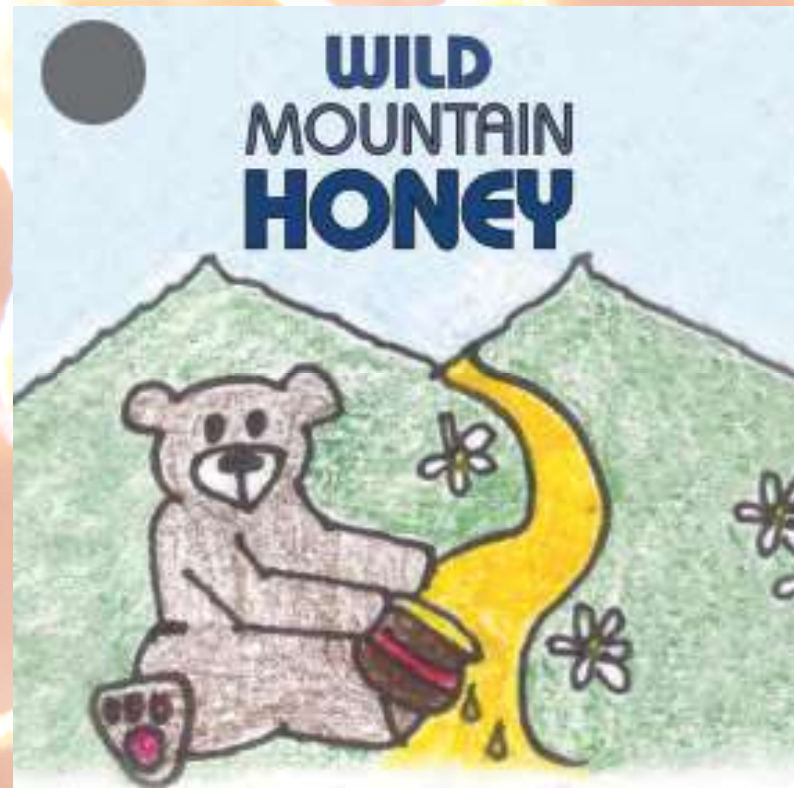


Winter Biology and Insulation of Hives



John. A. Gaut

October , 2016

Why Insulate Hives?



BIP Survey

Winter Preparation

The Bee Informed Partnership Management Survey Results (2014-2015)



Winter Preparation By Region

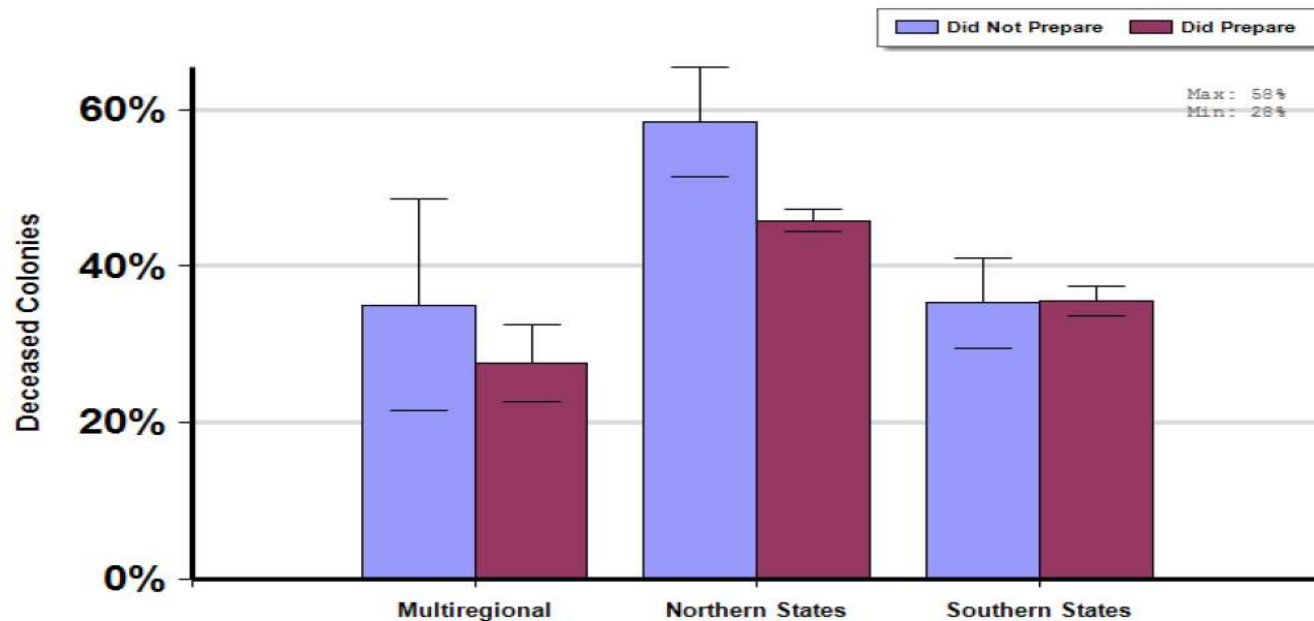
Management
Survey 2015

Average losses suffered by beekeepers who did and did not prepare their colonies between April and March for winter by region.

Winter

Report ID: 203-
2015

Some Significant Differences (within regions)



<https://beeinformed.org/results/the-bee-informed-partnership-national-management-survey-2014-2015>

BIP Survey

Winter Preparation

“Northern beekeepers who prepared their operations for winter lost 12.6 fewer overwintering colonies per 100 managed colonies (21.6% fewer losses) than beekeepers who did not prepare their colonies for winter.”

- Create or engage an upper entrance
- Place extra insulation on top of colony
- Wrap colonies with insulation
- Wrap colonies with tar paper or wintering sleeve
- Equalize colony strength
- Move colonies to southern location
- Move colonies to inside wintering buildings

“Correlation is not Causation”

- **As with everything in beekeeping, you should understand the rational for recommendations or suggestions and make your own decision for your colonies**

A close-up, microscopic view of a honeycomb structure, showing a grid of hexagonal cells. The cells are filled with a golden-brown substance, likely honey, and the walls are a lighter, translucent yellow. The lighting is bright, creating a warm, glowing effect.

Winter Survival

What are the basic requirements for a colony to survive the Mid-Atlantic winters?

Winter Survival

- A queen right colony with plenty of “winter bees”
- Food Reserves
 - Honey 60 pounds
 - Pollen 20 pounds
- Low mite parasitism
 - If the mite count is more than 6%, the colony only has a 50 % chance of surviving the winter (BIP)
 - Less than 1% is ideal
- A dry and wind protected hive in a sunny location

A microscopic view of plant cells, showing a honeycomb-like structure of hexagonal cells with thick, yellowish cell walls. The cells are arranged in a regular pattern, and the overall color is a warm, golden-brown hue.

Reasons given for not Insulating

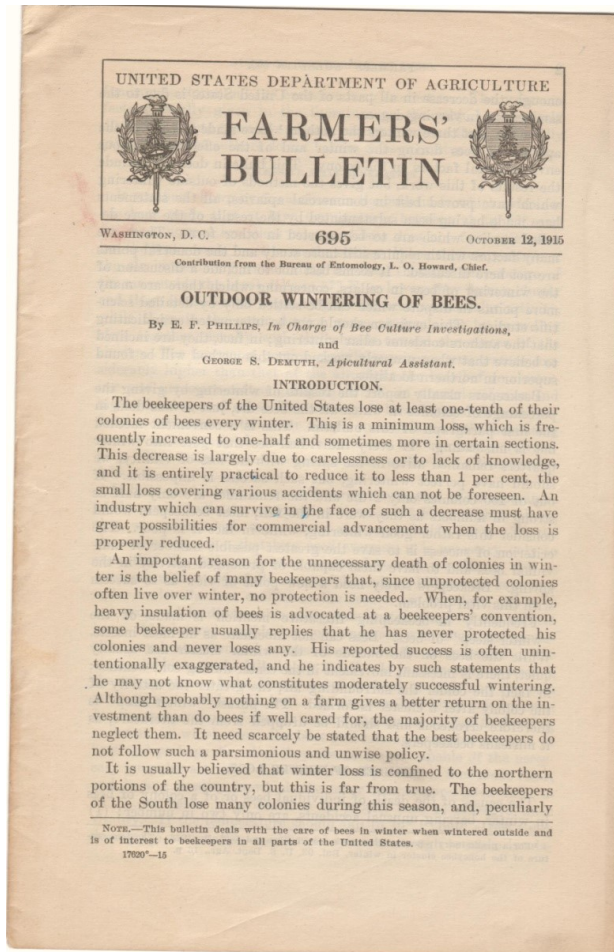
What are some of the reasons you have heard?

Reasons given for not Insulating

- “The bees can survive the winter without insulation.”
- “The bees get too hot”
- “Insulation makes the inside of the hive too moist. Cold does not kill the bees; moisture does.”
- “Insulation keeps the hive too warm; the colony doesn’t cluster, is more active and consumes more honey.”
- “Wrapping the hive with Black Roofing Paper is all that is needed.”
- “Insulation costs too much”
- “Insulation takes too much time”

Farmers' Bulletin 695

1915



- The beekeepers of the US lose at least 10% of their colonies every winter
- **It is entirely practical to reduce losses to less than 1%**
- Since unprotected colonies often live over winter, some believe protection is not needed.
- Summary and Conclusions:
 - Bees need protection from cold and wind
 - The beekeeper should give abundant insulation
 - Great care is needed to protect the colonies from the wind
 - A good queen is needed
 - Many colonies die of starvation
 - This is easily avoided

Summary of a Study in Wisconsin

- The Thermology of Wintering Honey Bee Colonies, By **CHARLES D. OWENS**, *Agricultural Engineering Research Division, 1971 “Still in force”* <http://naldc.nal.usda.gov/download/CAT72345678/PDF>

Summary of a Study in Wisconsin

- The area of the cluster within the 76° isotherm is the active or heat-generating area, with a relatively low density of bees.
- In hives heated up to 40° the cluster response is not different from that in insulated hives.
- Insulated colonies start brood rearing a few days earlier than unprotected colonies, but the latter tend to catch up shortly after warmer weather arrives.
- Honey bees make no attempt to maintain the temperature in the domicile outside the winter cluster.

Summary of a Study in Wisconsin

- **A cluster held for long periods under freezing conditions declines in strength. The rate of decline is dependent on pollen stores available, but it is slower in insulated than in unprotected colonies.**
- **Brood rearing will occur under subzero conditions in insulated colonies with plenty of pollen and honey stores in the cluster.**
- Under normal winter conditions either insulated or non-insulated colonies should survive at Madison, Wis.

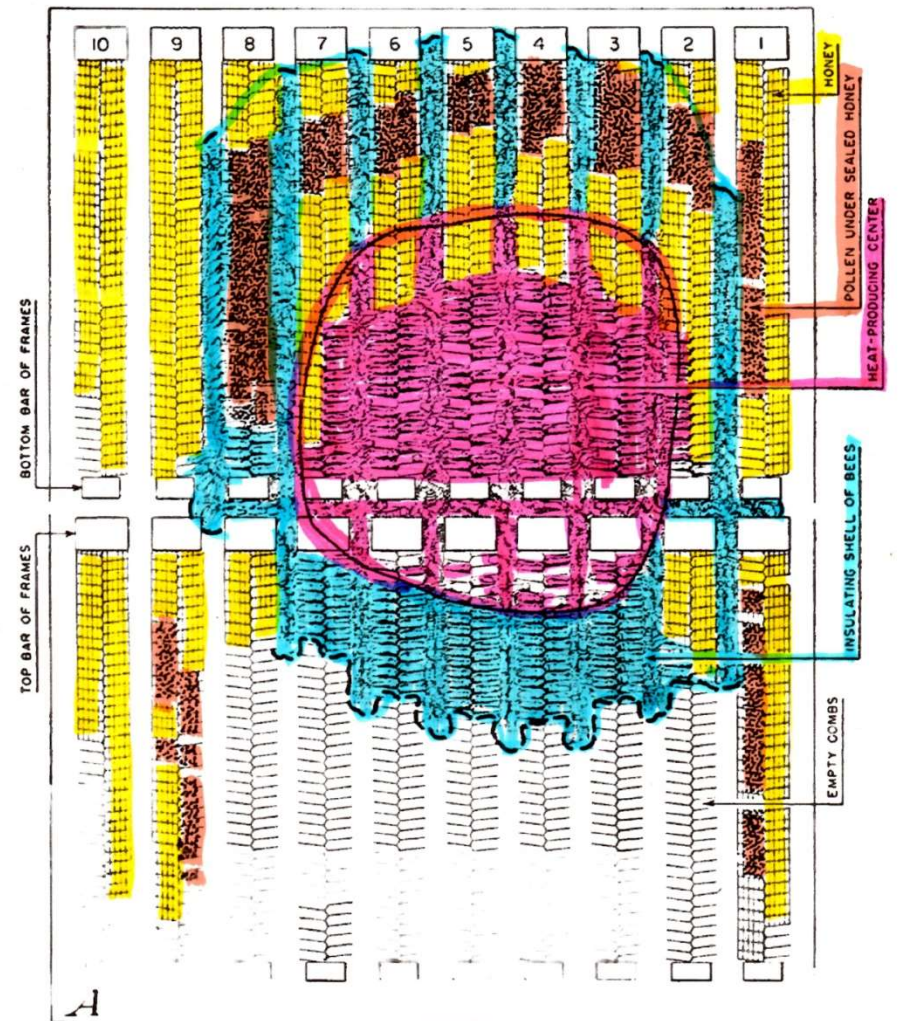
The Winter Hive Organization

7c

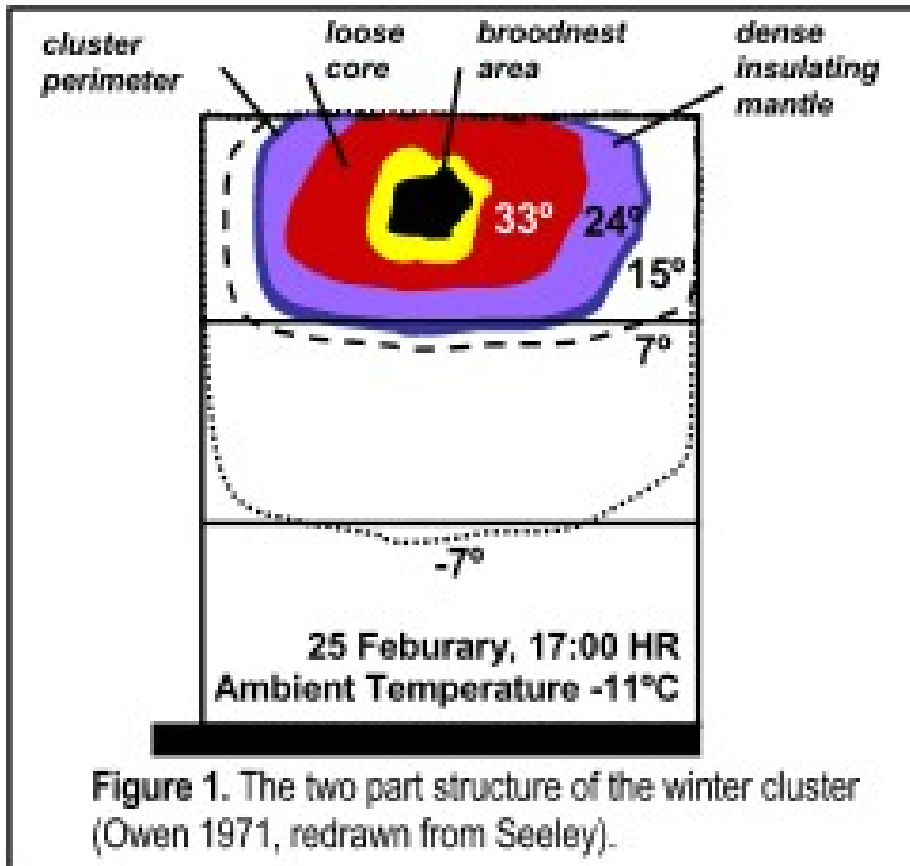
Circular No. 702
July 1944 • Washington, D. C.
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Productive Management of Honeybee Colonies in the Northern States
By C. L. FARRAR, apiculturist, Division of Bee Culture, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration



The Winter Cluster



The Cluster has 2 parts

- A loose inner core
- A dense insulating mantle

Cluster Temperatures

- **Broodnest: 35 C = 95 F**
- **Core: 33 C = 91 F**
- **Heating within 24C = 76F**
- **Insul. Mantle: 15C = 59F**
- **Never below 7C = 44F**

Why Insulate Hives?

My Observations:

- Survival
- Temperature and Moisture
- Honey Consumption
- Roofing Paper Wraps
- Insulation Cost and Time
- Benefits of Insulation

Survival

“The bees can survive the winter without insulation.”

- The colony can survive if there is enough bees, honey, pollen **and they can move to the honey and pollen.**
- Colonies with high mite loads collapse due to Parasitic Mite Syndrome
 - The mites infect the bees with viruses and colony suffers a virus epidemic
- Insulation improves the survival rate



Temperature and Moisture

“The bees get too hot”

“Insulation makes the inside of the hive too moist.
Cold does not kill the bees; moisture does.”

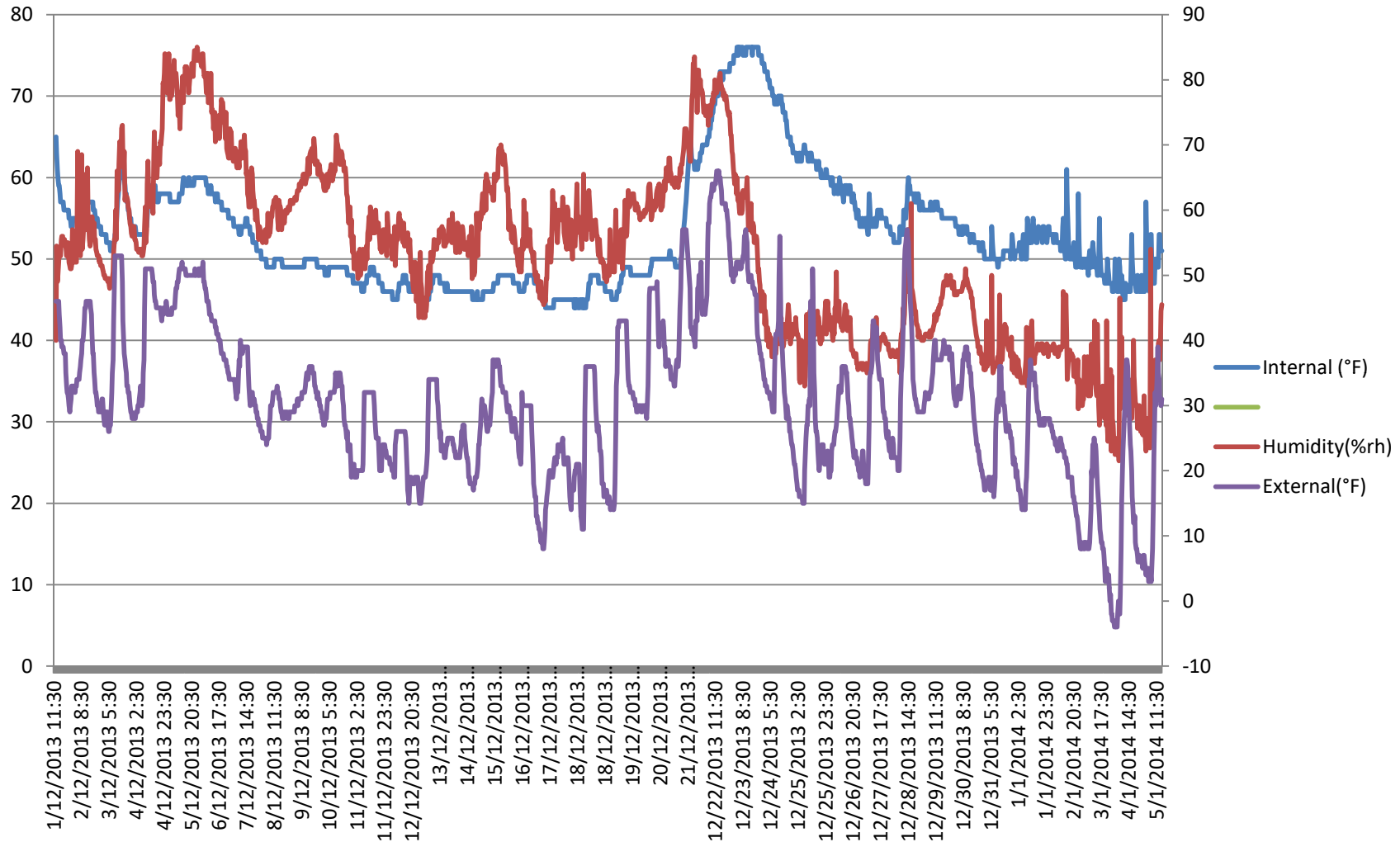
Ice on Inner Cover



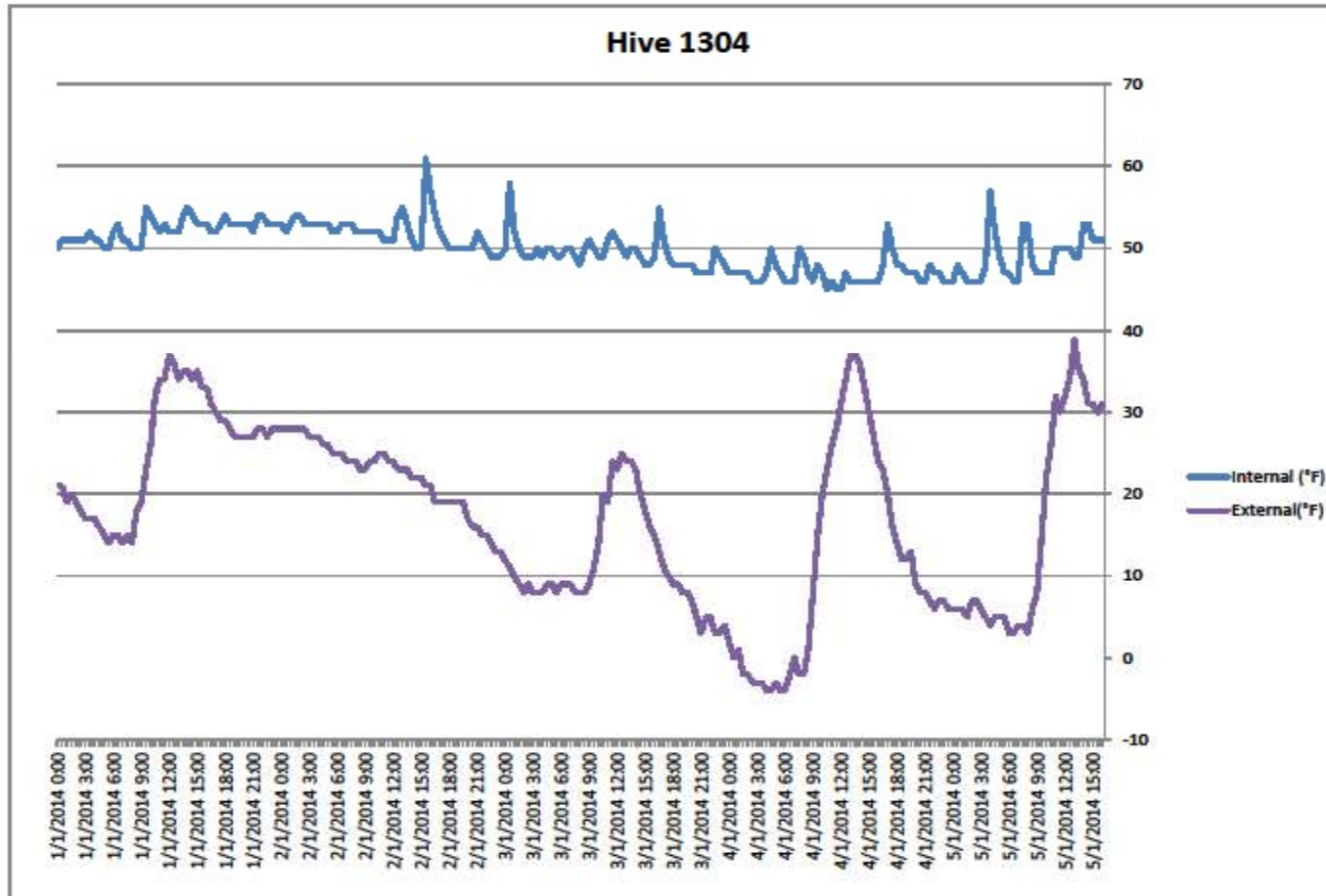
It is hard to see in the picture, but what you are looking at is the inside of a top cover upside down. All of the white substance is tiny stalactites, like frost standing up about 1/4 of an inch above the brood.

December 1, 2013 to January 5, 2014

Hive 1304 Int



The coldest days of 2014 January 1 to January 5



Brood Nest Temperatures



Temperature and Moisture

“The bees get too hot”

- The colony can thermo-regulate the hive very effectively and the hive does not over heat

“Insulation makes the inside of the hive too moist.”

Cold does not kill the bees; moisture does.”

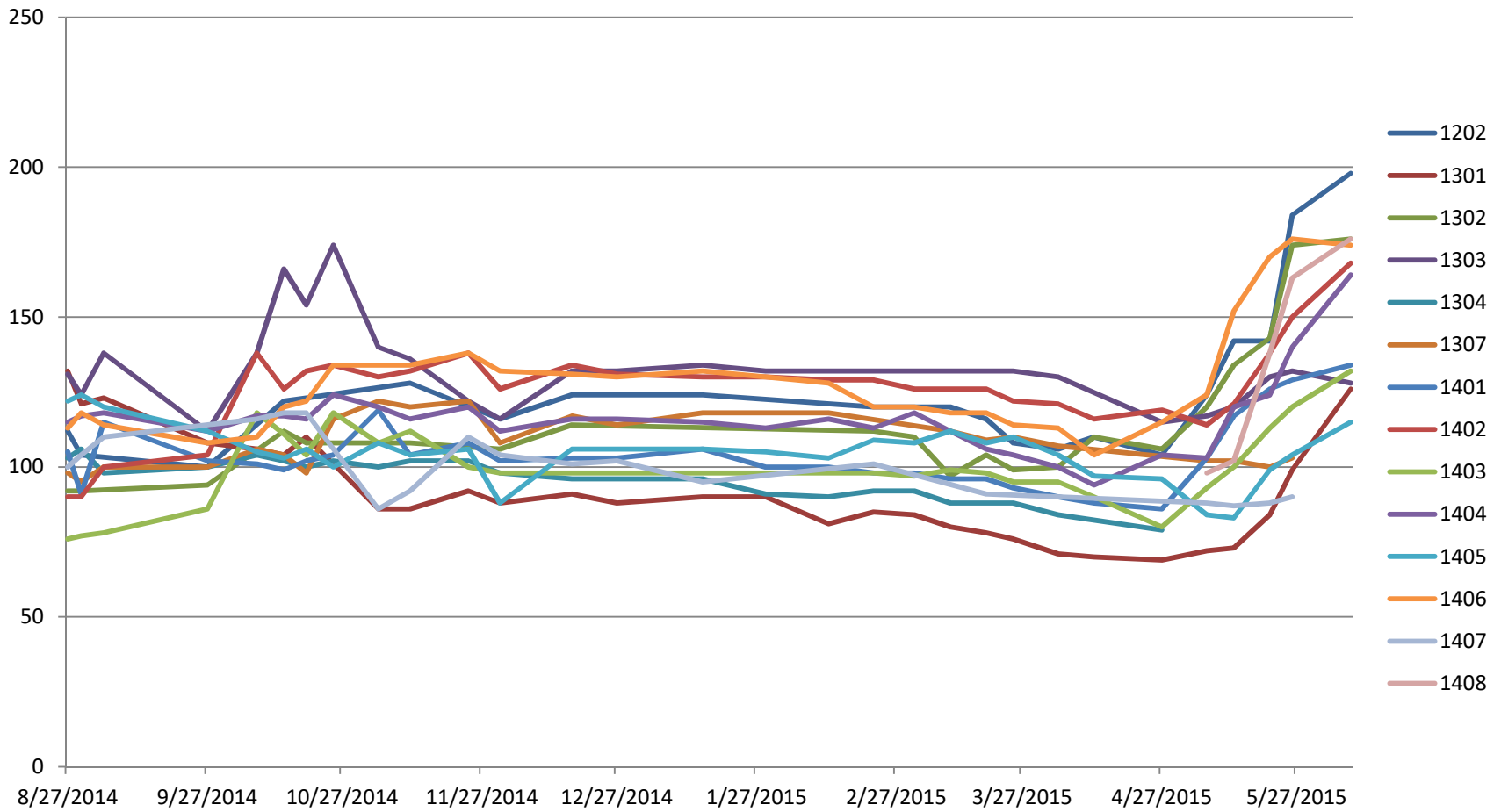
- Condensation (Liquid Moisture) does kill bees. Adequate ventilation is needed to remove moisture while it is a vapor.
- Insulation can help reduce condensation in the hive so the moisture can be removed by ventilation, **especially on top**. Also the sides.
- The colony can regulate the humidity in the brood nest very effectively (MB Ellis, 2008)
 - Actively by fanning
 - Passively by having moisture sinks - honey and cocoons



Honey Consumption

“Insulation keeps the hive too warm; the colony doesn’t cluster, is more active and consumes more honey.”

Hive Weights



Honey Consumption

“Insulation keeps the hive too warm; the colony doesn’t cluster, is more active and consumes more honey.”

- The bees begin clustering at 55 to 57 F. The cluster gets more compact as the temperature decreases.
- The hive weights are nearly steady until January and then start decreasing in February and March as the brood rearing ramps up.
- The hives have plenty of honey left in April

Roofing Paper Wraps

“Wrapping the hive with Black Roofing Paper is all that is needed.”

- The paper does help reduce air infiltration. Lack of wind protection is a major cause of winter losses.
- The black paper does passively heat one side of the hive on sunny days for a few hours.
- **BUT** on clear cold nights, the black roofing paper radiates heat back out on all four sides for 12 hours or more

Insulation Cost and Time

“Insulation costs too much”

- The cost is about \$25 per hive

“Insulation takes too much time”

- The hive can be insulated in a few minutes
- Cutting the insulation takes about 10 minutes per hive.
- The cut pieces are reusable every year.

Hive Insulation

- Materials
- Costs
- Details for installing

Hive Insulation

- **Extruded Polystyrene - EPS (Not Expanded Polystyrene)**
 - 2 Inch Thick is **R10** (13 times more insulating value than just the hive body)
 - **2 inches between Inner Cover and Outer Cover**
 - 2 inches on all four sides
 - 2 – 48 inch bungee straps
 - About \$25 per hive, reusable every year

Materials and Cost

One sheet will insulate 2 hives

2- 4ft Bungee Cords



Pactiv R 10 Unfaced Polystyrene Foam Board Insulation (Common: 2-in x 4-ft x 8-ft; Actual: 2-in x 4-ft x 8-ft)

Item #: 304090 | Model #: 304090.0

★★★★★ 25 reviews | Write a review

\$35.48

Lowes


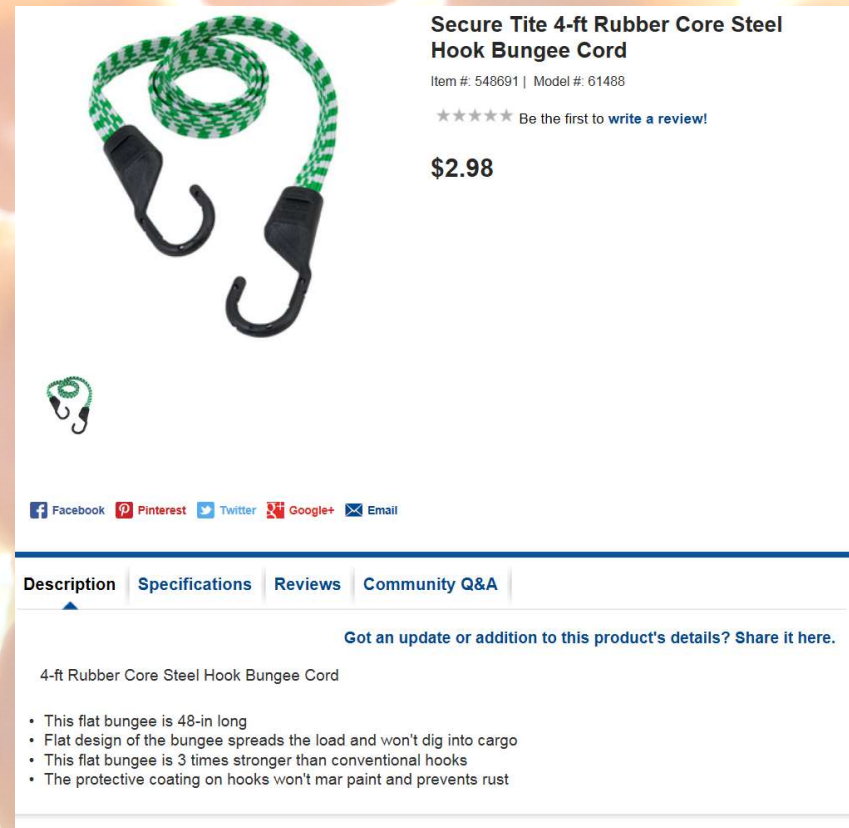
Facebook Pinterest Twitter Google+ Email

Description Specifications Reviews Community Q&A

Got an update or addition to this product's details? Share it here.

R 10 Unfaced Polystyrene Foam Board Insulation (Common: 2-in x 4-ft x 8-ft; Actual: 2-in x 4-ft x 8-ft)

- Does not absorb moisture
- Lightweight, durable, easy to use
- Meets and exceeds all type IV and type X specifications
- Retains insulating properties over time
- Maintains integrity



Secure Tite 4-ft Rubber Core Steel Hook Bungee Cord

Item #: 548691 | Model #: 61488

★★★★★ Be the first to write a review!

\$2.98

Facebook Pinterest Twitter Google+ Email

Description Specifications Reviews Community Q&A

Got an update or addition to this product's details? Share it here.

4-ft Rubber Core Steel Hook Bungee Cord

- This flat bungee is 48-in long
- Flat design of the bungee spreads the load and won't dig into cargo
- This flat bungee is 3 times stronger than conventional hooks
- The protective coating on hooks won't mar paint and prevents rust

Insulation Details

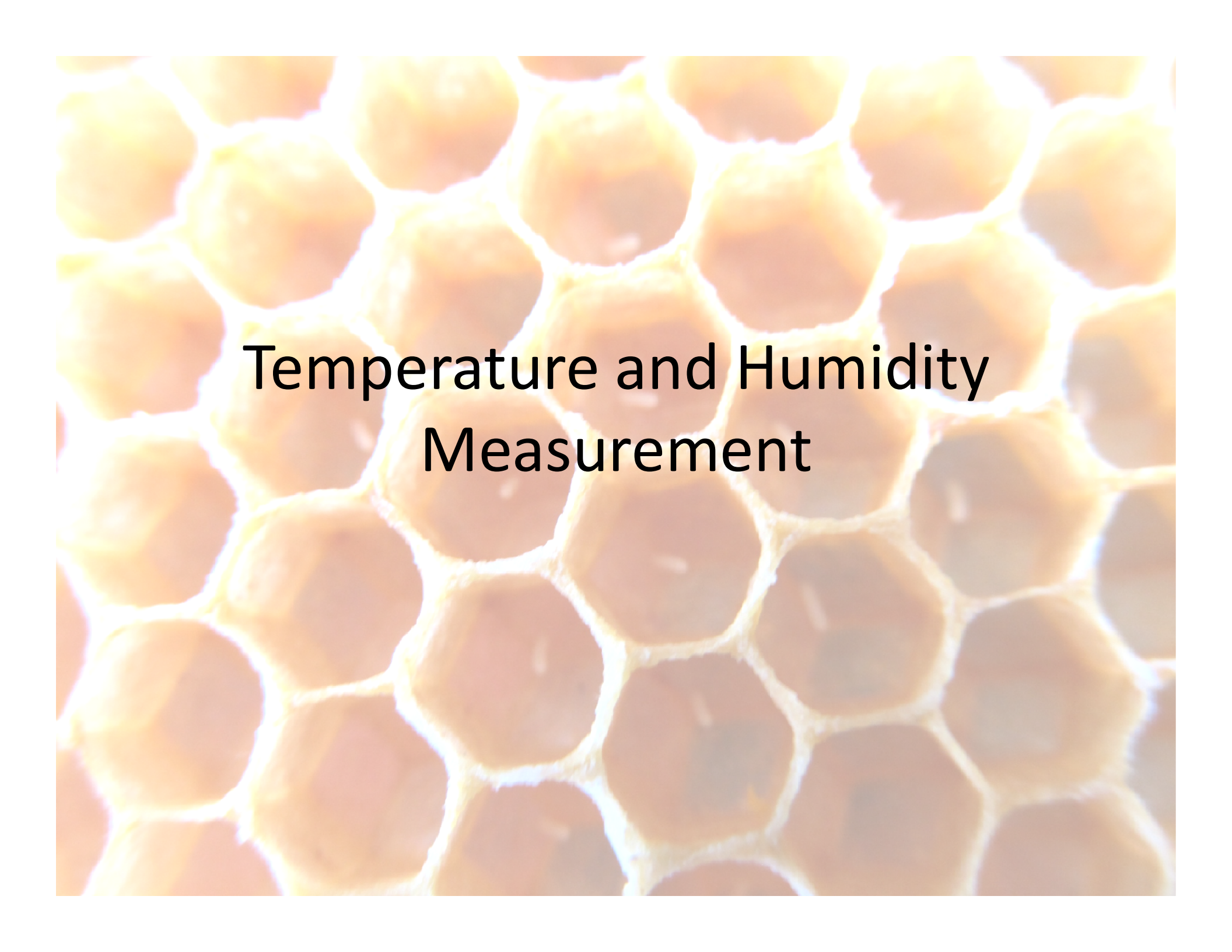


Top
Entrance



Top Insulation – 2 inches
In a 3 inch shim



A microscopic view of plant cells, showing a honeycomb-like structure of hexagonal cells with thick, yellowish cell walls. The cells are arranged in a regular pattern, and the overall appearance is that of a cross-section of a plant stem or leaf. The text "Temperature and Humidity Measurement" is overlaid in the center of the image.

Temperature and Humidity Measurement

Temperature and Humidity Measurement

EL-USB-2-LCD+

High Accuracy Humidity and Temperature Data Logger with LCD

- Higher accuracy sensor when compared to the EL-USB-2-LCD
- 0 to 100%RH measurement range
- -35 to +80°C (-31 to +176°F) measurement range
- High contrast LCD
- Immediate, delayed and push-to-start logging
- Calibration certificate available



Temperatures on February 14, 2015



Temperatures on February 16, 2015



With and without Insulation

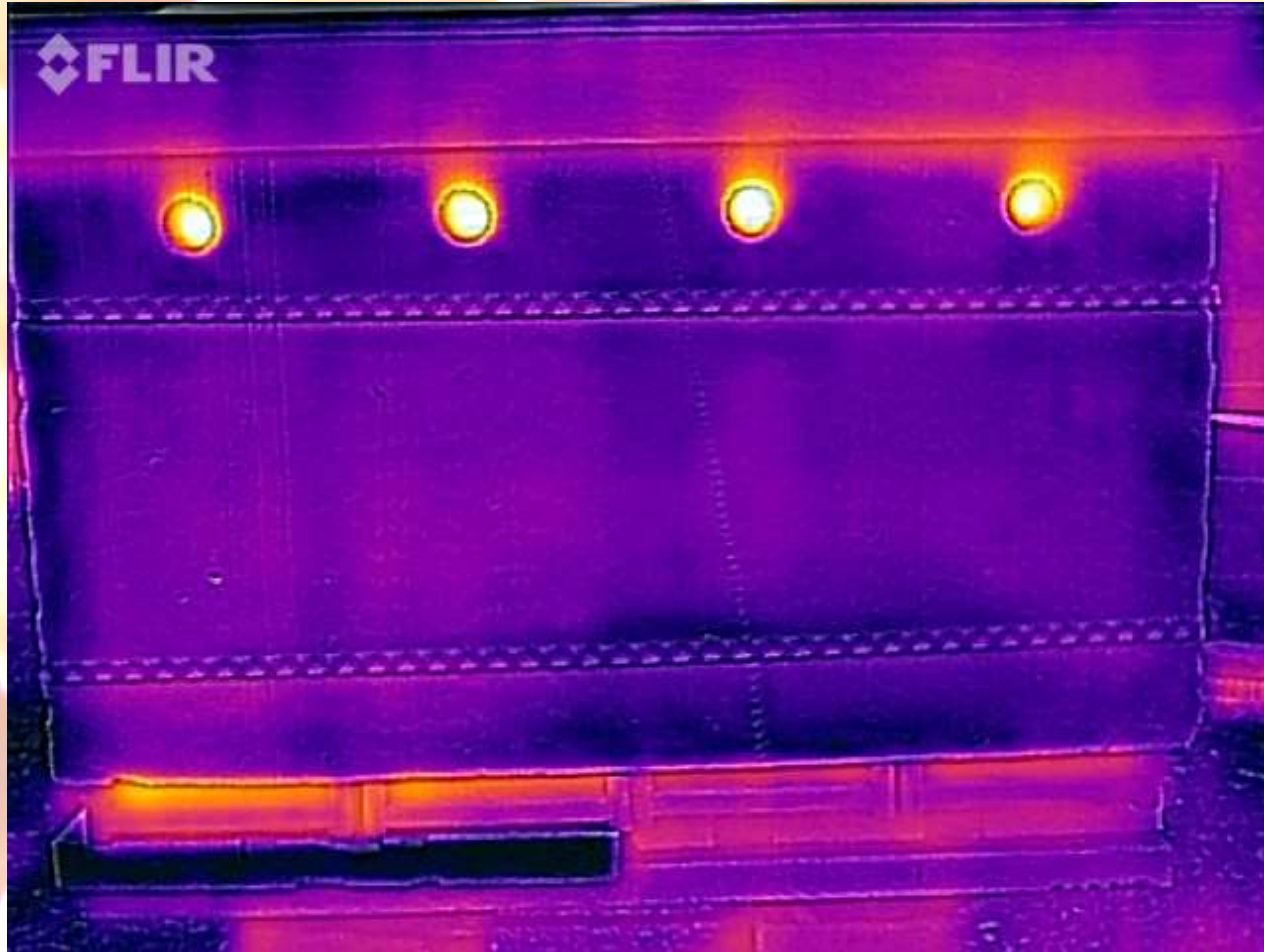
Insulation In Place



Insulation Removed

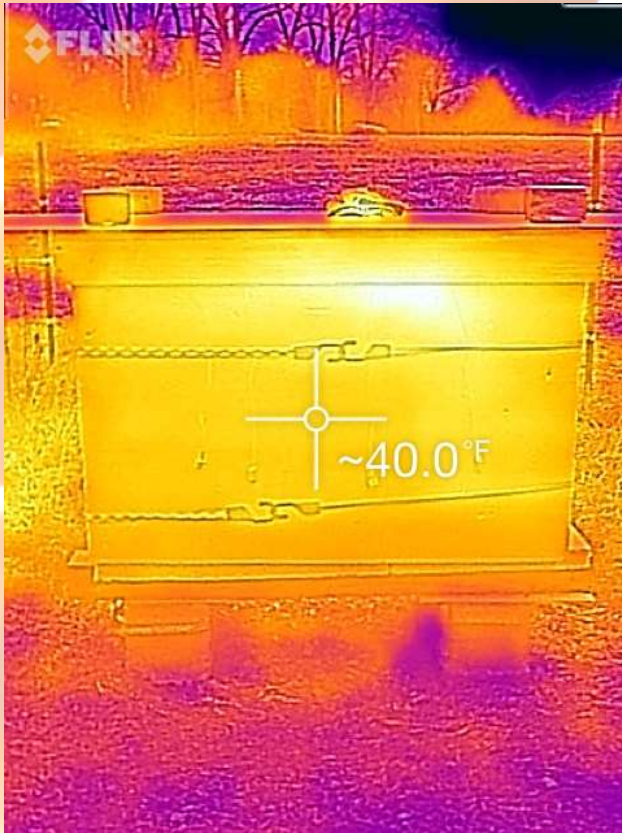


Nuc Condominium



Nuc Condominium

With Insulation



Without Insulation



Benefits of Insulated Hives

- Reduces heat loss and air infiltration
 - Especially on cold and windy nights
 - Allows bees to move to honey
 - Bees can't move if less than 44 F
 - 41 F is the minimum temperature that “shivering” is possible*
 - Bees will not walk on surfaces less than 45 F
- Reduces Condensation on the top cover and sides of the hive bodies
 - Condensation will kill the bees
 - Moisture (High Humidity) can result in Chalk Brood and other bacterial and fungal diseases
- Reduces the consumption of Honey
 - For every 11F degrees reduction in temperature, the bees must work twice as hard to keep warm and function. *
 - More honey and pollen for brood building and less used for thermo-regulation

*The BEE, A Natural History, Noah Wilson-Rich, p76

Benefits of Insulated Hives

- Enables colony to survive the winter along with:
 - Adequate Ventilation for the moisture removal. An upper entrance lets the moist air escape.
 - The colony must remove 3 to 4 quarts of water for every 10 pounds of honey consumed
 - Plenty of healthy young “Winter Bees” raised in August, September and October.
 - Mite Control so bees are not weakened from the parasites and the viruses they transmit
 - Low Nosema Levels
 - Adequate Nutrition including pollen and honey
- Enables more brood rearing in Jan, Feb and March when the outside temp is still cold
 - Reduces Chilled Brood and Chalk Brood
 - Cluster size and brood area can be larger, building “first class populations of young bees.”
 - More foragers for the early nectar flow in May and June

Benefits of Insulated Hives

**Enables a colony to survive the cold
windy nights in the winter and thrive
in the early spring**

Checklist for Winter Survival

- Adequate Honey Stores
- Good pollen reserves
- Large population of young healthy bees
- Low Mite levels
- Low Nosema levels
- Upper entrance and reduced/guarded bottom entrance
- Minimize Air Infiltration
 - Close Bottom Board on Screened Bottoms
- Insulate the top of the hive between the inner cover and the outer cover
- Insulate the hive sides

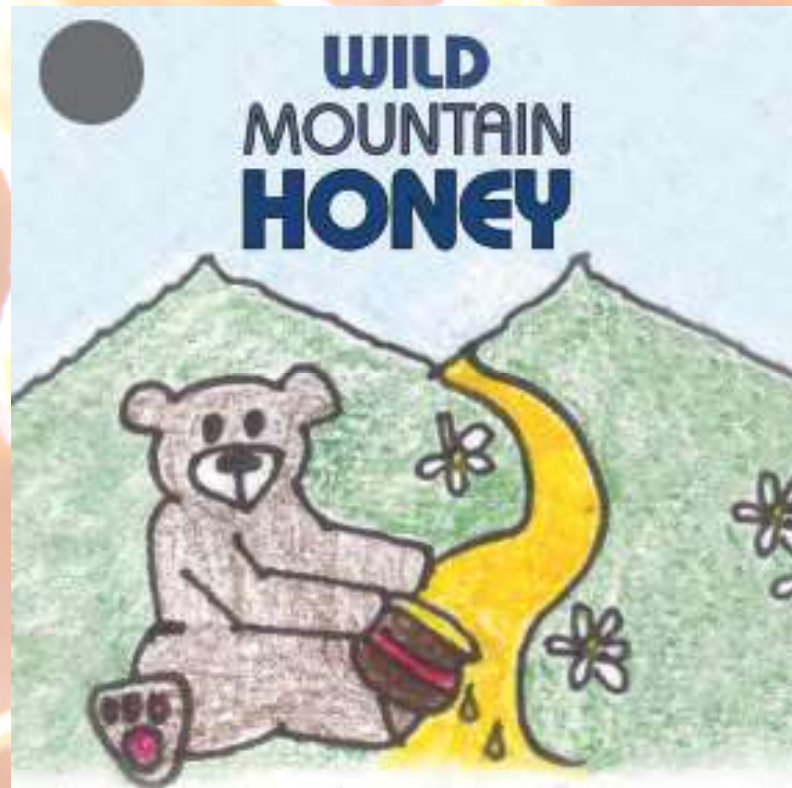
Insulating Hives



Questions?

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Thanks!



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