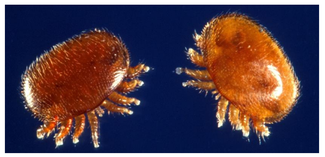
Team 02: Mite Monitor

Paige Rabideaux, Morgan LeFaive, Laura Goenner,
Kyler Cope, and Libby Gresley

Grand Valley State University

What is a Varroa Mite?

Varroa destructor mite is an external parasite that attaches to honeybees, feeding on the fat bodies and hemolymph of adult bees and developing brood.

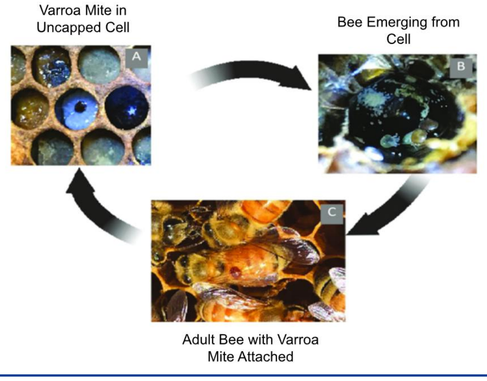


Bee Biology and Varroa Threat

Varroa mites weaken honeybees and spread harmful viruses. Infected bees have shorter lifespans, reduced ability to forage, and contribute less to colony maintenance. Over time, these effects lead to a gradual decline in colony strength and can result in complete collapse if the infestation is not managed.

Varroa mites can infest honeybees at every stage of development. Damage that occurs while a bee is growing inside its cell cannot be reversed once the adult emerges. Female mites enter brood cells during the first 10 days of larval development. After the cell is capped, the mite feeds on the developing bee and reproduces inside the sealed cell. By emergence, the bee may already be weakened or deformed.

The Mite Monitor system aims to identify signs of mite activity within capped cells. This intervention can stop the reproduction and spread of mites.



Current Methods of Detection

The most accurate existing detection technique is an alcohol wash. A sample of 200-300 adult bees are placed in a jar with alcohol, the jar is sealed, and then vigorously shook. This causes the mites to fall off the bees; however, this also kills the bees. This project uses a non-lethal method of detection.

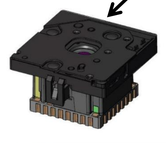
The System

The Mite Monitor is an enclosed imaging system built with an X–Z gantry and a long-wave infrared camera. The camera moves across the length and height of a hive frame, capturing thermal images of the brood area. This allows the system to map temperature patterns across the entire frame and identify early signs of mite activity.

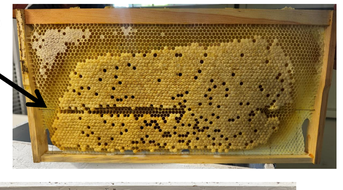
How the System Works:

1. Place hive frame into enclosure
2. Seal enclosure
3. Connect to the system via Bluetooth
4. Press start button
5. Save the data
6. Remove frame
7. Repeat

Lepton 3.5 LWIR Sensor



Langstroth Frame



System Interface

Users connect to the Mite Monitor through the project website via Bluetooth using a laptop or mobile device. The system collects thermal data from the beehive frame and uploads it as *.CSV files to the website for retrieval and analysis.

Using GNU Octave, researchers can convert the data (*.CSV files) into thermal images, compare temperature patterns, and track changes within the hive over time. This information can support continued research into brood activity, colony behavior, and overall beehive health.

Results

Result Table No.	Average Cell Temperature (°C)	Cell No.	Mites Observed
1	28.82	1-40	1
2	29.01	41-115	6
3	29.37	1-50	0
4	28.63	51-65	0

TABLE 2

Life Stage	No Mite Average (°C)	Mite Average (°C)	Difference (°C)
Larva	28.49	28.80	0.31
Pupa	28.95	29.00	0.05
Drone Larva	N/A	N/A	N/A
Drone Pupa	28.22	N/A	N/A
Pupa Dark Eyes	29.60	N/A	N/A
Drone Pupa Dark Eyes	28.36	N/A	N/A
Pupa Dark Body	28.10	N/A	N/A
Drone Pupa Dark Body	28.20	N/A	N/A

Compared to the overall frame temperature, the bee larvae cells containing mites were 0.21 °C colder. The bee pupae cells containing mites were 0.01 °C colder.

When comparing temperature difference between cells with and without mites, the bee larvae cells containing mites were 0.31°C hotter. The bee pupae cells containing mites were 0.05°C hotter.