THE GULCH ENVIRONMENTAL FOUNDATION

2022 ANNUAL HIVE STATUS REPORT: RAINMAKER FARM

2022

BEEHIVE MONITORING ANNUAL REPORT

RAINMAKER FARM

PREPARED AND PRESENTED BY

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1.1 INTRODUCTION

I was hired in April 2022 by the Gulch Environmental Foundation to establish, maintain, and monitor their beehives and European honeybee (Apis mellifera) colonies located at Rainmaker Farm (7500 Yearling, Billings, Oklahoma, 36.503588, -97.351307). I was also to quantitatively compare the performance of the traditional Langstroth hives with the newer designed Flow hives. This report summarizes the activities, maintenance, and monitoring results during 2022, from the date of my hiring through Dec 31.

1.1.1 BACKGROUND & SETTING

The farm is located in north-central Oklahoma, just off I-35 roughly 80 miles north of Oklahoma City. The landcover at the farm is a mix of annual crops, approximately 20 acres of mostly native grassland, riparian areas, seasonal creek, and two manmade ponds. In 2022 roughly 20 acres of native pollinator mix was planted along the creek, and an orchard with roughly 100 trees of a variety of species was established.

2022 was an extreme drought in this region of Oklahoma, with no rain for 50 days during the growing season, which impacted hive productivity.

1.2 2022 ACTIVITIES

Honeybees were not previously established at Rainmaker Farm, and 2022 was the first year they were introduced. This year the Gulch Foundation team built the hives, established a location, obtained nucleus colonies (NUCs), and then maintained the bees until hibernation.

1.2.1 COLONY ESTABLISHMENT

Prior to my hiring, four hives and four NUCs has already been ordered. The purchased hives consisted of 2 traditional Langstroth hives obtained from Beekeeping Etc. in Oklahoma City and two Flow hives purchased from Flow. All hives were assembled during a team building even on the farm immediately prior to obtaining the NUCs.

I worked with Angel Lance to choose a suitable location for the hives, considering flood and wind protection, sun exposure, water access, and foraging opportunities. The main factors for the location choice were flood and wind protection especially with how flat and open the farm was generally with the only other potential spot for wind protection being by the creek bed. The central location on the farm for foraging and water availability being secondary concerns. Ultimately, we chose an area on the crest of the northern berm of the perennial pond (Figure 1). This site is forested with mature trees, with easy access to water and good sun exposure (Photo 1).

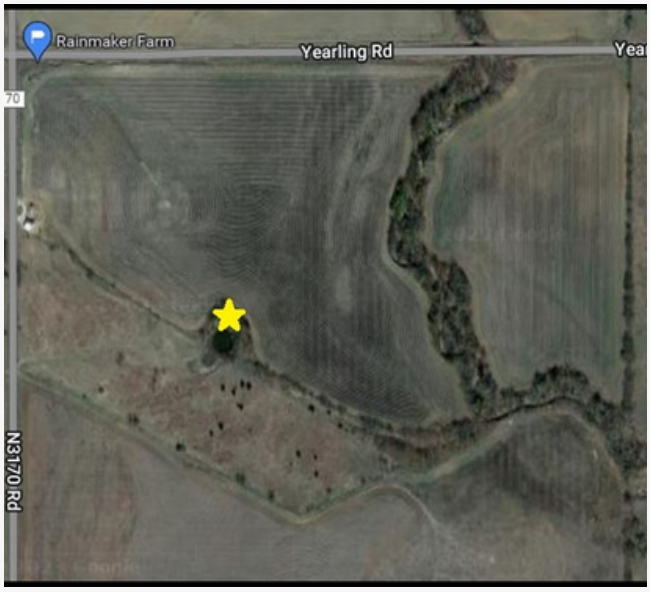


Figure 1 - Hive Placement

Photo 1 - Hive Placement

The hives are east facing and will be changing to south facing this spring. The reason for this is studies suggest it provides better wind protection and encourages better overwintering.

Each hive was painted light blue gray (Photo 2). This shade was good because it wasn't super dark or light; which is important because it allows for sun heating in the winter, but not too much heat from sunlight in the summer. The entrance of each hive was painted with different geometric shapes with different colors (Photo 3), as this allows the bees to easily distinguish between the hives and for us to track and monitor the individual hives as well. The two Langstroth hives were identified with yellow chevrons and purple triangles. The two Flow hives were identified with a green line and an orange line. The colors correspond to the identification in the monitoring results.

I retrieved the pre-ordered NUCs from a supplier near Oklahoma City on April 21, 2022. The bees were healthy and contained trace varroa mites.

1.2.2 **HIVE & COLONY MONITORING**

During the active season, I visited the hives roughly every two weeks initially, however as the queening situation changed rapidly this was changed to about once a week by about late June.

During site visits I check for primarily laying patterns/ health of larva and honeycomb development.

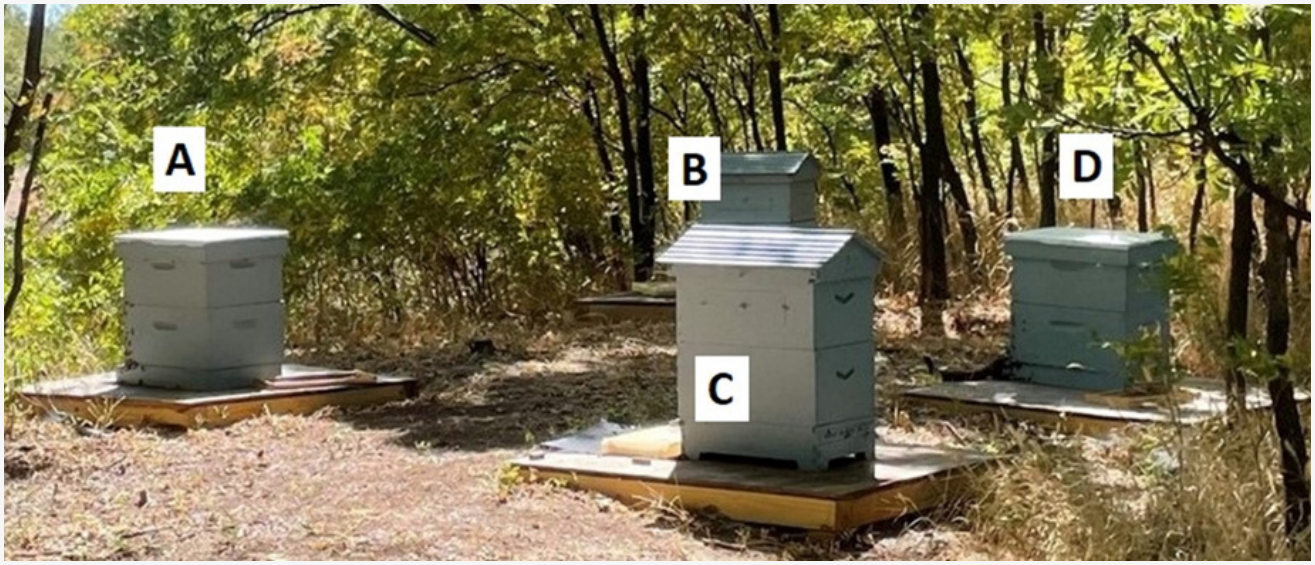


Photo 2 - Hive relative placement and entrance color markings
Hive A – Langstroth, Yellow. Hive B – Flow, Green. Hive C – Flow, Orange. Hive D - Langstroth, Purple.

Photo 3 - Identification Markers on Hive Entrance

1.2.3 **MONITORING RESULTS**

During select hive visits, hives were each monitored for development and health throughout the warm season (Table 1). Categories tracked included how many frames of wax had been built, the total capped honey frames currently in a given hive, and how many frames were currently being processed for honey by the bees.

Table 1 - Honeybee Hive – Productivity Monitoring Results

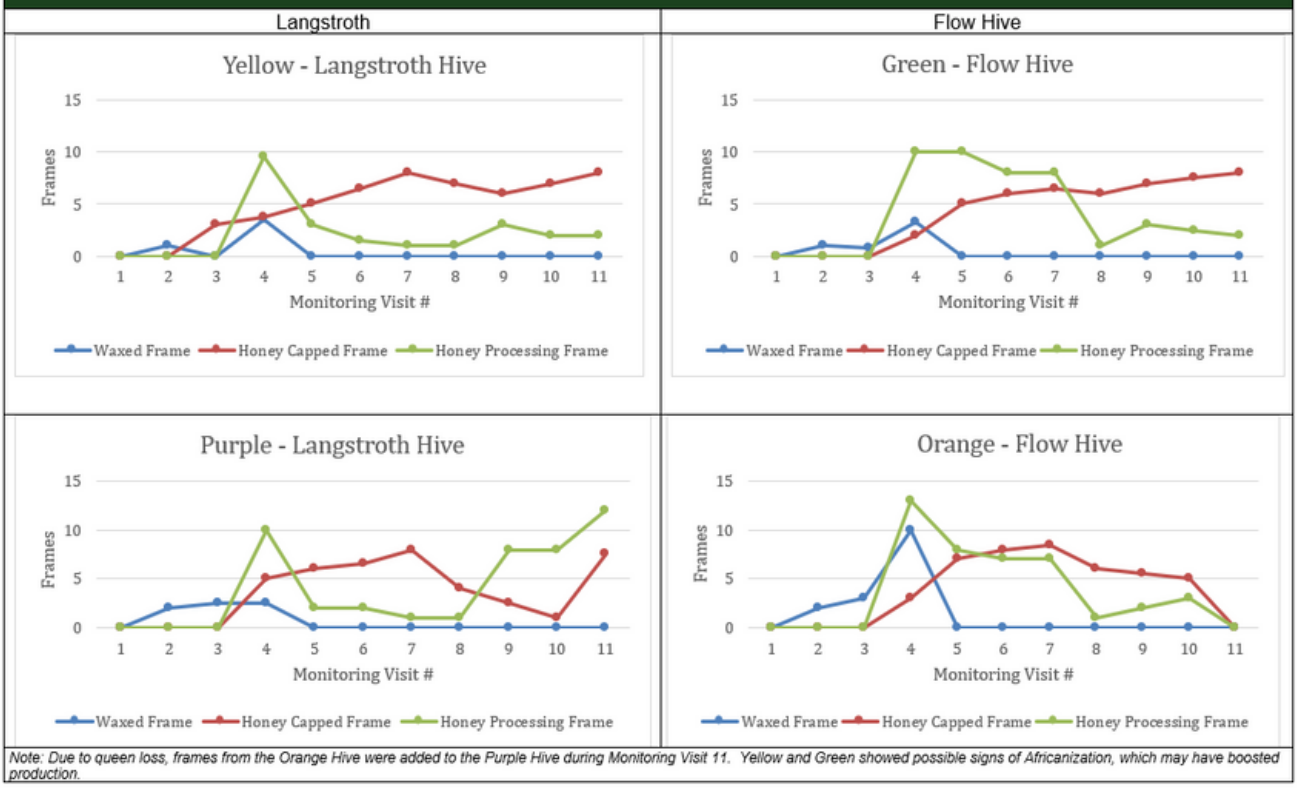
Visit Month	June	June	June	July	July	August	August	September	September	October
Visit #	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8	Visit 9	Visit 10
Visit Date	6/14	6/22	6/27	7/14	7/23	8/8	8/20	9/8	9/16	10/2
Hive ID										
Langstroth										
Yellow (Africanized)	1F	0F 3H	3.5F 3.7H 9.5P	5H 3P	6.5H 1.5P	8H 1P	7H 1P	6H 3P	7H 2P	8H 2P
Purple	2F	2.5F, 0H	2.5F 5H 10 P	6H 2P	6.5H 2P	8H 1P	4H 1P	2.5H 8P	1H 8P	7.5 H 12P
Flow										
Green (Africanized)	1 F	0.75F 0H	3.25F 2H 10P	5H 10 P	6H 8P	6.5H 8P	6H 1P	7H 3P	7.5H 2.5P	8H 2P
Orange	2F	3F 0H	10F 13P 3H	7 H 8 P	8H 7P	8.5H 7P	6H 1P	5.5H 2P	5H 3P	Folded into purple
All Hives							Feeding recomm-ended	Feeding Start	Feeding Cont.	Feeding Cont.

Note: F notes frames of wax built, H is total capped honey frames currently in the hive, and P is for frames in which honey is currently being processed.

Monitoring trends (Figure 2) showed that all 4 hives developed frames of built wax at similar rates. As the bees start to develop those waxed frames into honey and production, those frames are reassigned from wax built to those other categories. By the 4th monitoring visit, all 4 hives were developing capped honey frames. However only the Yellow (Langstroth) and Green (Flow) hives continued to maintain this level of honey capped frames. Both other hives decreased in the number of frames the remainder of the season. By the 4th monitoring visit, all 4 hives were developing honey processing frames at a similar rate, with one Flow hive (Green) having noticeably higher number of honey processing frames than the other three. Honey processing frames dropped off in the Langstroth hives by the 5th visit, but remained high in the Flow hives until the 8th visit, when the Flow hive dropped to the same lower level of the Langstroth hives – coinciding with drought impacted low nectar availability.

After the 8th monitoring visit, honey processing frames in three hives remained low and only the Purple (Langstroth) hive substantially increased honey processing frames for the remainder of the season (supplemented at the end by rolling the Orange (Flow) hives frames into the Purple (Langstroth) hive after the loss of their queen).

Figure 2 - Honeybee Hive - Productivity Over Time



Note: Due to queen loss, frames from the Orange Hive were added to the Purple Hive during Monitoring Visit 11. Yellow and Green showed possible signs of Africanization, which may have boosted production.

1.2.4 **HIVE MAINTENANCE ACTIVITY**

This spring I will redo all the nails in the wooden frames during the spring as they were nailed vertically instead of horizontally. This has caused the frames to fall apart when the hives are inspected, denying the beekeeper access to parts of the hive. I also would recommend we switch to once a week maintenance starting in April and going until mid-July. This way we will be to do closer monitoring to ensure swarming control and prevent queening failures. This will also give better data for hive growth.

1.2.5 COLONY MAINTENANCE ACTIVITY

1.2.5.1 SUPPLEMENTAL FEEDING

As indicated in Table 1, during my August 2nd visit, I noticed that honey supplies were low, and nectar flow was minimal and therefore recommended supplemental feeding. Supplemental feeding began on September 1st, with the placement of sugar water in three-liter internal feeders. Supplemental feeding continued at the same amount with increasing sugar concentration until it was too cold to visit the hives in October.

1.2.5.2 QUEEN REPLACEMENT

The queens of all hives needed to be replaced, with only the orange hive rejecting its queen. New cordovan and Russian queens were ordered from Lappes bee supply in Illinois. The new queens were placed with the colonies on August 17th. It was determined on September 2nd that the queen in Orange (Flow) hive did not take, and this hive was combined with Purple (Langstroth) hive (which had low honey stocks at the time).

1.2.5.3 PARASITE

Varroa mites and hive beetles were spotted, but not to the extent that any treatment was warranted. In 2023 we will note the status of parasites at each hive check.

1.2.6 HONEY HARVEST

Honey was not collected this year, as there was not sufficient production in these fledgling hives to both collect honey and assure survival over winter. This was partially due to the newly established hives, but also due to the extreme drought impacting the region, which impacted nectar producing plants and therefore colony establishment and honey production.

1.3 **SUMMARY & RECOMMENDATIONS**

My initial impression coming into managing these hives was that food supply was going to be an issue due to the sheer amount of cropland with what appeared to be relatively little flowering plants in the region overall. I was and still am concerned about wind speeds and the hives protection, though luckily, it's been a relatively mild winter. However, my initial concerns of food availability, at least initially proved to be wrong as the spring nectar flow was extremely good all across the state including Rainmaker Farm. Unfortunately, these good conditions did not extend into the critical months of July, August, and October. With nectar flow being available, but barely enough for 3 hives. However, the silver lining is that one of the queens did not take, and I was able to consolidate the 2 weakest hives together. **I recommend in the future keeping hives at 3 will be the way to go until we can guarantee excellent food sources even in a hundred-year drought.** All this being said, this year we were in a position to harvest from all hives and leave plenty to spare (with the condensed hives sharing the seasons production).

I was also concerned about Africanization (which makes honeybees more aggressive) because of the region where the bees were bought. Africanized bees are an established problem all across the southern U.S., stopping to the norther around Stillwater, OK. Most hives to the south, Oklahoma City and especially lower, are Africanized with the exception of a few apiaries and beekeepers who work really hard at staying free of Africanized bees. Two hives (Purple (Langstroth) and Orange (Flow)) turned out to be really sweet hives that did really well and showed no signs of Africanization, but these hives were poorly bred in other ways and swarmed rather quickly. The breeding issue has been resolved for all hive with the introduction of more familiar genetic stock. The other 2 hives (Yellow (Langstroth) and Green (Flow)) were possibly Africanized, and that issue was remedied during this the year as well. Africanized bees make more honey as a result of having higher populations during the producing months. So, remedying this issue will make it look like Green (Flow) and Yellow (Langstroth) hives produce less honey in 2023 compared to 2022 even under identical conditions.

One of my duties was to compare and contrast the traditional Langstroth hives to the Flow hives. I have established baseline monitoring and collected the data for this year. However, this year we cannot accurately compare these types of hives due to confounding variables such as Africanization issues, queening failures, and these hives being first year hives – so the data aren't truly comparable. However, I did make many qualitative observations that will inform our monitoring efforts going forward.

The Flow hives have two different types of frames in Flow hives. Frames in the bottom of the Flow hive are comparable to the Langstroth hives, and frames in the upper part of the Flow hive are different. The upper frames are a special design that allows for the harvesting of honey using the special Flow mechanisms. The upper Flow frames are thicker, and queen bees are excluded from the upper part of the Flow hive also. These differences have several implications for both use and monitoring. The thickness of the upper frames means it takes longer for the bees to fill them up, and one upper frame is a lot more honey than one lower frame. As we had been just tracking "frames" for the comparison, and the upper Flow frames are not comparable to the lower Flow frames or the Langstroth frames, the trends in the graphs are not directly comparable this year. **Next year we will track upper and lower Flow frames separately to allow for a more direct comparison.** That being said, as we will describe below the bees elected to leave the upper plastic Flow frames largely unused in 2022; therefore, all hives were essentially running on the basic Langstroth frame system with little structural difference in the active production areas with the bees.

For the most part, the bees did not use the thicker upper frames of the Flow hives this year and they were not filling with honey in the same way the smaller lower frames were being used. This problem was noticeable because of the low numbers of bees above the queen excluder working on the frames. This lower number of bees could be due to the use of queen excluders in the Flow hive design and the bees avoiding expending the effort to move their body through the plastic queen excluder (which takes several seconds).). Flow hives have queen excluders the Langstroth hives don't need. The Flow hives have queen excluders so bee brood will not go into the upper Flow frames, because due to the mechanics of Flow hives, the brood would be crushed and contaminate the honey. Due to the queen excluder, the bees might not consider the upper part of the Flow hive as available space; therefore, the bees may decide their hive is too small, and this causes more swarming events. . We do not yet have any data supporting this happening, but we are monitoring for it.

They wouldn't normally want to push up through the queen excluder because of the effort it takes. So, while both hive types have honey stores, the honey stores are more likely to cause swarming in the Flow hives. Another alternative scenario is the leftover honey stores (because we did not harvest any honey in 2022) allow for greater population growth in all hives at the start of the year 2023, and the bees move through the queen excluder of the Flow hive and develop the frames.

In early 2023 will substitute some metal queen excluders to use in the Flow hives, as the bees are able to better squeeze through the metal excluders because of larger gaps as well as the separating bars being round instead of square allowing for less friction when squeezing through.

I recommend a frame thickness that allows for 9 or 10 frames (as in the Langstroth and lower Flow hives) to maintain standardization so the bees will work evenly across frames, and the upper Flow hive frames only allow for 7 due to how thick the frames are. The reason for this recommendation for thinner frames is the bees like to work on multiple frames at once. The multiple frames also encourage laying in the frames, and bees, while young, work primarily on the frames they hatch on. This also influences use of the larger Flow frames in the upper box, because the bees are prevented from laying, and therefore hatching, on the thicker Flow Hives frames. If we used standard hives the bees could lay in them at the start of the season allowing for higher productivity. Bees don't tend to frames they weren't born on primarily. So, these upper frames would only be filled after the lower frames (where brood can hatch) are filled. Therefore, the Flow hive design made it very difficult for the bees to effectively work in all frames (specifically the upper frames), and this resulting in low amounts of honey on each frame, meaning some frames had to be removed to save space and allow for better heating in the hive. Removing these frames artificially inflated Purple hive's honey stores, but on the Green (Flow) hive (green) box two with the plastic frames was not touched by the bees. However, next year this issue of too much space to heat likely won't be an issue for established hives.

Overall, the Flow hives did well in the warm season. We will evaluate cold season performance in the spring, to assesses if the Flow hives were insulated enough to protect the bees.

The honeybee colonies will become active again during late February or early March in 2023.At that time, I recommend a more consistent checking schedule to do better swarm prevention, once per week, especially given the good nectar flow of last year. Also, the replacement of the plastic Flow queen excluders with metal ones. In the year 2023, I anticipate that we will have fully developed upper boxes and enough honey flow (hopefully) to pull honey in August leaving about 50 lbs per hive for overwintering.

Note: Report drafted by Zachary Royko with assistance by Dr. Aviva Rossi at the Gulch Foundation