

DETERMINING THE POLLINATION POTENTIAL OF A HONEY BEE COLONY

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Introduction

With the price of cranberries at an all-time low and the price of honey at an all-time high, the interface between the beekeeper/pollinator and the cranberry grower may be at a critical juncture. For a beekeeper to decide to make cranberry pollination a part of his/her beekeeping activity, it has to be preferable to the production of a crop of honey, i.e., more profitable. We should realize that a Wisconsin beekeeper makes a conscious choice between these two activities every year.

Unlike the pollination of apples, almonds, and most other bee-pollinated crops, the relocation of a honey bee colony to the cranberry property usually removes it from a location at a time when leaving it there would have resulted in significant honey production. Wisconsin beekeepers anticipate and plan to produce their major honey crop between mid-June and mid-August, with only occasional small honey crops earlier or later. Thus, cranberry growers require that the beekeeper bring his/her bees to their properties for pollination at an inopportune time. The current price for bulk honey packed in fifty-five gallon drums and sold in truck-load lots is about one dollar fifty cents per pound: that's one thousand dollars per drum or sixty thousand dollars per truck-load. Wisconsin beekeepers regularly produce about one hundred pounds of honey per colony; they can expect to gross one hundred fifty dollars per colony if the colony is simply left on its "permanent" location and supered adequately. Granted, there is no guarantee of a one hundred pound honey crop, nor is there a guarantee that the price will be one dollar fifty cents per pound.

What is needed to persuade a beekeeper to pollinate your cranberries is remuneration for the portion of the honey crop that has been sacrificed by the colony relocation, and also remuneration for the labor and out-of-pocket expenses for transporting the bees to and from the cranberry property. Other concerns of the beekeeper who rents bees for pollination include an increased risk from insecticides applied to the cranberry crop, or to nearby crops (if any), theft or vandalism of bees located outside the normal operating area of the beekeeper, exposure to bee diseases and/or bee parasites from the colonies of other beekeepers moving to the cranberries, and the wear and tear on the equipment and personnel trucking bees, often done under critical time constraints and during the night.

Granted, there are beekeepers that are doing their bee thing just for the fun of it, but they don't operate enough bee colonies to do most cranberry growers any good. Beekeepers operating enough bees to provide the pollination that you require are in the bee business to make money. For the most part, they are honest and hard-working businessmen and women. Unfortunately, there are a few exceptions, and you may even know one or two of these. I'll leave the evaluation of the beekeepers up to you, and we will now turn our attention to the evaluation of the honey bee colony.

Colony Evaluation

First we need to think of a honey bee colony as a dynamic and living organism. It begins life as a swarm (in nature) or as a package-bee-colony or as a colony "divide" or nucleus hive called a "nuc" (when produced under beekeeper management). These "newborn" colonies are not suitable for pollination rentals because most of their activity and energy is directed to the care and nurture of bee larvae to increase their colony's adult bee population as quickly and as efficiently as possible. We usually expect a productive colony from one of these new "starts" after two or three of their twenty-one-day brood cycles, i.e., forty-two to sixty three days; the actual duration dependent upon availability of bee forage and good weather and/or proper feeding by an astute beekeeper. It is such a young and populous colony that will provide you the desired pollination, if properly managed while on the crop. More mature colonies may become heavy and difficult to transport and may even be so overloaded with honey that their foraging activity declines.

Thus, you see, for a beekeeper to provide you the best pollination service possible, there needs to be advanced notice about what your expectations are so that the bees can be managed in anticipation of a move to the cranberries in late June. Honey producers that migrate south for the winter establish new bee colonies every year before they move to their summer locations in the Midwest. Several years ago I met with the North Dakota state beekeepers and was told that in that particular year, 350,000 honey bee colonies had been moved into their state for honey production. Such is the scope of commercial beekeeping in our country today. We might call the process that they employ as applied population control-and for the beekeeper, proper timing of colony initiation and population development is vitally important.

The most obvious criterion that you, the cranberry growers, have for a windshield inspection of what you have rented is the number of "bee boxes" that you see on your property. However, such an assessment is only valid if you have a pretty good idea what is inside those boxes.

Colony Evaluation Field Experiment

About twenty years ago I designed and we conducted an experiment comparing single-story, double-story, and triple-story honey bee colonies in a pollination situation. These were all standard nine-and-five-eighth-inch Langstroth brood chambers with appropriate amounts of bees and brood and a young, laying queen. Each colony also had adequate storage space for honey in a six-and-five-eighth-inch Illinois-depth honey super with drawn comb placed on top of the brood chambers. The particular crop involved happened to be an onion seed field in full bloom and my experiment was conducted during two different years in Yuma County, Arizona.

Each bee colony in my experiment had its population estimated by counting frames covered with bees and then multiplying that total number of frames for each colony by 1,500, the number of bees we had found on average when bees were shaken from individual frames. To measure the relative number of foragers visiting our target crop (onion), we employed an animal behavior technique called capture and recapture. Color-coded metal tags were glued onto the abdomens of foraging bees "captured" while visiting the onion flowers. These metal tags were then "recaptured" on magnets mounted above the hive entrances, thus recording those foragers that returned to every hive. Other data evaluated and presented here include the weight gained (honey, pollen, new bees, etc.) and the rate of flight at the entrances of these bee colonies.

The data (Table 1) clearly show that the numbers of foraging bees collected from the flowers of the target crop were proportional to the honey bee populations of the hives from which they had originated. The rate-of-flight data and the weight-gain data also were very much a function of the colony's populations. When the data are calculated on the basis of the numbers of frames of bees per total tags, pounds gained, or bee flights per minute, in all but one case there were no significant differences between one-, two-, and three-story colonies. The conclusion one makes from this is that it is the number of bees present that is important, and that they can be in colonies of various population sizes. Please note, however, that all of these colonies were provided with adequate storage space for incoming nectar and pollen, and they were not crowded for space when their populations increased.

Because the colonies were distributed in small apiaries adjacent to these fields, and because the metal tags were applied at six tagging sites uniformly distributed within these fields, we have data on distances traveled by colonies of three populations. On a seventeen-acre field with colonies placed on both sides of the field, half of the foragers went to the nearest tagging site sixty meters away (first-year study). On a ten-acre field with colonies only on one side, one-third of the foragers were tagged on the nearest tagging site thirty-six meters away (second-year study). Some have speculated that bees from the weaker colonies will not travel as far when they forage, as will the foragers from stronger or more populous colonies. There was no evidence of this behavior in our results.

Paying According to Colony Strength

The almond growers in California have a reputation for their insistence on quality honey bee colonies for pollination, as well as their willingness to pay a rental fee based on the hive inspection reports that they request and pay for. The present demand for pollination of California almonds requires about one million colonies every year in February. Thus, there is a mass movement of U. S. migratory beekeepers and their bees beginning as soon as the previous year's honey crop is harvested. Many beekeepers have learned the importance of fall feeding with syrup and pollen substitutes, so that their bee colonies will measure up to the almond growers expectations when inspectors evaluate colonies to determine the price to be paid for pollination rental colonies. Because the weather in February can be marginal for honey bee flight activity, almond growers have learned to be particularly harsh about weak colonies with small bee populations; they refuse to pay anything for such units.

For an unbiased assessment of the colonies you rent for cranberry pollination, I suggest that a beekeeper accompany you, but not the beekeeper who owns the rented colonies. You should have the beekeeper examine about ten percent of the colonies present at every location. Have someone record the information provided to you by the beekeeper as he tips every box back and tells you how many frames he sees that are fully covered with bees. A few frames should be removed for a close examination, especially if a colony appears to be particularly inferior to the majority of the hives that are opened. I emphasize the need to tip the hives back and look upwards into each box from the bottom. Often the bees on the topbars tell you little about the number of bees further down on the combs where the bees really count. Also, an experienced beekeeper can observe brood in the combs rather easily from the bottom, but the brood is nearly impossible to see when looking down between the thicker topbars.

Since I relocated back to Wisconsin in 1995, I have had occasion to visit cranberry properties and to inspect rental colonies nearly every year. I also assisted Dr. Marla Spivik, from the University of Minnesota, after I had recommended her to you when someone from your

association requested help with some research on pollination of cranberries. I am a part-time bee inspector for the Wisconsin Department of Agriculture Trade and Consumer Protection (WDATCP). It is through my affiliation with WDATCP that, this past summer, I became involved with the examination of some colonies that had been rented from an out-of-state beekeeper for cranberry pollination in central Wisconsin

Using my method of tipping up every super and hive body to assess populations of bees, I and one assistant that the growers provided for recording the information were able to assess bee populations in 252 colonies on five properties in one day. Many of the colonies that we examined consisted of only one brood chamber and one honey super. Such a minimum hive would be all right if the brood chamber was more or less full of healthy brood and bees and the honey super contained drawn comb without much honey. However, many of these so-called story-and-a-half colonies had their honey supers already filled with combs of sealed honey, and there was no storage room for incoming nectar. In addition to overall populations, we were able to document some queenless or failing-queen colonies (3%), dead colonies (15%), and "plugged-out" colonies that could do little foraging owing to a lack of storage space (19%). Not including the dead colonies, our colony examinations showed that 90% had populations greater than 10,000 bees and that 75% had populations greater than 15,000 bees. Using the methods for colony assessment described herein, I would recommend that a minimum acceptable colony for remuneration be set at 15,000 bees when bees are rented for pollination. Such a minimum colony would have the equivalent of ten Langstroth deep brood frames covered on both sides with worker bees.

Further Reading

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Table 1. Colony size and honey bee foraging activity during two years in Arizona.

Brood Boxes Present	Average Hive Populations		Bees Exiting per Minute	Foragers tagged per colony	Wt. Gain per colony (lbs)
	Frames	Bee No.			
First Year					
1	8.5	12,750		28.4	9.8
2	16.1	24,150		40.1	14.8
3	23.3	34,950		55.0	21.9
Second Year					
1	10.3	15,450	71.6	33.2	13.8
2	18.4	27,600	118.9	61.7	25.4
3	26.1	39,150	182.7	91.9	43.6