Specialty Crop Block Grant Sustainable Beekeeping Using Top Bar Hives

Abstract
The Kearsarge Beekeepers Association received funds from NH Department of Agriculture, Markets & Food's Specialty Crop Grant Program for a Sustainable Beekeeping Project to test the efficacy of top bar bee hives in New Hampshire. This report summarizes the purpose, goals, results, and conclusions of this project.

Purpose
Decreasing availability of affordable land for farming, economic and demographic factors, and high property taxes combine to make specialty crops a linchpin of New Hampshire's economic engine. Specialty Crop growers depend greatly upon the work of pollinators, wild and domestic, to produce crops. Honeybees alone pollinate about $10 million worth of crops in the US annually.

New Hampshire's long, cold winters and unpredictable weather during the short growing season make beekeeping a challenge at the best of times. In recent years, many additional problems have beset honey bee colonies, including parasites, fungi, viruses, and contamination by fungicides and pesticides, all of which have had a cumulative negative effect, resulting in the disappearance of most feral honey bee colonies and a significantly higher average annual loss of honey bee colonies managed by beekeepers across the United States.

These higher annual losses have resulted in increased pressure on the honey bee industry as a whole. Bee package and queen producers struggle to keep up with the demand for replacement colonies in addition to new colonies, and the quality of these bees has appeared to decline as a result. In addition, the shortage of these starter colonies has caused prices to rise and has limited access of hobby beekeepers to these resources. As a result, there has been a strong movement toward more sustainable practices and the use of alternative beekeeping methods.

Goals

This project explored alternative beekeeping in Kenyan Top Bar hives to test claims that these hives use a more natural beekeeping methodology to reduce exposure to traditional management related stress, such as pesticide contaminated wax foundation, intensive colony manipulation, and honey bee pests and diseases. Top bar hives have been touted as easier to manage, cheaper to build and maintain, healthier for the bees, which potentially would increase the bees resistance to pests and diseases, and a more natural way of keeping bees that allows the colony to manage itself to meet its own needs. Emphasis is supposed to be placed on the health and well being of the colony as opposed to managing the colony for maximum honey production or crop pollination.

However, there is some doubt that the colonies will survive the winters in New Hampshire due to their clustering behavior. In traditional Langstroth hives as well as in natural hives in tree cavities, bees form a tight cluster to keep warm during the cold winter months, eating the stored honey above them for energy. As the cluster consumes the honey within reach, it moves upward with the warmer air in the hive to maintain contact with available honey stores. In contrast, in top bar hives, the bees will need to move horizontally or even down and around combs to reach available honey stores. There is some doubt that our European honey bee clusters are willing and able to move in this way.

Related project goals included expanding apiarists' expertise in sustainable beekeeping practices and raising public awareness of the importance of all pollinators to New Hampshire's food security.

Following a presentation on top bar beekeeping by Christy Hemenway of Gold Star Honeybees, the majority of the beekeepers received two Kenyan top bar hives each (with the exception that 2 beekeepers received 1 hive each), plus a package of bees with a caged Italian queen to be placed in each hive. Beekeepers were allowed to replace the package queens with their own queens of other races of honey bees if they wished.

The project participants assembled the hives, installed the bees, and provided starter food in the form of sugar syrup, or rarely, honey. The participants then monitored the progress of the colonies, committing to at least one inspection per month to be recorded on inspection sheets specifically designed for the project by participants. Beekeeping skills varied widely, ranging from beginners with apparently very little experience to advanced beekeepers who had been practicing traditional beekeeping for several decades.

Results

Beekeepers encountered several problems and setbacks during the course of this project. Although spring arrived several weeks early in New Hampshire in 2010, cold, wet weather in the southern states where bee packages and queens are produced resulted in delays in spring build up and forced subsequent delays in the shipment of packages. When the packages were received in mid May, many appeared weak and sluggish, and several absconded soon after being installed in the hives. One queen arrived dead, necessitating immediate requeening of the colony. In addition, the packages arrived too late to take advantage of the spring/summer nectar flow, the best source of nectar for most of New Hampshire.

The early spring in New Hampshire was followed by a dry, hot summer. The lack of rain resulted in a dearth of nectar and pollen until September or even October in some regions. Many queens stopped laying eggs by July due to the lack of food resources and did not resume until September. On a few of the hotter days, some of the heavier wax combs, softened by the high temperatures, began sagging and many broke from the top bar.

Of the 36 colonies of honey bees installed in the top bar hives, 9 were reported lost before winter due to absconding, swarms, queen failure, or starvation. 26 of the remaining 27 colonies died during the winter and early spring. Only 1 out of 36 colonies survived the winter and is entering its second season. That hive had been combined with a Russian hybrid nucleus colony back in mid August, because the original Italian queen was observed to have stopped laying eggs and did not resume after feeding for several weeks.

In keeping with the project's secondary goals of increasing public awareness and encouraging pollinator habitat, UNH Co-operative Extension Entomologist Alan Eaton led a spring workshop, *Encouraging Native Pollinators,* at Warner's Pillsbury Free Library. Over 25 people attended.

Conclusions

Top bar hive proponents portray the hives as easier to manage, cheaper to build and maintain, and healthier for the bees, making them more resistant to pests and diseases. Most of the project participants agreed that the top bar hives were easier to manage in some ways. After the hives were assembled, there was very little heavy lifting involved with maintaining the hives, except for the cumbersome cover that had to be removed each time the beekeeper needed to refill the feeder or conduct an inspection. The bars were at a comfortable working height for inspections and manipulation, so no reaching or twisting with heavy boxes was involved, making these hives easier on the beekeepers' backs. In addition, the bees seemed easier to handle during inspections, likely because lifting a bar for examination created a much smaller opening in the hive than when a beekeeper removes an entire box from a Langstroth hive, exposing the tops of 10 combs.

Langstroth hives often use wax or wax coated plastic foundation imprinted with a pattern of worker cells and inserted into rectangular wooden frames. This helps to ensure that uniform combs of worker cells are drawn out that fit together to form the standard 3/8" bee space between combs inside a wooden box, as well as between upper and lower surfaces in additional boxes. Unfortunately, the wax used for foundations or the coating come from commercial beekeepers that sell their excess beeswax to bee supply companies. This wax is usually contaminated with low, but detectable levels of pesticides either used by the beekeepers or brought back to the hives by the bees as they forage in areas that have been treated.

In the top bar hives, the bees draw out their own wax comb attached to wooden bars. Proponents of natural comb believe that it allows the bees to build cells of various sizes as they would in the wild, and avoids using wax contaminated with pesticides. They believe that this makes the colony healthier and more able to resist the various diseases and parasites, such as varroa mite.

Varroa mites feed on adult bees and pupae by piercing the exoskeleton and sucking out the hemolymph, or blood, of the bees. The mites reproduce in the cells occupied by immature bees. The mites enter the cells just before they are capped, mate, and feed on the immature bees in relative safety in the closed cells. During feeding, the mites can transmit viruses to the bees. Viruses have been implicated as one of the components that can cause a colony to collapse, a malady known as Colony Collapse Disorder (CCD).

Top bar hive beekeepers have often claimed that they observe low levels of varroa mites in their hives and do not have to treat the hives, but the more experienced participants in this project found these claims questionable. Higher mite levels were observed in some of the stronger colonies that were able to build up to larger populations. Unfortunately, the hive design did not allow for conventional treatments for varroa mites, requiring more improvisation on the part of the beekeeper. Although many participants reported low mite levels, this was most likely due to the fact that these weak colonies had raised very little brood during the dearth in the summer months. Many queens stopped laying until the fall. Without the developing brood, the mites can't reproduce. A break in the brood cycle where no brood is produced for a short period is often recommended in traditional beekeeping as a way to reduce mite populations.

Successful experienced beekeepers regularly monitor the local weather conditions and assess colony health and development. They anticipate the needs of the bees based on those factors, providing more storage or brood space as needed in the form of bars or comb, and feeding colonies syrup and/or pollen patties at key times in the development of the colonies and in periods of dearth. For beekeepers experienced with Langstroth hives, the top bar hive style made it more difficult to accurately determine the strength and condition of the colony.

New Hampshire potentially has two major nectar flows during the growing season. The best nectar flow is normally in late spring/early summer, and the other flow is in the fall. Most traditional beekeepers try to manage the colonies to build up early to take advantage of that spring/summer flow, or at least build up on the flow. Often the colonies will store enough honey on this flow to make it through the long winter months. Unfortunately, the bee packages used in this top bar hive project were received too late for them to take advantage of the 2010 spring/early summer nectar flow.

The hot, dry summer that followed the early spring resulted in a dearth of nectar and pollen. What little pollen was available was likely very poor in quality, as research has shown that pollen produced by flowers in these conditions contains reduced levels of protein. When rains resumed in the fall, the colonies did not have time to recover from the dearth, raise enough winter bees, and store enough nectar to see them through the winter.

Although top bar hives were touted as requiring very low input from the beekeeper, the more experienced beekeepers in this project recognized that the dry, hot weather might result in a shortage of food resources, and the new colonies would not be able to draw enough comb, rear enough bees, and gather enough food during the short season. These beekeepers continued to feed the bees sugar syrup and/or pollen from the time the bees were hived in May, until late fall in November. Even then, some of these beekeepers reported that they did not think the bees had stored enough honey to make it through the entire winter.

Either due to lack of experience or infrequent inspections, most participants did not continue to feed beyond the first month after installing the bees. Several of the colonies in these hives absconded or attempted to supercede the package queen within a month after installing them. Some beekeepers reported that their colonies swarmed, but in most cases it appears that the beekeepers mistakened the supercedure process or absconding for swarming. According to the data in the inspection reports, these hives appeared too weak to have swarmed. Some participants resumed feeding syrup in the late summer or early fall, but by then it was too late for the

colonies to recover. These colonies did not rear enough winter bees in August and September, and thus entered winter with too few bees to sustain the cluster until spring. Many of the hives died between January and March, indicating that the bees died of starvation or freezing because the clusters were too small or the hive did not have enough honey stores.

Feeding the colonies in the top bar hives proved to be challenging due to the design of the hives. Although part of a basic syrup feeder was supplied, it was an internal feeder that required frequent refilling. A few of the more experienced beekeepers tried other methods, but were frustrated by the limitations of the hive design. Lack of provisions for feeding pollen patties or fondant was also a problem. Fondant or granulated sugar can be used to feed colonies that have run low on food during winter months. The beekeepers improvised, but did not feel that the available methods were able to provide adequate food resources close enough to the brood or the clusters to support them properly.

In addition to the lack of adequate feeding provisions, the participants were frustrated with several other limitations of this top bar hive design. The dimensions and the shape of the hive prevented the beekeepers from being able to effectively transfer combs, brood, or food stores from their Langstroth hives or nucleus hives to strengthen the top bar hive colonies. Had they been able to do so, more colonies might have survived. There also did not appear to be enough ventilation in the top bar hives during the winter months. Air movement within the hive is required to remove excess moisture, which could drip on the cluster and cause it to freeze to death. Also, the depth of the box and the close proximity of the comb to the screened bottom during colder periods in spring, fall, and winter was seen as a possible detriment to the colonies, particularly smaller ones. Lack of effective tools and other equipment designed specifically for top bar hives was a common complaint as well.

In conclusion, the project results are not necessarily a condemnation of top bar hive beekeeping in New Hampshire, but rather an indication of just how challenging it can be to keep honey bee colonies alive through a year of New England weather while colonies are simultaneously beset by so many pests and diseases. Attempting to overcome these challenges in an alternative beekeeping system such as the top bar hive adds one more unnecessary complication. Although we found in this trial that over wintering colonies in these top bar hives was more difficult than in Langstroth hives and there are several design issues that need to be fixed, this project may not have been an adequate evaluation of the hives due to the encountered problems unrelated to hive design. The project resulted in over 97% loss of colonies, but many of those losses stemmed from weak packages and queens, unfavorable weather, and lack of beekeeper experience. The same beekeepers that lost colonies because they did not continue feeding the bees throughout the season likely would have lost any new packages installed mid May on foundation in traditional Langstroth hives as well. There just wasn't enough quality natural food resources available to the bees in most areas last season to fuel the development of a colony and sustain it through the winter months.

Colony losses sustained by the more experienced beekeepers indicate flaws in the design of the top bar hive, but there is not enough data to be definitive. What can be inferred from this project is that the top bar hives are likely not for beginning beekeepers. These beekeepers lack the experience and knowledge to properly assess the needs of a colony during inspections and need a support network of reference material, advice from NH beekeepers experienced in top bar hive beekeeping, and equipment that does not exist for top bar hives. These beekeepers would be more successful learning to keep bees using traditional methods in Langstroth hives before attempting beekeeping in top bar hives. There are a lot of modifications and techniques that could improve the success of top bar beekeeping, but they have to be tested through trial and error. However, the lower productivity and less advanced methods of beekeeping in the top bar hive, combined with the expense and limited number of bee packages, may result in these hives being more of a curiosity appealing to a small number of niche beekeepers.

Finally, the cost of the hives purchased for this project was prohibitive, in the opinion of most participants, especially considering that the main purpose of the top bar hives prior to the recent interest in "natural"

beekeeping was to provide income from hive products to people in poorer countries, with minimal costs. The top bar hives were meant to be built very cheaply with whatever materials were on hand. The modifications made to the design of the project's top bar hives made them easier for most people to assemble, but for the most part were unnecessary and did not improve the success of keeping colonies in those hives.