TWO COLONY HIVE PRODUCTIVITY TRIALS
FNEOO-308
A NORTHEAST SARE 2000 FARMER/ GROWER GRANT APPLICATION

Goals of the Project

The original goal of this project was to compare the productivity of the Vertical Partition Two Colony Hive with that of the standard 10 frame Langstroth Hive. The Two Colony Hive is slightly wider than the Standard Hive (18 inches wide versus 16 1/4 inches); both hives contain ten frames in each hive body but the two colony hive has a 3/4 inch thick divider board in the middle of each hive body. The Two Colony Hive has two entrances on opposite sides of the hive and contains two separate swarms of bees. It is not unusual in the bee industry to have beehives with separate compartments especially among queen breeders; in most cases,though, the divisions are not continued above the firsr hive body. It is believed that the Two Colony Hive should be more productive than the standard hive because Spring buildup time should be dramatically reduced; each cluster only has to fill ten frames in a two story Two Colony Hive before honey supers are placed above as compared to 18 or 20 frames that a standard hive has to fill out. The Two Colony Hive is not intended to replace the standard hive. It is my intention to use this hive to produce "nucs" (3 to 5 frames of brood and bees with a queen). These nucs are used to restock standard hives that have died during the previous winter. The Two Colony Hive can then be "re-started" with two frames of brood and two queen cells. After ten days the new queens have taken their mating flights and begun laying eggs; after another twenty one days, young bees begin to emerge from their cells. If a standard hive was run in this manner, it would have little hope of producing a surplus for that growing season. Because each Two Colony Hive cluster is only occupying half as much space, this hive can be abused in this manner in the middle of May and will be producing surplus honey by around August 1. In terms of productivity, the most important measure being used in this project is dollars earned. The amount of money earned by the Two Colony Hive from nuc sales and honey production is being compared with the money earned by standard hives from pollination and honey production.

Farm Background

Johnston's Honey Farm is a sideline operation that has grown from 100 to 150 hives during the course of this project; 60 of these hives are now Two Colony Hives. Income for this operation is derived from honey production, apple pollination during May, and the sale of bees to other beekeepers. During 2001, a 20 foot by 24 foot warehouse was constructed for the operation; this warehouse has been used for both woodworking and honey extracting at different times. An addition is under construction for the warehouse. Most of the income is reinvested in the operation but we make a decent profit almost every year anyway. Michael Johnston, owner, has a full time job at Madison County Soil and Water Conservation District as Sr. District Technician. His resume' includes nearly 10 years with commercial package bee and queen producers. He would like to go into the bees full time but it is hard to give up a regular full-time income. He and his wife, Maureen, have three children ages twelve, eighteen, and twenty; two of them are now in college. Maureen is an R.N.; she thinks the bees are O.K. as long as they are kept at a distance. Maureen helps with selling honey and marketing the bees.

Cooperators

Dr Ray Cross – President, Morrisville State College. Dr. Cross is highly supportive of agricultural development projects and has been the first point of contact during my project with this SUNY school.
Dr. Wayne Hausnecht – Formerly Dean of Engineering and Technology at the college. Dr. Hausnecht has now returned to being a peofessor at the college.
Professor Leno Mbaga – Professor Mbaga works directly with Morrisville State College students in the Wood Technology lab.
Shannon Nichols – Shannon is a co-worker at Madison County Soil and Water Conservation District. She is the Grazing Specialist. Shannon helped critique a display that was prepared for an October, 2004 SARE conference.

Work Done During the Grant

This was a Year 2000 SARE Grant that was begun January, 2000. Work has been done during all of the subsequent years. Accomplishments will be summarized on a year by year basis.

Year 2000

During February, March, April, and May, Two Colony Hive bee equipment was built and assembled by SUNY Morrisville students at the Wood Technology Department there. Under a contract signed with the college, our bee outfit supplied the needed amount of white pine lumber; the college would supply paid student interns who would do the woodworking. The contract was for 50 beehives that would be completed before the end of April. Students actually finished building 49 complete hives by Memorial Day weekend. The equipment was then painted and put into service during early June. It was originally expected that this equipment would be stocked during early May. Because of the one month delay, we were able to have hives that were strong enough to go into winter but we didn't have any meaningful results in terms of honey production.

Year 2001

In Year 2001, the project focused its attention on a comparison of wintering, nuc production (a nuc is 3,4, or 5 frames of bees, brood, and a queen), pollination, and honey production between the Two Colony Hive and the standard Langstroth hive.

Wintering

In early December of 2000, a census was taken of hives located in my best wintering yard. All of these hives had queens that were raised during the 2000. It was noted that there were 17 standard hives in this yard and 23 1/2 (47 clusters) Two Colony Hives at that time. The winter of 2000/ 2001 was a particularly brutal one for New York beekeepers. Here in Central New York, we had just over 193 inches of snow reported in Syracuse and missed the record by 0.2 inches. Spring was very slow in coming with snowpack lasting through the middle of April. Many beekeepers in the Northeast reported losses over 50% with some reporting losses of over 90%. Of the hives located in the yard in question, 8 out of 17 standard hives overwintered while 33 out of 47 clusters in the Two Colony equipment survived the winter. This amounts to 47% overwintering for standard equipment compared to 70% overwintering for the Two Colony equipment.

Another way to consider overwintering would be to consider the ratio of clusters surviving to the number of beehives involved.

For standard hives this ratio would be 8 clusters surviving/ 17 hives = .47 ;

For Two Colony Hives the ratio would be 33 clusters surviving/ 24 hives = 1.375.

Over the winter of 2000/ 2001, Two Colony Hives brought (1.375/ .47) 2.93 times the number of clusters through the winter than standard hives.

Sales of Bee Products

In early Spring in Upstate New York, there are two ways that my bee operation makes money: the sale of nucs to other beekeepers, and apple pollination. Other beekeepers are looking to buy nucs and restock their dead hives during the month of May; apple pollination begins as early as May 10 and ends as late as May 31. Since both operations are happening at around the same time, beehives have to do one or the other. In my operation, the Two Colony equipment is used for nuc production while the standard hives are sent off to pollination.

Income for standard hives:

8 hives at $35/ hive minus cost of trucking at $2/ hive = $264

Net income is $264/ 17 hives = $15.53/ hive

Income for Two Colony Hives:

19 nucs at $40/ nuc minus cost of 95 new frames at $1.50 each =

$760 minus $147.50 = $512.50

Net income is $512.50/ 24 hives = $21.35/ hive

Honey Production

Twelve Two Colony hives were tested in the same bee yard for honey production with twelve standard hives. These were not the exact same hives used in the previous test. All beehives had young queens and had been newly started in the month of May. Generally, the standard hives were produced by converting Two Colony Hives to standard hives when it was found that only one queen had successfully mated. In

this way, both the standard hives and the Two Colony Hives were started using the same number of brood frames. At the start of the test, though, three of the standard hives were the stongest hives in the bee yard because these hives had been dead outs that had been re-stocked earlier in the Spring. The bees were moved to a good honey location on July 3 but only the three best standard hives were built up to full strength at that point. All of the hives were supered on the morning of July 4. Production was measured before and after extracting on a platform scale. The results are as follows:

	Standard Hives	Two Colony Hives
Top Producers	One @ 80.5 lb. Four best averaged 68.4 lb.	Three averaging 154.7 lb. Plus two averaging 103 lb.
Low End	Eight averaging 23.4 lb.	Seven averaging 46.1 lb.
Total Production	460.5 lb.	993 lb.
Average/ hive	38.4 lb.	82.75 lb.

Year 2002

Overwintering

The hives used in the summer honey trials were observed the following spring for overwintering success. The winter of 2001/ 2002 was the mildest ever observed by this individual. The following are overwintering results as well as my initial manipulations of these hives:

	Standard Hives	Two Colony Hives
#1	OK	#1 Strong/ Strong (add 3rd hive body)
#2	OK (added bees from 11)	#2 Strong/ Dead (filled #12 standard hive)
#3	Weak (switched with 10)	#3 OK/ Dead
#4	OK (switched with 11)	#4 Strong/ OK (Twist to switch field force)
#5	Good	#5 Strong/ Good (Twist)
#6	Dead	#6 Strong/ Strong (add 3rd hive body)
#7	Good	#7 Strong/ Good (Twist)
#8	Dead	#8 Strong/ Strong (add 3rd hive body)
#9	Strong	#9 Strong/ OK (Twist)
#10	Strong	#10 Strong/ OK (Twist)
#11	Very Strong (add 3rd hive body)	#11 Strong/ OK (Twist)
#12	Dead	#12 Good/ Good

91.7% of the clusters in the Two Colony equipment overwintered while 83% of the standard hives survived.

While the standard equipment overwintered .83 clusters/ hive (10/12) the Two Colony Hives overwintered 1.83 clusters/ hive (22/12).

Sales of bee products

Standard Hives

Pollination: 10 hives x $35/ hive for pollination = $350

Income/ hive = $350/ 12 hives going into winter = $29.17/ standard hive

Two Colony Hives

Pollination: I hive @ $35	= $35
Nucs: 18 sold @ $45 each,	
2 sold @ $40 each	= 890
Minus value of 100 frames	=-150
Brood Sold: 48 frames @ $8 each	= 384
Minus value of 48 frames	= -72

	Total $1087

Income per hive = $1087/ 12 = $90.58

Because of the milder winter, bees built up earlier. Besides selling nucs from the Two Colony Hives, I was able to sell frames of brood to a beekeeper who was purchasing queens from another source. Demand for nucs in 2002 was better than in 2001 simply because I did a better job of running classified ads in the bee journals. (The deadline for the April issues in the two journals are February 25 and March 1.)

Honey Production, Summer of 2002

The exact same hives were not used in the honey producing trials during the summer of 2002. This is because the standard hives and two colony hives go in different directions in the process of selling nucs and going to pollination. During this honey season, 15 Two Colony Hives were compared to 9 standard hives. These hives were moved to their summer yard on July 5 and supered on July 7. All were single story hives except for two standard hives that already consisted of two deep hive bodies with two medium depth supers. The medium depth supers had been placed on these hives a week earlier and the bees had moved into them but had not yet stored any surplus honey. honey production results are as follows:

Two Colony Hives	Standard Hives
#1 58 lb.	#1 175 lb.
#2 53 lb.	#2 98 lb.
#3 32 lb.	#3 80 lb.
#4 61.5 lb.	#4 49 lb.
#5 34.5 lb.	#5 112 lb.
#6 32 lb.	#6 61.5 lb.
#7 125 lb.	#7 no surplus
#8 47.5 lb.	#8 no surplus
#9 177 lb.	#9 no surplus
#10 120 lb.	
#11 126.5 lb.	
#12 47 lb.	
#13 32 lb.	
#14 56 lb.	
#15 no surplus	
Total	
1002 lb.	575.5 lb.
Average:	
66.8 lb./ hive	63.9 lb./ hive

2003

Overwintering

Hives that were involved with honey production trials in 2002 were moved to a good yard for wintering in late Fall of 2002. 9 standard hives and 15 two colony hives were involved. In the Spring of 2003, standard hives were prepared for pollination while two colony hives were "broken up" for either nuc sales or transferred to standard hives for pollination. All 9 standard hives survived the winter for a 100% overwintering success. In the two colony hives 21 out of 30 queens survived the winter so the two colony hives had a 70% overwintering success.

Income - Standard Hives

9 hives to pollination @ $35 each = $315
2 hives to 2nd pollination, local @ $25 each = 50
6 frames of brood sold @ $8 each =($48 minus value of 6 frames @ $1.50 each)
= 39

Total $404

Income per hive = 404/ 9 = $44.89

Income - Two Colony Hives

16 five frame nucs sold @ $45 each	= ($720 minus value of 80 frames @ $1.50 each)
	= $600
2 converted to standard hive @ $35	= 70
16 frames of brood sold @ $8 each	=($128 minus value of 16 frames @ $1.50 each)
	= 104

Total	$774

Income per hive = $774/ 15 = $51.60

Two Colony Hives brought in 15% more Spring income per hive than the standard hives.

2003 Honey Production Trials

As in earlier years, the exact same hives were not used for the Summer honey trials as were used in the previous year. This is because during Spring the standard hives go to pollination and get mixed up with the rest of my standard hives and the two colony hives get re-started with two frames of brood and two queen cells after break up. In 2003, 10 two colony hives and 6 standard hives were used for the honey production trial. Unlike previous years, the standard hives did not have young queens. These hives had overwintered and had returned from apple pollination and were some of the best hives in my operation. At least three of these hives were breeder queens and had supplied brood for queen cell grafting. All 16 hives were moved to their summer yard on June 29. All of the two colony hives were single story hives that still had to grow to a full two story hive before honey supers could be added as the 3rd and higher level. All of the standard hives were at least two stories tall; the #1 and #2 hives were already four deeps tall. Honey production results are as follows:

Two Colony Hives	Standard Hives
A. 65 lb.	#1. 234 ½ lb.
B. 133	#2. 264 ½
C. no surplus	#3. 144 ½
D. no surplus	#4. 125 ½
E. 145	#5. 114
F. 26	#6. 34
G. 6 ½	
H. 55	
I. 13	
J. 75 ½	
Two Colony average = 51.9 lb.	Standard Hive Average = 152.8 lb.

Obviously, we were not comparing apples to apples. For the two colony hives to make a good showing under these circumstances, a good honey flow during August and September is needed. In 2003, the flowers were available but more heat was needed. The standard hives were already producing a surplus when they landed at the summer yard and had a month's head start over the two colony hives. They did extraordinarily well considering 2003 was not even as good a honey year as 2002.

2004

Overwintering

Unlike past years, beehives that were used in the 2003 honey trials were not moved to a less exposed location for overwintering. Standard hives did not have year 2003 young queens so it would be expected that overwintering success would be less than previous years. The Two Colony hives did have queens raised during 2003. The results are as follows:

Two Colony Hives	Standard Hives
A Dead Dead (lid blew off or was taken off during winter)	1 Dead
	2 Live (decent but not strong)
B Live Live	3 Dead (some bees, no queen)
	4 Dead
C Live Live (weak)	5 Dead
D Dead Dead	6 Live, Strong, Drone Layer (put good frame of brood in middle of cluster)
E Live Live	
F Live Live	
G Live Live	
H Live Live	
I Dead Dead	
J Live Dead	

Results

Standard hive # 6 apparently had lost its queen late in the winter and was taken over by a drone laying worker. Hives with drone laying workers will not successfully raise themselves a queen or accept a queen cell. I gave this hive a good frame of brood anyway since I don't always believe everything that I'm told. This beehive never recovered and is counted among the dead. Overwintering success for these standard hives with older queens was 17%.

The Two Colony Hives did have young queens raised during the 2003 season. All of these beehives had large rocks placed on their lids at the start of winter. This beeyard is located near a snowmobile trail.

When I returned in early Spring, Hive A, at one end of the yard, no longer had a rock or lid remaining and had succumbed to the rain and snow. Of the remaining 18 clusters of bees, 13 made it through the winter. Overwintering success was 72% for the Two Colony Hives.

Obviously, it is not fair to compare the overwintering success of these two groups of hives because it is expected that young queens should overwinter better than old queens. The standard hives proved this point even though they had been very good honey producers during the 2003 season and their queens had already survived one previous winter.

2004 Honey Production Trials

Only 2 Two Colony Hives were not "nuked out" in the Spring of 2004. These two hives were run at full strength in order to assess their full potential for honey production. I had intended to run more of these hives for honey production but there was high demand for nucs in the Spring even though I did not advertise and overall, my operation had only a 60% success rate of overwintering.

Some of my best standard hives were brought to the same yard as these Two Colony Hives. A total of 26 hives with many different histories (young queens, old queens, swarms, standard hives, two colony hives) were in the yard by the end of the season. I measured the honey production from only the best hives since I was looking to assess the potential for maximum honey production. Some of the best standard hives in other yards were also measured. The results are as follows:

Two Colony Hives with full strength
Hive E 370 ½ lb.
Hive B 344 lb.

Standard Hives – best in same yard
Hive #11 188 lb.
Hive #12 156 ½ lb.
Hive # 13 97 lb.
Hive #14 100 lb.
Hive # 15 116 lb.

Standard Hives – best in other yards
Hive # 21 193 ½ lb.
Hive # 22 141 lb.
Hive # 31 216 lb.

Discussion
2004 was a below average honey production year in New York State. Our local bee inspector inspected the test bee yard on August 2. At that time he said "2004 was the worst honey year that he had ever seen". On August 2, I took off 150 lb. from Hive E and 109 lb. from Hive B. We both estimated that Hive E would probably make around 300 lb. by the end of the season. The weather improved considerably for the remainder of the growing season and production picked up for all hives. The bees generally produced less than normal in 2004. A fair number of hives in some yards did not produce any surplus crop. Hives with 2004 queens raised in late June did not do well.

The known record for honey production by a standard hive is 404 lb. by Ormond and Harry Aebi of Santa Cruz, California and was set in 1974. We were able to approach this record using only 2 Two Colony Hives during a below average year but in a very good bee yard. Our two hives averaged 357 lb. while the eight best standard hives in our operation averaged 151 lb. It is very possible that Two Colony Hives will not outperform standard hives as dramatically during a better honey year but the Two Colony has shown in this test that it has very good potential for honey production.

Results

Through the course of this experiment, it has been shown that the Two Colony Hive will consistently bring more clusters of bees through the winters of Upstate New York. Even in 2003 when 100% of the standard hives survived the winter and 70% of the Two Colony Hive clusters survived, each standard hive brought 1 cluster through the winter while each Two Colony Hive brought an average of 1.4 clusters through the winter. During the years 2000 to 2003 when hives with comparable queens were tested, 1.49 clusters per Two Colony Hive overwintered and 0.71 clusters per standard hive overwintered.

It has also been shown that the Two Colony Hive should bring in more springtime income to the beekeeper than the standard hive. Even if the beekeeper is only using the Two Colony Hive to restock his standard hives and then go to pollination, he can expect at least 1.4 times more pollination money in the worst of years. In 2002, by selling nucs to other beekeepers, the Two Colony Hives brought in 3.1 times more spring income than comparable standard hives that went to pollination.

For non-migratory beekeepers operating in northern climates, overwintering losses are a fact of life. For most beekeepers, restocking these hives can be a major expense that is directly proportional to the percentage of hives that are lost. During the past three years while selling nucs, I have spoken with a number of beekeepers who have lost over 90% of their hives. Suffering large losses each winter is certainly not a sustainable form of agriculture. Most beekeepers purchase queens from southern states where the breeder queens can not be chosen based on their overwintering ability. Two Colony Hives would be a good supplement to any beekeeping operation where the beekeeper knows how to raise queens. It is ironic that instead of having a major expense, this beekeeper has been able to turn other beekeepers overwintering losses into a source of income for himself by employing the Two Colony Hive.

For most of the course of this experiment, I was not running Two Colony Hives for maximum honey production but as a means of producing nucs to restock hives that died during the winter. During the 2003 experiment, I compared the honey production of Two Colony Hives that had produced nucs with standard hives at full strength. The standard hives far outperformed the Two Colony Hives under these circumstances. During 2004, the honey production of 2 Two Colony Hives at full strength were compared with the honey production of the best standard hives in my whole operation. Under these circumstances, the Two Colony Hives more than doubled the average production of these select standard hives. These results exceeded expectations and brings into question whether I should be running more of these hives for maximum production.

Economic Findings

Through the use of simple algebra, I have calculated that there are 15.56 board feet of one inch stock lumber in a two story standard hive while there are 19.23 board feet in a two story Two Colony Hive. (Frames are not considered in this calculation since both hives have the same number.) It takes an additional 3.67 board feet of lumber or 24% more wood to build a Two Colony Hive. If white pine lumber is going for one dollar per board foot (I have been paying $0.40 per board foot) then the beekeeper producing his own equipment is going to invest an additional $3.67. It really does not take an additional 24% more labor to build Two Colony equipment since the extra labor mainly goes into fitting the divider boards into the hive bodies. Managing Two Colony equipment for the production of nucs is certainly labor intensive. In any case, I would like to see at least 24% more benefit from running the Two Colony Hive.

Overwintering

During the course of this experiment, 51 Two Colony Hives brought a total of 76 clusters through the winter while 38 standard hives brought 27 clusters of bees through the winter. On average, a Two Colony Hive overwintered 1.49 clusters while a standard hive overwintered 0.71 clusters. The Two Colony Hive increased overwintering by 110%.

Spring Income

The following table shows how much more Spring income the Two Colony Hive brought in on a per hive basis:

Year	Standard Hive	Two Colony Hive	% Increase
2001	$15.53	$21.35	37%
2002	$29.17	$90.58	211%
2003	$44.89	$51.60	15%

Honey Production

The results of comparing honey production between the Two Colony Hive and the standard hive are as follows:

Year	Standard Hive Average/ # Hives	Two Colony Hive Avg./ # Hives
2001	38.4 lb. avg. / 12 hives	82.75 lb. avg. / 12 hives
2002	63.9 lb. avg. / 9 hives	66.8 lb. avg. / 15 hives
2003	152.8 lb. avg. / 6 hives	51.9 lb. avg. / 10 hives
2004	151 lb. avg. / 8 hives	357 lb. avg. / 2 hives

In the years 2001 and 2002, we were comparing newly started Two Colony Hives with newly started standard hives. Generally, the queens were very similiar though they may or may not have been from the same breeder queens. I tried to make sure that the standard hives were stronger on average than the total strength of the Two Colony Hives when the bees were moved to their summer yard. In 2002, two of the standard hives were quite a bit stronger at the start of the test which helped to bring up the average of the standard hives. In 2003, I compared newly started Two Colony Hives with some of my best overwintered standard hives. The standard hives had a two month head start in honey production and outperformed the Two Colony Hives. In 2004, 2 Two Colony Hives were run at full strength and far outperformed my best standard hives also run at full strength. The production levels demonstrated by these two hives were so high that this part of the experiment will need to be repeated with the assistance of independent observers.

New Ideas Generated by the Project - The Next Step

I believe that we have established that the Two Colony Hive has a viable place in a northeastern United States bee operation that would like to replace its winter losses without having to buy bees or queens from the southern United States. Not only will the Two Colony Hive produce nucs each Spring but it can be re-queened with just queen cells and will probably produce a surplus honey crop before the end of the growing season.

The Two Colony Hive also has tremendous potential as a honey producer if the beekeeper does not choose to produce nucs with this hive in the Spring. A higher level of management is definitely needed for this hive than is required for standard Langstroth beehives. Because the Two Colony Hive can grow so rapidly, it is certainly prone to swarming. Selling nucs and knocking back the population annually takes care of the swarming problem. The beekeeper who runs the hive for honey production needs to check to make sure the bees have enough room on a weekly basis.

It seems that the next step is to repeat the honey production tests under the observation of s credible observer who can confirm the results that are claimed. Concurrently, I can go ahead and start promoting

the hive and selling this bee equipment on a modest level. Towards promoting this hive, I plan to put together a web site that will contain the results of this grant and any future research.

In December of 2004, I applied for another SARE Farmer/ Grower grant to begin testing of a second beehive that I have originated that is known as the Combination Queen Rearing Nucleus And Comb Honey Hive. This second beehive is well suited to producing queen bees and will complement the Two Colony Hive. This second hive also produces comb honey, a high value product that is in demand.

Continuing the Practice

It is my plan to continue increasing my numbers of Two Colony Hives as fast as I can produce them. I probably will not advertise nuc sales in the bee journals in 2005. In 2004, I also did not advertise and I had more calls asking for nucs than I could supply. This year I would like to run more hives for maximum honey production than just the 2 Two Colony Hives that were tested in 2004.

Maryann Frazier of Penn. State Cooperative Extension has applied for a SARE Partnership Grant to continue the testing of the Two Colony Hive. Under the proposed grant, Two Colony Hives would be run at three different sites including here at Johnston's Bee Farm. Hopefully this application will be successful. The results of the experiments funded by this Farmer/ Grower Grant have been so successful that independent tests are now needed to confirm that this beehive is a good as I say it is.

Outreach Program

The leading magazines for the American beekeeper are the American Bee Journal and Bee Culture. Both of these magazines are monthly publications. Because these two magazines would probably not want to publish identical articles, I have written two different articles each of which, I believe, is best suited to the idividual magazine. *SARE Grant Research Produces Big Results in Two Colony Hive Trials* will be submitted to the American Bee Journal. *Two Colony Hive Revisited* will be submitted to Bee Culture. Copies of these articles are included with this report.

Respectfully Submitted,

Michael Johnston
December 28, 2004