Peak Performance Splitting of Honeybee Hives

2009 Final Report

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Summary

PROJECT BACKGROUND
Briefly describing my operation: I keep honeybees. Over the years I have grown from a hobby beekeeper to a small-scale commercial operation (still part-time) with 150 hives. My “farm” is small, nothing more than a modest house on a large lot outside of the city limits. I have over thirty locations for my beehives, placed free of charge at the request of local farmers who desire to have bees on their property. The bees provide local pollination and my main “crop” is the honey. I am a stationary beekeeper, as opposed to being migratory, following the bloom and charging for those services.

Before receiving this grant: I consciously work at fostering sustainable practices in my beekeeping operation. For most of my beekeeping experience, I have not used commercially approved chemicals in my beehives. (What we’re finding now is a growing, sub-lethal accumulation of these “safe” chemicals in the beehives that are essentially poisoning our bees). I raise my own queen honeybees from stock that survives my chemical-free methods and I incorporate a host of Integrated Pest Management practices to combat pests and diseases. Some of these practices would include the addition of essential oils and screened bottom boards.

DESCRIPTION
My project goals: In its purest form, my goal was to develop a sustainable, working model for beekeepers to multiply the number of their existing hives in order recoup their seasonal losses (dead hives) without undue financial expense, or expand their existing hives sustainably for increased production or additional income. My ulterior goal was to multiply the maximum number of hives with a minimal impact on honey production and an avoidance of the expenses for off-farm resources (namely buying southern nucleus “nucs” colonies from southern beekeepers.

This project also sought to evaluate proposed methods to “split” (divide) bee hives in order to make more colonies available for new beekeepers at a reasonable price while allowing an experienced beekeeper to create a buffer of extra hives to cover winter losses (or sell to another beekeeper for extra income).

How I planned my research: What made this project unique and innovative is that hives would not be conventionally split during the early spring (seasonally, one of the hive's weakest moments) but rather split during the peak of summer production when nectar and pollen are in abundance and hives were at their greatest population levels. (Most beekeepers I've talked to fear this will diminish their honey production, but this is the time of year when the weather is most favorable and colonies are at their peak strength).

Conventionally, most beekeepers will purchase southern-raised queen honeybees in the spring, force the new queens to endure the stresses of the shipping/mailing journey, fight the weather to install the queens in the split, then hope the queens are accepted as the hives build up for the nectar flow. At best, strong, over-wintered hives can be split into two hives, one with the newly purchased queen, one with the old, existing queen. This amounts to one hive expanded from each existing hives, provided the hive made it through the winter with sufficient strength to be split—many do not. Additionally, there is a negative, though acceptable, impact on honey production. Spring splits, however, is the easiest method of preventing swarming.

Though this practice of spring splits is the widely accepted convention, this method divides the hives at their weakest time, produces the fewest possible splits, and requires the purchase of queens when they are most expensive and least available due to their greatest seasonal demand and weather challenges of the south in the early spring.

This project sought to find a better, more sustainable way by evaluating an innovative, almost counter-intuitive method of splitting hives at a different time in the season. The goal of "peak performance splitting" is to gain the maximum number of splits during the honey production window with enough time to build up sufficient populations in these nucs for winter survival. This project used conventional equipment, and would allow an experienced beekeeper to utilize traditional on-farm resources they likely already owned.

What made this project different is that hives were not conventionally split in the early spring but rather split during the peak of summer when nectar and pollen are in peak abundance. This is also the time when most beekeepers have their eye on honey production. The perceived fear that honey production would be diminished or limited was not noticeable (but this past summer was an incredibly abundant, exceptional year for honey production in southeast Missouri).

This project also evaluated splits with 1) purchased queens, 2) queens raised locally from adapted stock under ideal conditions, and 3) creating an "emergency" situation when the bees are forced to raise their own queens under some "less than ideal" situations. This third option was designed for the more timid, less experienced beekeeper (likely the one with the fewest resources with which to expand).

The goal of "peak performance splitting" is to gain the maximum number of splits with enough time to build up sufficient populations for winter survival. Conventional splitting, done in the spring, usually produces one split for each hive, and the resulting honey production cannot be expected to match the unsplit hive. Generally, this project created four times more hives than conventional splitting in the spring. Honey production was noticeably diminished, but not necessarily perceived as an economic hardship. The trade-offs seemed to be very tolerable (but again, it was a good year and a rising tide of nectar floats all boats, uh, hives). The earlier the split, the better, and all splits needed some feeding during the summer months. Granted, extra feeding of sugar syrup and pollen substitute patties was an additional cost and required non-farm resources to be purchased.

Overall, the project produced exceptionally satisfying results. The ideal of the project was also to create a locally-adapted model of expansion that was economically feasible and reproducible for the most inexperienced beekeeper. The hives are now going into the winter with the options of either 1) expanding on-farm apiaries next spring, even creating new opportunities for expansion in other locations potentially benefitting pollination in areas devastated by bee losses, 2) providing an on-farm resource to replace winter

“dead outs” eliminating the cash out-flow for purchased replacements of southern-raised bees or 3) offering a resource which can be sold to increase additional on-farm income.
A fourth option exists because an element of each one of these options is possible. That’s the beauty of beekeeping! Not all hives need to be committed to each option. Any beekeeper could commit 1/3 of their hives to each of the three above listed options.

PROCESS AND RESULTS

Three other beekeepers from the Jackson Area Beekeepers Association assisted me in making the splits (John Thompson, Herb Dyer and Claude Swain). We tried, more or less, to divide test hives into three groups (designated as A, B, and C) to use for making the splits. Not everyone had hives strong enough in all the phases of the experiment to split so participation was not always equally divided between the test yards or each of the respective producers. The data and observations from the experiment were lumped together. It was my hope to diversify the management skill and the geographic location to even out any anomalies.
As the 2009 season began last March, thirteen hives were initially selected to be split in the conventional method with early season, purchased, mail-order queens purchased from R. Weaver Bees in Navasota, TX. Sixteen hives were unsplit and cared for in the normal methods of swarming prevention and normal expectations of honey production. These two groups acted, more or less, as “control” hives.
Thirty-six hives were designated to be split during the seasonal peak honey flow. Of these hives chosen for peak performance splits, three different requeening options were explored: a) splits given purchased, mail-order queens, b) splits given queen cells that were raised intentionally in a Nicot queen rearing kit (available from Mann Lake, Ltd.), and c) splits not given any queens but forced to rely on their own resources to raise “emergency” queen cells.
Splitting the hives commenced on June 1 and continued through the end of July. Three frames of brood were pulled from the donor hive and given a new queen or queen cell, and as the hive recovered, a subsequent split was made two or three weeks later. Four series of splits were made over the course of the nectar flow. The nectar flow in southeast Missouri was intense this year due to a mild spring, ample rains and an abundant clover bloom. Temperatures described as “below normal,” and conditions were called “cool and wet,” but we fared very well with exceptionally good honey yields.
It should be noted that the nectar flow was extended about three weeks beyond our normal expectations due to abundant rainfall. No doubt this greatly influenced our results and extended the time available to make splits.
As these three other beekeepers assisted me, I gave direction and instructions, then recorded the observations. We lumped the hives in this project into Control Group A (conventional splits), Control Group B (not split until after the harvest), and Experimental Group C (peak performance splits made during the honey production).
Control Group A Process: In late April, thirteen hives were each conventionally split into two hives, the hive without a queen was given one of the purchased queens. The queens cost $25 each plus shipping. Rainy weather produced delays in requeening the splits. Eleven hives were successfully requeened. The other two (which apparently rejected and killed the new queen) were left to raise their own queens. This left this group with thirteen hives with old queens, eleven hives with newly purchased queens and two hives left to raise their own queens.
One producer complaint arose in that these hives required the queen to be found prior to splitting, a task that is difficult for some beekeepers. Making spring splits is the conventionally accepted method to prevent swarming, however, it is widely considered to reduce potential honey harvests. This reduction is often accepted as a benefit of reducing the hive’s tendency to swarm. It also makes for a smaller, more manageable hive.
Control Group B Process: Sixteen hives were left in the same condition (unsplit) and “checkerboarding” (e.g., Walt Wright) measures were taken to prevent swarming. As expected, these hives grew to expansive hives with large populations. They required extra attention to prevent swarming.

Both Control Groups A and B were supered in the normal methods for honey production. Honey was harvested from July 15 to July 27 and crudely weighed in plastic, five-gallon buckets using a common bathroom scale.

Control Group A Results: These hives that were split and requeened with purchased queens produced an average of 28 pounds of honey. The two hives that were allowed to raise their own queens did not produce any honey and did not grow sufficiently to produce harvestable honey (not sure why). Still, twenty-six hives were ready for late summer, post-harvest treatments to reduce mites. This was a growth rate of 100%.

Control Group B Results: These sixteen hives, left unsplit, were managed to reduce swarming using the techniques championed by Walter Wright of Elkton, TN., a technique he calls "checkerboarding." Their average honey production weighed in at 76 pounds per hive.

At first glance, a 76 pound average was obviously better than 28 pounds. However, this was not surprising. Checkerboarding offers greater cell space and more frames for more honey storage. Further, the army of nectar foragers is always greater in more highly populated hives. The issue at hand becomes a question of whether to operate twice as many hives that produce roughly one-third the volume of honey, or stay with larger hives and a higher production. The former requires purchased queens, the latter requires more intense efforts and attention to prevent swarming. Higher populated hives, as in Control Group B, also require taller hives, and with the weight of heavy supers, present an issue for older beekeepers with bad backs or arthritic shoulders. There are trade-offs everywhere.

Choosing between the models of either Control Group A or Control Group B may depend on how much extra equipment is on hand (largely tops and bottoms). It also may depend on whether the producer is more concerned with the average production per hive versus the total overall honey production. Hives with smaller populations (Group A) also tend to be more gentle, less defensive and less aggressive, and thus easier to work without undue stinging episodes.

The real key came at the end of July when the hives of Control Group B were split. These highly populated hives were easily split four ways, approximately five frames per nuc. They were also supplied with locally-produced queen cells which I raised from my locally-adapted stock. The queen cells rendered a 100% acceptance and the old queens from the over-wintered colonies were considered too old for the 2010 season and they were destroyed.

The end result created sixty-four nucs from the original sixteen colonies in Control Group B, a growth of 400%. Likewise, these hives are also being prepared for winter. With the younger, summer raised queens, these hives show an exceptional brood pattern going into the winter. Further, honey production greatly favored this post-harvest splitting but these hives were also harder to manage with all the extra supers.

We believe these results sufficiently challenged the conventional spring splitting methods, but the results were not without trade-offs. It would also depend upon one's purpose for keeping bees and how one would pursue those goals.

Experimental Group C: The "Peak Performance" Split Hives: These thirty-six hives were managed for swarm prevention as Control Group B, supered on May 8 for honey production. A queen excluder kept the queen in the lower two brood boxes.

On June 1, entering the peak nectar producing season, two frames of brood and bees were set in a nuc box given a purchased mail-order queen. Queen prices should have gone down as the seasonal demand declines with each passing month. They remained the same, however, and queen producers lamented a "shortage" of bees that was driving up the price. Thirteen queens were purchased at $25 each as this was the smallest order with the best shipping price.

Also on June 1, twenty-three, three-frame nucs were made by removing three frames from the other respective hives in this group. These splits were allowed to raise their own queens so it was insured that each nuc was given frames with ample bees and available eggs. All nucs were fed sugar syrup and given pollen substitute patties even though nectar and natural pollen were available. This is a standard practice. In each of these original hives, frames of fresh wax foundation were given to fill the vacancies created by the frames removed to establish the nucs.

On June 14, another thirty-six nucs were created by removing three frames from each of the hives, with frames of fresh wax foundation given to replace the removed frames. Bees in half of the nucs were forced to raise their own queens, the other half received locally produced queen cells (would have been more but this batch of queen cells didn't work out as well). Nucs were conventionally fed.

On June 24, the process was repeated. Three frames from each hive were again removed to a nuc to add another thirty-six nucs. Each nuc was given a home-grown queen cell and fed syrup and pollen substitute pollen patties. Three new frames of fresh foundation were added to fill those vacancies in the donor hive.

At this point, a surprising revelation came to the forefront. The colonies from which the frames of brood were "borrowed/robbed" for nucs welcomed the new frames with fresh foundation. Upon later inspection, most of these frames were completely drawn out and completely filled with developing larvae. It has become a suggestion at several bee meetings that we need to swap out our old, black comb in favor of new, fresh foundation. The rationale is that old, black brood comb contains increasing levels of residues and pollutants accumulated from years of production. However, few beekeepers will follow this advice as it seems too costly. Now, I'm not so sure our frugality is valid. As we were "forced" to bring new foundation to our production colonies, we were surprised at how the colonies excelled with brand new foundation.

One of the participants compared the robbing of frames of brood to that of "pruning" or "pinching" back plants. In response to the stress of taking the brood out and given new foundation, it would appear our donor hives seemed to rise to the occasion and produce greater amounts of brood.

Also on June 24, the first splits (made on June 1) in this Experimental Group C were evaluated. The thirteen splits made with mail-order queens were about twice the size as the splits that were forced to raise their own queens. This was expected as a mail-order queen is ready to start laying eggs upon acceptance. With the nectar flow going well, all thirteen queens were accepted. All of the rest of the hives, twenty-three had raised their own queens.

The developmental differential between mail-order queens and the self-made "emergency" queens was cause for alarm, initially. As the summer wore on, and given more time during the summer months, the differential was not such a concern, however, the mail-order queens were clearly more advanced.

On July 6, the process was repeated. In normal years with normal rainfall, this last split would not likely be an option. However, we felt adventurous and pushed the bees to adapt to our ambitions, hopes and dreams. Three frames were removed, three new frames of fresh foundation replaced the missing frames in the donor hive. All thirty-six nucs were given locally-raised queen cells and fed sugar syrup and pollen substitute patties.

On July 6, the splits from June 14 were evaluated. Though it was still early in their development, it would appear that splits forced to raise "emergency" queen cells were not as vigorous as the colonies headed by locally produced queen cells. We deduced that our queen rearing colonies (source of our queen cells), dedicated to that task, had larger populations of bees that cared for the developing queen larvae better than the smaller colonies left to their own resources with smaller populations.

Honey was harvested from these thirty-six original hives between July 24 and July 28 and averaged 22 pounds per hive. This amount was a pleasant surprise given the fact that we now had multiplied our nucs four-fold and we still had the original hives. My feeling is that the decrease in the average honey production (from 76 pounds in the unsplit (Group B) to 22 pounds (Group C), a value of approximately $162 per hive at maximum retail prices) was more than offset by the increased number of nuc hives. It may have been the resources (nectar/honey) required to draw out the additional frames of fresh foundation likely contributed to the decrease in honey production. The value of each nuc, in the following spring is around $80. The sale of two nucs would cover that loss.

When compared to the conventionally split colonies in Group A with 28 pounds of harvestable honey, we were very, very pleased with the production in Group C. We felt the difference of 28 (Groups A) pounds to 22 (Group C) pounds of honey may have been close enough given the variables of location, plus we had all of our splits/nuc colonies on top of the honey. These results were very satisfying.

It also should be noted that our honey production was measured by the honey that was extracted and the honey collected from the cappings as they drained for 24 hours. Differences in production will undoubtedly

vary between locations, and between hives. I shot for an average to try and even out these variables.
For the months of August, hives were fed High Fructose Corn Syrup and evaluated. Non-chemical treatments for mites was conducted during September, October and November and more syrup was fed to insure winter survival. Most of the existing queens in the donor hives were replaced and the hives prepared for winter.
As a rough summary, conventional splits (Group A) yielded a total of thirteen nucs from the original thirteen hives, a 100% increase. Conventional unsplit hives (Group B) easily yielded a post-harvest sixty-four nucs from the original sixteen, a 400% increase. The peak-seasonal splits (Group C), making periodic nucs and giving the original hive new frames, created four nucs from each original hive, a 400% increase. We started with thirty-six hives in Group C and ended up with one hundred and forty-four nucs ready to be overwintered. If this had been a normal year, without the addition of the last splitting opportunity, we still would have ended up with one hundred and eight nucs, a 300% increase.
As this experiment moves into the winter months, winter survival is now the final test. All splits made during the summer months required feeding of sugar syrup and pollen substitute patties.

PEOPLE

I utilized three beekeepers from the Jackson Area Beekeepers to make splits. These beekeepers were selected based on their desire to grow and expand and my familiarity with their beekeeping skills. All three have at least 4 years of beekeeping experience and maintain apiaries of twelve hives or more. The club membership hovers around 24 members, all of whom had an interest in our work, but many of them decided it was too much work until we finished in the fall and presented our rough conclusions at the October meeting.
It is our hope to offer this experiment to this club in our spring meetings, as well as to offer a mentoring oversight to those who wish to expand.
Consultations via e-mail and the Internet included five individuals and two beekeeping groups in Virginia and Maryland.
Beekeeping is a unique operation, and not generally resourced by local extension services or state conservation agencies. Without sounding negative, there are more pressing enterprises with higher revenues that attract the time and talent of their respective personnel. Beekeeping is not perceived as an economically significant enterprise in our area. Missouri ranks approximately 26th among the other states in honey production. Beekeeping still wears the mantle of a “hobby” in this part of the country. Additionally, the threat of stings keeps many supportive officials reclosed in their offices more interested in a conversational level of support.

DISCUSSION

What did we learn? Generally, I think the best thing we learned was the merit of taking risks and thinking “outside the hive.” One of the intrinsic values of a SARE grant is the pragmatic license to push the envelope without incurring irreversible hardship. The grant is like a safety net that gave us permission to try something new. Further, the experimental mission stimulated by the grant created a commonality and collegiality that we would not likely have developed on our own. In sharing the resources provided by the grant, we were able to overcome the natural inclination of “what’s in it for me?” and convert it into, “Man, this is sure fun working together!” (Southeast Missouri dialect added for affect.) Since no one was really at risk, no one felt protective of the outcome.
Specifically, we challenged the conventional perceptions of spring splits as the best method of honey production. Our eyes were opened with the advent of adding new foundation to existing hives, fearing rather ignorantly that such practices would stress the hive too much. Instead, it seemed to stimulate the queen to lay more and more eggs, which provided for us the seeds for additional nucs/splits.
How has this affected our operation? I think the obvious effect lies in challenging the status quo of conventionally accepted practices—not that there’s anything wrong with them. We worked together to find a better way that increases the sustainability of our operations. More importantly, the successful results

gave us an incredible insurance policy against a dependency from purchasing spring nucs from southern producers. We anticipate having local nucs for sale whose availability is independent from weather anomalies in the south and queen shortages.

Did we overcome our barriers? I would answer confidently that we found a better way to increase the sustainability of beekeeping. With the shortage of bees created by Colony Collapse Disorder, with the high cost of replacing dead hives with southern nucs, with the increased awareness and interest in beginning beekeeping (and the high cost of getting started), with the opportunities to expand without incurring difficult financial investment, and with the potential to sell extra nucs to an eager market, I would call our experiment a success. Secondarily, we proved to ourselves we could do it. In retrospect, it wasn't as hard as we feared. The SARE grant opened that door enabling and empowering us to try something new!

What are the advantages/disadvantages? As I outlined in the above paragraph, beekeeping is expensive to initiate and maintain through the seasonal losses of hives, this experiment reduced that financial barrier to those who wish to start and those who wish to expand. It also, as was my initial hope, to create the possibility for someone who suffered horrific losses to CCD to rebuild, economically and with sustainability, from what was left. On the flip side, it's a lot of work and the timing of raising one's own queens is rigorous and leaves no room for extended spells of bad weather or procrastination. The experiment of splitting hives during the peak honey flow also did not diminish our production as much as we initially feared, but instead gave us a good model to maintain some level of production.

Recommendations? I think the best recommendation of this project is the flexibility. A beekeeper can use it to varying levels of production, and not every hive has to be committed to being split. Even just one hive (or a small percentage of a larger operation) can be split in order to provide some nucs that could insure the sustainability of the enterprise. It was also our hope to create a model that any beekeeper could follow and reproduce.

PROJECT IMPACTS

The economic impact seems to be the largest component to this experiment. A single nuc to replace a dead hive costs $80 (plus any transportation costs to pick it up). The difference between the conventionally split hives and Peak Performance splits was a weight difference of 6 pounds of honey, and at best, the retail price for that missing honey is $3 per pound or a loss of $18 for one hive in honey production. Yet the net gain if just one nuc is produced is $62 on the positive side. Now multiply that $80 for each nuc by the four nucs produced per hive ($320) and whether sold or used for replacements for dead hives, this experiment shows some significant savings to the beekeeper. (This is gross as each new nuc requires approximately $23 in new equipment and supplies. However, if a beekeeper experienced hive deaths and used these nucs to rebuild and recover from the loss, much of that equipment could be reused and would not have to be purchased.) The splits required approximately $12.72 in supplemental feeding in the form of sugar syrup and pollen patties.

On an environmental impact, things start to get interesting. Due to CCD, Colony Collapse Disorder, the losses in the number of hives in the United States has been devastating. Simply finding hives of bees to replace seasonal "dead-outs" is becoming increasingly difficult. The impact to the almond pollination has been especially hard requiring more hives to be transported across the country to meet demand. Additionally, bees from Australia have been imported to California to meet the almond pollination. There are grave concerns and a host of normally irrational paranoia that believes imported bees will only bring in more disease threats to an already endangered U.S. honeybee industry. Conceivably, this experiment shows the potential for significant expansion utilizing existing hives rather than bringing in potential disease threats.

Socially, there is a grass-roots effort to teach beginning beekeeping classes and the demand is overwhelming, particularly in urban/suburban areas like St. Louis, MO. Beginner kits run from $150 to $200 per hive, and that doesn't count the cost of the bees. Bees and nucs are in short supply, and available largely from southern states where the winters end earlier. This experiment shows that the availability of bees does not need to a limiting factor to prevent a new beekeeper from entering the

business. In fact, bees could be produced locally from adapted stock that would likely increase the beginner's success.
More information is included in the Farmer Rancher Benefits and Impacts Form.

OUTREACH
Beekeeping is seasonal, and during the process of running the experiment, updates and verbal progress reports were shared with the Jackson Area Beekeepers. Additionally, I spoke to the Parkland Beekeepers (Farmington, MO), the SEMO Honey Producers (Poplar Bluff, MO) and a brief synopsis at the Missouri State Beekeepers Fall Meeting in Jefferson City, MO. I gave them a talk about raising locally produced queens. Updates were shared but our final numbers were not tabulated and no written report was yet generated. Due to the on-going nature of the experiment, a field day/demonstration was not suitable.
Future plans include follow-up to these meetings as well as two articles for publication in Bee Culture and the American Bee Journal. The editor of the Missouri State Beekeepers newsletter requested information. Because the information is rather limited to the beekeeping industry, these were the most suitable outlets.
My daughter would like to make a DVD "video" of our process next summer as we repeat our work and distribute it, perhaps on "YouTube.com."

Introduction

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