Cucumber Production in Louisiana With Honey Bees As Pollinators[1]

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Abstract. The quantity and quality of cucumber (**Cucumis sativus** L.) fruits were increased by the use of honey bees (**Apis mellifera** L.) into caged vs. field studies. The three areas in which the test was conducted are suitable for the production of cucumbers as an agricultural crop. In Louisiana, native bees other than honey bees can do much of the pollination. In this test, production of cucumbers was greater than in previous tests in Arkansas, Wisconsin, Michigan, and Texas and slightly more than in Maryland.

POLLINATION of cucumber (*Cucumis sativus* L.) by honey bees has been studied in various parts of the United States, but the environmental conditions which vary from one area to another have not been studied properly. Increased yields of cucumber fields were reported in Maryland, Arkansas, and Texas when honey bees (*Apis mellifera* L.) were used to increase pollination. Edgecombe and Martin reported the beneficial effects of honey bees in the production of cucumber seeds.

Alex attributed fruit set of cucumbers caged to exclude honey bees to halictid bees that entered through the screen mesh and to ants visiting the flowers; Szabo and Smith observed *Megachile rotundata* (F.) pollinating cucumbers in a greenhouse.

No study of cucumber pollination has been conducted in Louisiana; therefore, we conducted spring and fall studies to determine 1) the feasibility of producing pickling cucumbers in three areas of Louisiana, and 2) the effects of populations of bees (caged and uncaged) on yields.

Materials and Methods

Test locations included 1) Northwestern University at Natchitoches (NW area); 2) Louisiana Tech University, Ruston (NC area); and 3) the Louisiana Agricultural Experiment Station Sweet Potato Research Center at Chase (NE area). The three sites are in different areas of the State with different environmental factors.

Plant variety. At each test location a one acre field of Piccadilly variety of gynecious hybrid pickling cucumber was planted. The fields at Natchitoches and Chase were cultivated into beds (rows) 16 inches high and 4 feet apart (center to center) similar to corn lister rows but with flattened tops, but at Ruston the field was left flat. Three seeds were planted by hand in one inch holes, 12 inches apart in the beds (rows). Within two days after the seeds had been planted a preemergence herbicide was applied to retard grass and weed development. Only 150 plants were allowed to grow within the field, and caged plots at each location and all developing cucumbers on each vine in all plots were removed to equalize the development of fruit.

Within each of these fields, six test plots 18 feet x 24 feet equal to about 1/100 acre were randomly selected. Three were designated field plots, and three were placed under cages covered with clear saran screen with a six per cent light reduction factor. The frame of each was built from ½ inch galvanized pipe.

Honey bee populations. The population of honey bees that were observed on competitive flowers was augmented by placing two standard two-brood-chambered Langstroth hives (40,000-60,000 bees each) in the test field at Natchitoches; at Ruston where large numbers of bees were observed on competitive flowers, no colonies were introduced; and at Chase which seemed to have a bee population between those of Ruston and Natchitoches, one standard two-brood-chambered Langstroth hive was placed in the test field. Also, at each location a two-story, 11-frame nucleus hive was placed in one cage, two in another, and none in the third. Each nucleus had three lbs. of honey bees, or about 11,000 individuals.

Cultivation of plots. At each test location the caged and field test plots were weeded by hand and irrigated by ditch or sprinkler three times. Periodic rains reduced the number of irrigations needed. Just before cultivation, 600 lbs. of 8-12-8 fertilizer was applied on each test field.

Yield data. The fruit in each plot at each location was hand-picked every third day beginning June 15 and ending July 20. Cucumbers were weighed and graded according to USDA Standards. An analysis of variance was run to test the interaction of data collected that was related to yields, grades, and locations.

Cash values computed for the picked cucumbers were based on prices paid at the beginning of the season (1st week of June) at the buying sheds. As the season progressed and cucumbers became more plentiful, the prices paid by buyers declined considerably.

Results

Yield data. Differences in yields X locations for the caged plots were non-significant (Table 1) because cucumber fruits were produced in the caged plots without bees at all locations. Probably, some parthenocarpic development of fruit occurred; however, the major reason for the production was undoubtedly the foraging of small halictid bees (*Dialictus inconspicous* (Smith)) that managed to crawl through the screen mesh of the cages. In one 10-minute observation period, 42 of these bees were caught trying to squeeze through the screen mesh to get out of the cage. Other halictids were crawling into the cage. Thus, the differences in yields from the caged plots without honey bees at the three locations may have resulted because of different populations of these halictid bees. From the data (Table 1), the combined pollination activity of these small solitary bees in cages without honey bees plus possible parthenocarpic development were responsible for cash values for cucumber fruits produced of $426 to $733 per acre. The portion of the yield results from these small bees in the cages with honey bees was not estimated. They often visited flowers after a honey bee had just left.

The interaction of yields X treatment for the open plots and the cages with no honey bees was highly significant at all three locations, indicating that honey bees are essential for increased

yields of cucumbers. However, the total yields (Table 2) for the open plots at Ruston and Natchitoches were less than the yields from the caged plots treated with one-nucleus hive per acre and the yields from the caged plots treated with two-nucleus hives per acre were still higher. Apparently, the populations of honey bees per flower in the open plots at Ruston and Natchitoches were smaller than the populations in the caged plots treated with one-nucleus hive per acre. In contrast, the total average yield (Table 2) for the three field plots at Chase was similar to the yields from the caged plots at the three locations that were treated with 1-nucleus hive per acre. The caged plots at all locations treated with two-nucleus hives gave the highest total yields of any plots, open or caged, and those at Chase had the highest total yield, 51,300 lbs. of cucumber fruits/acre. Since the interaction between yield X location was nonsignificant, all three areas were equally suitable for the production of pickling cucumbers.

Because of a shortage of labor, the cucumbers grown in the test plots were picked every three days instead of every two days. This delay in picking increased the number graded as culls, since 57 per cent were too long and had too great a diameter for grading as No. 2 or 3 though they had the proper shape. A decrease in the number of culls and a corresponding increase in the No. 2 and 3 yields would have increased the cash value per acre.

Discussion

The results of the test therefore indicated that cucumbers can be profitably grown in the three study areas regardless of variations in soil types, weather factors, competitive plants, and honey bee populations. Indeed, the yields were higher than those reported by Alex (Texas), Warren (Arkansas), and Kauffeld and Williams (Wisconsin) and slightly higher than those reported by Steinhauer (Maryland).

Cash yields (gross) per acre such as those obtained in the present test could increase the annual income of small farmers devoting small acreages to cotton and obtaining an average maximum cash value per acre of about $250 (two bales/acre). Even if the yields and cash values reported here were divided in half, they would represent a substantial increase in annual incomes. However, a great deal of work in cooperative extension between researcher, grower, and processing agencies will have to be undertaken to achieve a good market capable of absorbing increased production.

Honey bees may not be needed as much in some areas because of the activity of native bees. In addition, yields can vary from one area to another because of environmental factors. One such factor, the competition for insect pollinators from plants in the immediate vicinity of test plots, should be studied to determine its importance.

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Table 1. Cucumber yields per grade (U.S. Standards) and cash values for three caged test plots in a pollination study conducted at Chase, Natchitoches, and Ruston, Louisiana. 1970.

U.S.	Chase						Natchitoches						Ruston					
	0 Nucs		1 Nuc		2 Nucs		0 Nucs		1 Nuc		2 Nucs		0 Nucs		1 Nuc		2 Nucs	
Grades†	lb	Cash‡ $	lb	Cash $	lb	Cash $	lb	Cash $	lb	Cash $	lb	Cash $	lb	Cash $	lb	Cash $	lb	Cash $
1	1,400	122	2,900	232	3,600	288	3,300	264	4,800	384	4,500	360	3,800	304	8,300	664	10,700	856
2	5,000	250	10,800	540	11,600	580	8,000	400	11,900	595	12,500	625	7,500	375	13,400	670	18,500	925
3	3,200	64	6,700	134	8,500	170	4,600	92	9,300	186	8,100	162	2,700	54	6,600	132	500	10
Cull	6,100	0	20,200	0	27,600	0	12,600	0	17,700	0	21,000	0	9,500	0	13,700	0	18,700	0
Total	15,700	426	40,600	906	51,300	1,038	28,500	756	43,700	1,165	46,100	1,147	23,500	733	42,000	1,466	48,400	1,791

†Grading was based on USDA standards for length, diameter, and shape.

‡Prices (in cents) per grade at the beginning of harvest (1st week of June) were No. 1 = 0.08, No. 2 = 0.05, No. 3 = 0.03, and No. C = 0.00. July 20 prices were No. 1 = 0.05, No. 2 = 0.03, No. 3 = 0.01, No. C = 0.00.

Table 2. Average of cucumber yields and cash values per grade (U.S. Standards) for three open test plots in a pollination test conducted at Chase, Natchitoches, and Ruston, Louisiana, 1970.

U.S.		Chase 1 hive/acre		Natchitoches 2 hives/acre		Ruston No hives/acre	
Grades†	‡Price/ lb	Total lb/ Acre	Cash $ Value	Total lb/ Acre	Cash $ Value	Total lb/ Acre	Cash $ Value
1	0.08	4,400	352.00	3,700	296.00	3,400	272.00
2	0.05	13,500	675.00	9,300	465.00	8,700	435.00
3	0.02	8,800	176.00	6,400	128.00	6,700	134.00
Cull	0.00	16,300	0.00	13,700	0.00	12,400	0.00

†Grading was based on USDA standards for length, diameter, and shape.

‡Prices (in cents) at beginning of harvest season (1st week of June). July 20 prices were U.S. No. 1 = 0.05, U.S. No. 2 = 0.03, U.S. No. 3 = 0.01, Culls = 0.00.

SADDER BUT WISER

by B. LUVER
Washington State

An odd occurrence has been nagging at me for several months. A friend bought queens at the same time as I did from the same breeder. His bees didn't build up as well as mine did. Darned if I could figure it out. I asked him had he been using powder formula "Terramycin." "No," "Had he fed them?" "Yes," "How much?" "About four gallons." — I had fed maybe a gallon and a half. It didn't make sense. Had he spilled the powder on open brood, that might have explained it.

A couple of nights ago I got a phone call. Another friend wanted to know if he could use lard in his antibiotic extender patties. I said I didn't know but was of the opinion that lard would probably become rancid, which couldn't be good for bees, and might also affect the flavor and aroma of any honey in the hive. In a scrapbook I found the original article (American Bee Journal, Sept. 1970, p. 348) and it did not recommend lard.

In addition and more interesting, in the same scrap book I found an article written by a gentleman then (1958) teaching at Colorado State College. That article gave the results of prolonged feeding of terramycin medicated syrup. Compared to colonies not medicated, the TM fed colonies had only about 80 percent as much brood. The article went on to say that preventive medication was useful and recommended, but not so feeding beyond the recommended one gallon total.

That turned on the light. I called my first friend, the one whose hives hadn't built up too well. "Hey, chum, about that spring feeding, you said you didn't use powder formula preventative medication. Did you feed TM syrup?" "Yup." "How much?" "Oh, I put TM in all the syrup I feed my bees." I then told him about the magazine article and, sadder but wiser, he concluded to follow recommendations in the future.

The captured swarm was dumped onto a board in front of a hive containing a smaller swarm captured earlier. As soon as Frank Weiss, the association's vice-president (holding the smoker), tapped on the side of the hive with his hive tool, all the bees immediately turned to the hive opening and marched into the hive.

William H. Julian of Cambridge, Md. sent us this interesting photo of a cutaway portion of a bee tree. The knife stuck in the side of the tree is a present he received during World War II as an overseas serviceman.

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Footnotes

[1] Received for publication ..... In cooperation with the Louisiana Agricultural Experiment Station and Louisiana Tech University and Northwestern State University of Louisiana.

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PART II. NECTAR AND POLLEN PLANTS COMPETING WITH CUCUMBERS FOR HONEY BEE VISITS[1]

by N. M. KAUFFELD,[2] T. HERNANDEZ,[3] J. WRIGHT,[4] and S. MISARACA[5]

ABSTRACT: The quantity and quality of cucumber (CUCUMIS SATIVUS L.) fruits were increased by the use of honey bees (APIS MELLIFERA L.) in caged vs. field studies. The nectar and pollen plants competing for honey bee visits in Louisiana were generally different from those in Michigan and Wisconsin.

POLLINATION of cucumber (*Cucumis sativus* L.) by honey bees has been studied in various parts of the United States, but the environmental conditions which vary from one area to the other have not been studied properly.

Martin[4] and Kauffeld and Williams[3] noted that honey bees on cucumber were predominantly collecting nectar and found little cucumber pollen in the pollen samples collected by honey bees. Martin[4] found that in Michigan the sugar concentration of the nectar of cucumbers ranged between 20 and 50 per cent and Kauffeld and Williams[3] noted that in Wisconsin the concentration was 36 per cent on a rainy day and 41 per cent on a clear day. Collison and Martin[2] listed 36 nectar and pollen plants that could be considered competitive with cucumbers for the attraction of honey bees. Kauffeld and Williams[3] reported 6 plants with lower concentrations of sugar than cucumbers that attracted honey bees. Thus, some factors other than sugar concentrations of the nectar were probably the basis of attraction for these honey bees.

No observations have been made of the nectar and pollen producing plants in Louisiana that compete with cucumber flowers for honey bee visits, therefore, we made observations of the plants in the same area that were in bloom at the same time cucumbers were.

Methods and Materials

The plants that were blooming in the same areas of the cucumber pollination tests were observed for honey bee visitations. Those observed having honey bees collecting nectar or pollen were cut and photographed in color for identification. Also the concentrations of sugar in nectar from the honey stomachs of 10 bees that were visiting the plants were determined by Abbe' refractometer. The nomenclature of the observed plants was checked by taxonomic botanists of the Smithsonian Institute.

Results and Discussion

Eleven species of plants blooming in the vicinity of the three locations were considered competitive with cucumbers for honey bee visits, Table 1. When this test was compared with the list of plants competing with cucumbers for honey bees in Michigan[2] and in Wisconsin[3] only two on the Michigan list and none on the Wisconsin list were observed in Louisiana. A change in competing plants for any crop requiring honey bees for pollination could change both the pollination requirements (colonies/acre) and also the yield.

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Table 1. Nectar and pollen plants in Louisiana that competed with cucumber flowers for honey bee visits, the average concentrations of sugar in the nectar, and the value to honey bees.

Common name	Latin Binonial	% sugar Concentration	Food‡ value
Cucumber	**Cucumis sativus** L.	38	N+P
Blue vervain	**Verbena litoralis** H.B.K.	41	N+P
Buttonbush	**Cephalanthus occidentalis** L.	29	N+P
Peppervine	**Ampelopsis arborea** (L.) Koehne	34	N+P
White evening-primrose	**Oenothera speciosa** Nutt.	....	P
Johnsongrass	**Sorghum halepense** (L.) Pers.	....	P
White clover	**Trifolium repens** L.	34	N+P
Bitterweed	**Helenium amarum** (Raf.) H. Rock	16	N+P
Smooth Sumac	**Rhus glabra** L.	44	N+P
Hairy Sumac	**Rhus typhina** L.	33	N+P
Chinese tallow tree	**Sapium serberium** Roxb.	36	N+P

‡ — N = nectar source; P = pollen source.

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