The Effect of Crushed Coal on Beehive Temperature in Winter

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ABSTRACT

The winter months are stressful to honey bees because the cold temperature can keep them from reaching their food source (honey) in their beehive. An experiment was conducted in Barkhamsted, CT in order to determine if there is a way to increase the temperature within a beehive using crushed coal. Three beehives were obtained and modified. Temperature loggers were used in order to record hourly temperatures within and outside of the beehives. This data was analyzed to determine if there was a relationship between crushed coal and the internal temperature of a beehive.

INTRODUCTION

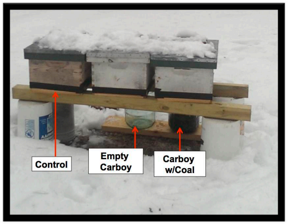
Bees are without a doubt one of the most important components of our food production. Approximately 90 percent of our crops in the U.S. depend on bee's pollinating behaviors. During the warm months, bees gather nectar and pollen from flowers for food during and in the process carry one flower's pollen with them to the next flower they land on.

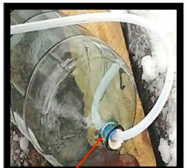
Without bees, our crop production, food supply, and economy will decrease. Beekeepers are trying to find ways to help our bees stay alive and increase their population. One of the ways to help keep bee populations from dying is to increase the temperature of the beehive during winter.

Each individual honeybee is exothermic (maintaining body heat from outside), but collectively the hive is endothermic (maintains body heat from within). With the arrival of winter, the bees, now called winter worker bees, assemble into a cluster, and shiver their flight muscles against each other in order to produce a moderate degree of heat for the hive (4).

The main purpose of the winter worker bee is to help the colony survive until spring. During the cold months, honey bees swarm tightly together in a cluster around the queen when the air dips below 54 °F to 57 °F. The cluster loosens up as the weather warms and tightens back together as it cools. As the temperature continues to decrease, the cluster becomes close-fitted and bunched as the bees cling tightly together on the combs in the hive. The bees at the core of the cluster maintain a temperature of approximately 64-90 °F, while the perimeter of bees sustain a temperature from about 48-57 °F (4).

The winter worker bees rotate through the cluster from the outside to the inside so that no bee gets too cold. The colder the weather is outside, the more compact the cluster becomes (2). During warm periods, the cluster shifts its position to cover new areas of comb containing honey. An extremely prolonged cold spell can prohibit cluster movement, and the bees may starve to death only inches away from honey (4).



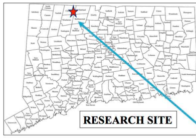


Air Lock Rubber Stopper

MATERIALS AND METHODS

1. Three Beehives (without the bees)
2. Six Feet of ½ inch Ethylene Vinyl Acetate (EVA) Tubing
3. Crushed Coal
4. Two – Air Lock Rubber Stoppers
5. Two – 5 Gallon Glass Carboys
6. One 2x12 Wooden Board
7. Three (3) - Temperature Loggers
8. Frost King Insulation Foam Tape
9. Four 5 Gallon Plastic Barrels
10. Two wood boards 4x4's ~6 feet long

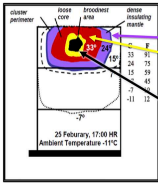
- An attempt was made to crush the coal with a sledgehammer but anthracite is very comprehensive. The coal was placed inside a burlap bag and crushed with a backhoe bucket. Unfortunately, this methodology did not produce as fine a rock powder as is needed to fill a 5 gallon glass carboy.
- One temperature logger was placed in each of the three hives before they were sealed with the Frost King insulation foam tape. The numbers on each logger were recorded.
- Three feet of the EVA tubing was connected and sealed from/to a beehive and to the carboy with coal.
- Three feet of the EVA tubing was connected and sealed from/to a beehive and to the empty carboy.
- The third beehive was sealed and did not have any attachments. This hive was used as the control.
- A one inch opening, the entrance for the hypothetical bees, was left unsealed in each of the three hives.
- In order to allow space for the glass carboys under the beehives, four barrels were placed, upside down, on the ground and a 4x4 piece of wood was place on the top providing a surface to place the beehives.
- The 3 beehives were places on the boards .

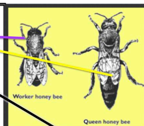


The snow acts as an insulator!

Honey Bee on Apple Blossom

Bee pollination not only results in a higher number of fruits, berries or seeds, it may also give a better quality of produce. The appropriate amount of pollination helps the development of all the seeds in a fruit. An apple, for example, will only develop all the seeds inside if it has been pollinated by several bees and fully fertilized. It is possible for an apple flower to develop about ten seeds. If all the seeds do not develop, the fruit itself does not develop where the seeds are not developing. This results in poorly shaped apple of low weight (3).

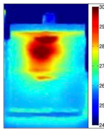




You can call me *queen bee*……..

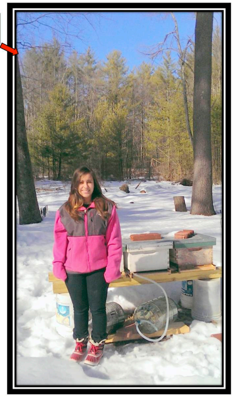
Within this cluster, the Queen is kept warm-about 93° F – with heat generated by the worker bees. Bees winter best on combs that have been used for brood rearing. (6).

Temperature Loggers

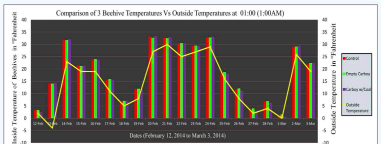


A long-wave infrared image of a beehive during winter showing the bees clustered in the center protecting the Queen Bee (7).

Ariana inspecting The Bee Hives



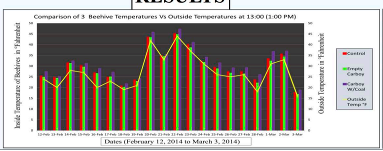
RESULTS



Comparison of 3 Beehive Temperatures Vs Outside Temperatures at 01:00 (1:00AM)
Inside Temperature of Beehives in °Fahrenheit
Outside Temperature in °Fahrenheit
Dates (February 12, 2014 to March 3, 2014)
Control
Empty Carboy
Carboy w/Coal
Outside Temperature

1:00 AM Temperature Data

Date	Control	Empty Carboy	Carboy W/Coal	Outside Temp °F
12-Feb	3.357	3.357	2.414	2
13-Feb	14.268	14.083	14.368	-4
14-Feb	31.791	31.743	32.042	23
15-Feb	21.576	21.238	21.242	19
16-Feb	23.956	24.01	23.728	19
17-Feb	15.681	15.863	15.598	11
18-Feb	6.793	7.072	7.033	5
19-Feb	11.808	12	11.778	8
20-Feb	33.138	32.691	33.288	27
21-Feb	32.691	32.542	32.842	30
22-Feb	30.429	30.529	30.325	25
23-Feb	29.406	29.509	29.299	27
24-Feb	32.841	32.79	33.04	29
25-Feb	18.365	18.714	17.995	16
26-Feb	11.678	12.128	11.065	8
27-Feb	3.65	4.015	3.012	2
28-Feb	6.724	7.002	6.194	4
1-Mar	1.175	1.558	0.582	0
2-Mar	29.097	29.097	29.404	26
3-Mar	22.08	22.469	22.402	19



Comparison of 3 Beehive Temperatures Vs Outside Temperatures at 13:00 (1:00 PM)
Inside Temperature of Beehives in °Fahrenheit
Outside Temperature in °Fahrenheit
Dates (February 12, 2014 to March 3, 2014)
Control
Empty Carboy
Carboy W/Coal
Outside Temp °F

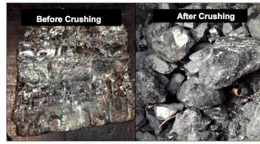
1:00 PM Temperature Data

Date	Control	Empty Carboy	Carboy W/Coal	Outside Temp °F
12-Feb	25.578	25.041	27.538	24
13-Feb	24.879	24.499	25.201	20
14-Feb	31.692	31.39	32.491	28
15-Feb	30.429	29.714	31.339	27
16-Feb	27.064	26.695	28.994	20
17-Feb	25.041	25.147	27.275	23
18-Feb	21.011	20.331	21.855	19
19-Feb	23.682	23.023	24.337	21
20-Feb	43.716	43.534	45.941	42
21-Feb	35.103	34.565	35.589	33
22-Feb	45.399	44.856	47.334	44
23-Feb	40.204	38.7	41.23	37
24-Feb	32.443	31.942	34.223	31
25-Feb	29.559	28.891	31.591	26
26-Feb	27.642	26.906	29.251	25
27-Feb	27.642	26.537	29.354	26
28-Feb	23.846	22.302	26.164	18
1-Mar	33.633	32.542	36.939	31
2-Mar	35.83	34.468	37.081	33

CONCLUSIONS

Based on the data retrieved from the temperature loggers; during the day, the carboy with the coal heated up more than the carboy without the coal and the control beehive. The control beehive heated up more than carboy without coal.

Overnight, when the temperature is below 25 °F, the carboy with the coal does not have any affect increasing the temperature of the beehive. The empty carboy registered a higher temperature than the carboy with the coal.



Anthracite coal is a dense, hard sedimentary rock with a jet- black color & metallic luster. It contains between 86% and 98% carbon by weight. Anthracite has the highest energy content of all coal and is very comprehensive (1).

DISCUSSION

Based on the data from February 12 to March 3, 2014, the average outside temperature at 1:00 am was 14.8 °Fahrenheit. Interestingly, all three of the beehives maintained an average of 19 °Fahrenheit (the control beehive 19.03 °Fahrenheit; the beehive attached to an empty carboy 19.1 °Fahrenheit; and the beehive attached to the carboy with coal 18.88 °Fahrenheit) during the night.

Based on the data from February 12 to March 3, 2014 the average temperature outside at 13:00 (1:00pm) was 27.2 °Fahrenheit. The beehive attached to the carboy with the coal maintained an average temperature of 32.3 °Fahrenheit, while the control beehive maintained an average temperature of 30.1 °Fahrenheit; a difference of 2.2 degrees. The beehive attached to the empty carboy maintained an average of 30.0 °Fahrenheit; indicating the empty carboy does not offer any increase in temperature within the beehive.

Further research needs to be done to determine if the 2 degree increase in temperature in the beehive attached to the carboy with coal during the day is enough to reduce the stress on the bees during winter by allowing them to expand the cluster and reach the food more readily.

Also, more experimentation needs to be done using a carboy full of crushed coal in order to determine if this would increase the temperature more than 2 degrees; thereby providing the bees with a much better advantage to expand the cluster and reach the honey and eat during the winter months.

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ACKOWLEDGEMENTS

I want to thank Charlotte Rand, the Natural Resources Conservation Academy Program Coordinator (NRCA), for all of her encouragement and support during and after the summer 2013 program. I also want to thank the University of Connecticut and the NRCA for giving me the opportunity to enrich my education. Without this educational opportunity this project would have been impossible.

I want to thank Tracy Brown, Northeastern Restoration Coordinator, for loaning me the temperature loggers and for downloading the data.

A special thanks to Alice Daly for her support and for putting me in touch with Al Avitable.

Most of all, I thank my grandfather, Arian Gorishti, for acquiring and transporting the beehives; and for all of his help and continuous support throughout this experiment…and life.