bees per cage[2]	Average number of days to 50% mortality
	Bees Collected Oct. 2-5		
Ben Hur	No	177.9	13.0
Dow 1	Yes	152.7	12.0
Dow 2	Yes	167.8	10.6
Home	Yes	162.9	17.4
	Bees Collected Nov. 12-17		
Ben Hur	No	144.4	6.9
Dow 1	Yes	161.7	6.9
Dow 2	Yes	178.7	5.3
Home	Yes	173.0	7.3

[1] Bees were collected during morning hours with entrance traps.
[2] Average of 10 cages per apiary.

Longevity Studies

Ten cages of approximately 150 forager bees each were collected in each apiary during the morning with entrance traps on October 2-5 and November 12-17, 1970. These caged bees were then held in an incubator at 88° F, and 60% sucrose solution was provided as the only food source. Dead bees were removed daily from the cages and counted to determine the postcapture longevity.

Prevalence of Nosema

Three times from September to February, adult honey bees were trapped at hive entrances with a sampling device designed at this laboratory. Then the level of Nosema in each apiary was determined by averaging the spore counts obtained from bees from all 20 colonies. The counts (two per colony) were made with an improved Neubauer type Levy® hemacytometer after suspensions were prepared by homogenizing the abdomens of 100 bees/colony in 100 ml of distilled water with a Sorvall Omni-Mixer.®

Results

Table 1 shows that forager bees collected October 2-5 lived twice as long as those collected November 12-17. Also Table 2 shows a drastic reduction in brood rearing and a 50% reduction in the amount of stored pollen between the 2 dates. The first group of bees was collected when the amount of stored pollen was twice as high as that prevailing when the second group was collected.

The counts of 0.22 x 10^6 spores/bee of *Nosema apis* Zander in the Ben Hur Yard indicated a relatively low level of infection during the period of September 18-24, 1970 (Table 3), which is in agreement with previous data obtained in Louisiana by Oertel (1964) and the 0.01 x 10^6 spores/bee by Kauffeld (1973). In the Ben Hur Yard, by the February 16-23, 1971 sampling period, the infection rose to a relatively high level of 4 x 10^6 spores/bee, which was less than the 26 x 10^6 spores/bee observed by Kauffeld (1973). However, the increased levels of infection found in the 4 test yards were not high enough to markedly affect the colony populations. Also, data in Table 2 show that brood rearing increased steadily after November 11, 1970, but that a sharp decline in the square inches of brood occurred between the October and November sampling dates. Kauffeld (1973) showed that brood rearing, even with nuclei, can be continuous throughout the winter months in Louisiana. The primary floral sources for pollen during fall and early winter of 1970 in Louisiana were goldenrod (*Solidago* sp.: September 15 — November 15), smartweed (*Polygonum* sp.: September 15 — November 20), small and great ragweeds (*Ambrosia bidentata* Michx and *A. trifida* L.: September 17 and 20 — October 28 and 23, respectively) and asters (*Aster* sp.: October 3 — December 12).

Table 3. Nosema apis spore levels from bees collected at hive entrance.[1]

Apiary	Avg. number of spores/bee (X 10^6) 9/18-24	11/12-17	2/16-23
Ben Hur	0.22	0.40	4.00
Dow 1	0.23	0.43	1.31
Dow 2	0.41	0.69	2.50
Home	0.43	0.23	2.36

[1] Average of 100 bees/colony from 20 colonies in each apiary.

Discussion

In October 1970, heavy rains further reduced the availability of pollen, which had been affected previously by markedly restricted plant growth because of a dry period. This reduction in the supply of pollen is reflected in a substantial decrease in brood rearing. Also, the amount of honey stored during the study period exhibited a typical trend: an increase apparent at the November sampling date resulting from the fall flowers was followed by a gradual decline during the period November to January. A more pronounced drop in honey stores was recorded in February at the time of the spring increase in brood rearing when the stored pollen increased (Table 2). This latter increase coincided with the availability of

Table 2. Winter conditions found in 2-story hives of 30 commercial and 10 laboratory colonies in the Baton Rouge area.

Date	Average number of square inches: Brood Comm.	Brood Lab.	Pollen Comm.	Pollen Lab.	Honey Comm.	Honey Lab.
			Bees not fed soybean + Drivert			
10/70	892.6	918.6	182.3	189.9	942.0	1,567.7
11/70	116.8	28.5	59.6	46.5	1,377.9	1,717.1
12/70	136.5	78.5	19.1	46.6	1,228.0	1,400.3
1/71	211.6	385.5	145.1	162.1	1,063.1	1,202.3
2/71	605.9	966.4	98.0	72.9	687.5	275.6
			Bees fed soybean + Drivert			
10/70	1,209.5	924.8	179.6	262.4	1,007.5	1,489.7
11/70	146.2	69.8	64.0	87.7	1,249.9	1,348.8
12/70	151.3	117.8	96.5	76.8	1,129.8	1,236.0
1/71	174.3	417.8	139.0	209.2	1,013.4	1,001.3
2/71	684.6	540.4	106.9	73.9	660.6	640.6

pollen from red maple (*Acer* sp.), which bloomed from December 20, 1970 to January 17, 1971.

The monitored colonies did not show any signs of the so-called "disappearing disease," but a typical reduction in brood rearing was observed from the latter part of October until the blooming of red maple. The stores of honey remained adequate through the winter, and populations in the colonies increased rapidly as a result of the stimulus of the red maple pollen (Table 2). Since bee colonies can forage almost daily throughout winter in the southern part of Louisiana and other Gulf Coast States, some colonies in these regions may require pollen in the form of supplemental feeding to permit brood rearing and subsequent replacement of older foraging honey bees that die. Without a continuous replacement of adult bees, the populations of weak colonies could dwindle rapidly and die, as in disappearing disease. Although the peculiar collapse of honey bee populations was not observed in any of the colonies monitored, it seems likely that such occurrences in the southeastern United States are related to abnormally low supplies of late summer and autumn pollen. This contention is supported by Foote's report (1971) relating similar situations in California to areas of known pollen dearths and to the fact that many of the 100's of dead colonies observed by Oertel in Louisiana during 1963 had little or no pollen and no brood.

Acknowledgment

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FOOTNOTES

[1] In cooperation with Louisiana Agriculture Experiment Station.

[2] Mention of a commercial or proprietary product in this paper does not constitute an endorsement of this product by the USDA.

DESERET —

(Continued from Page 215)

not willing to try the name a fourth time. Sentiment against the name was best expressed by the statement, "Deseret may be a sweet name but it has a sting."[14] Unfortunately, even a name change could not convince Congress to accept Utah as a state because the anti-polygamy feeling in Washington was too strong.

Fortunately, the polygamy question was finally resolved and laws were passed against it, both on the national level and in the territory of Utah. This action removed the last obstacle to statehood and on January 4, 1896, President Grover Cleveland proclaimed the admission of the 45th state, Utah.

The name, Deseret, is now almost forgotten, at least on a national level though it does survive in some business and religious names in Utah. The most obvious surviving remnants of the honey bee state are the Great Seal of Utah which depicts a beehive and Utah's nickname, the Beehive State (see figure 1). Under slightly different conditions the introduction to this article might have actually occurred and the honey bee would have had a state for its namesake.

END NOTES

[1] **G. O. Larson,** Outline History of Utah and the Mormons (Salt Lake City, 1958), pp. 21-22.

[2] **Ibid.,** p. 18.

[3] **D. W. Morgan,** The State of Deseret, Utah Historical Quarterly, (Salt Lake City, 1940), **Vol. 8,** p. 68.

[4] **Ibid.,** p. 89.

[5] "And they did also carry with them deseret, which, by interpretation, is a honey bee; and thus they did carry with them swarms of bees . . . ." Joseph Smith, Jun., The Book of Mormon (Salt Lake City, 1949), **Ether 2:3,** p. 480.

[6] **E. G. Reynolds,** A Dictionary of the Book of Mormon (Salt Lake City, 1891), p. 170.

[7] **D. W. Morgan,** The State of Deseret, Utah Historical Quarterly (Salt Lake City, 1940), **Vol. 8,** p. 86.

[8] **Supposed oath:** "You do solemnly swear in the presence of almighty God, his holy angels, and these witnesses, that you will avenge the blood of Joseph Smith on this nation, and teach your children; and that you will from this time henceforth and forever begin and carry out hostilities against this nation, and to keep the same intent a profound secret now and forever. So help me God.
Miscellaneous Documents Printed by Order of the House of Representatives During the First Session of the Thirty First Congress, Misc. Doc. No. 43, rec'd December 31, 1849 by the U.S. House of Representatives.

[9] **Report of Committees,** 1st Session, 31st Congress, **Vol. 2** (1849-1850), Report No. 219.

[10] **D. W. Morgan,** The State of Deseret, Utah Historical Quarterly, (Salt Lake City, 1940), **Vol. 8,** p. 120.

[11] **Ibid.,** pp. 111-113.

[12] **Ibid.,** p. 137.

[13] **Ibid.,** pp. 148-149.

[14] **Ibid.,** p. 153.

SWEET CORN —

(Continued from Page 213)

amounted to 0.8 sprays or an estimated $180 per field (based on spraying costs of $4 per acre in an average field of 50 acres). All sprays during bloom were eliminated, and several cooperating companies were able to reduce their insecticide control costs by half. Other processors in the immediate vicinity applied approximately 2.5 sprays per field at a cost of $400 to $500. Lima bean yields in 1973 averaged 1780 lbs. per acre compared to the Maryland average of 1650. Defective bean levels never exceeded 2.4% in any field compared to the tolerated 5% level for most companies. These results indicate that the average processor was applying more insecticide control on lima beans than was necessary to produce a normal yield with normal quality. The results also demonstrate that potential savings in control costs by pest management will more than defray the scouting costs.

The corn and bean pest management program in Maryland has a ways to go, but already several companies have modified their field operations to include the sampling and decision-making procedures developed by the program. The federal monies are limited for this program, but hopefully sweet corn and beans among other crops in Maryland can benefit from the pest management approach to chemical insecticide control. The costs of this approach as demonstrated in Maryland are more than offset by the processor and grower return, and the environment and beekeepers are much better served. This 'new' pest management program works — we need more.

This bee skep honey-holder makes an attractive display. (By Robin Willis)