Can non-invasive oxygen monitoring be used to quantify stress in honey bee hives?

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Introduction

It is known that transportation stresses honey bees. This stress affects the health of the superorganism. However, no one has quantified how this stress affects honey bee colonies during transportation. Therefore, the goal of this research was to quantify stress in the hive by using agitation as a stressor and oxygen consumption as a proxy. The hypothesis is that non-invasive oxygen monitoring can be used to quantify stress in honey bee colonies.

Methodology

- A homemade whole hive respirometer was used. This apparatus is composed of a Neofox® oxygen sensor and an acrylic shroud.
- Using this apparatus, paired with a vibrating motor, the goal was to measure oxygen levels of whole colonies, nucleus colonies, and mini-nucleus colonies.
- The vibrating motor was used as a stressor on each colony after baseline oxygen consumption was measured. Oxygen consumption was measured while the colony was stressed for an hour.
- Due to time constraints, only data on mini-nucs, nucs, and no bees were collected.

(Left) Shroud measuring oxygen levels of a mini-nuc.

(Right) Whole honey bee hive.

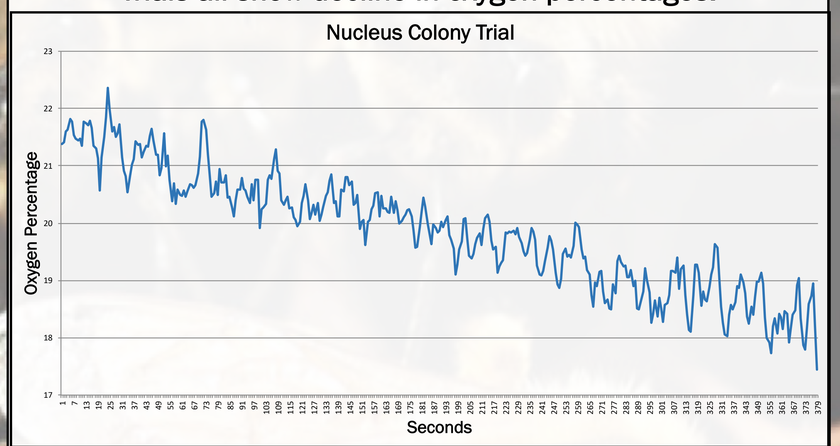
- The Neofox® oxygen sensor uses a technique called “non-invasive oxygen monitoring”. This technique uses a flashing blue excitation light onto a 6mm fluorescent patch which fluoresces depending on how much oxygen is present in the environment.
- After using a two-point calibration based on two known oxygen percentages, the sensor, in theory, reads oxygen levels present inside the container which houses the fluorescent patch.

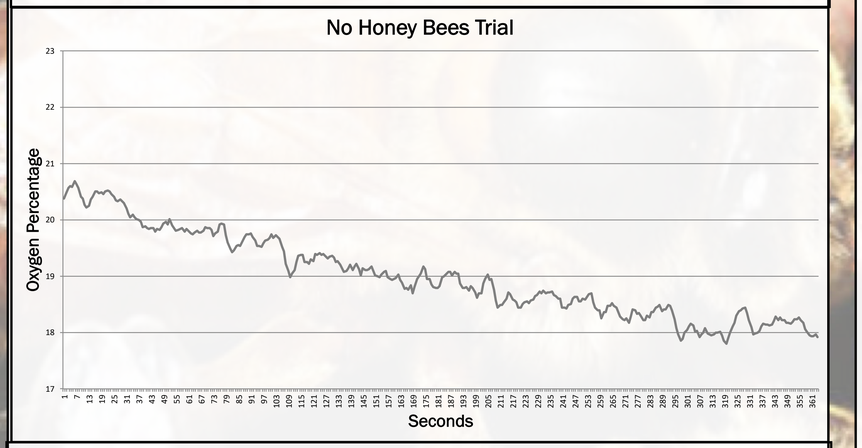
Honey bee nucleus colony

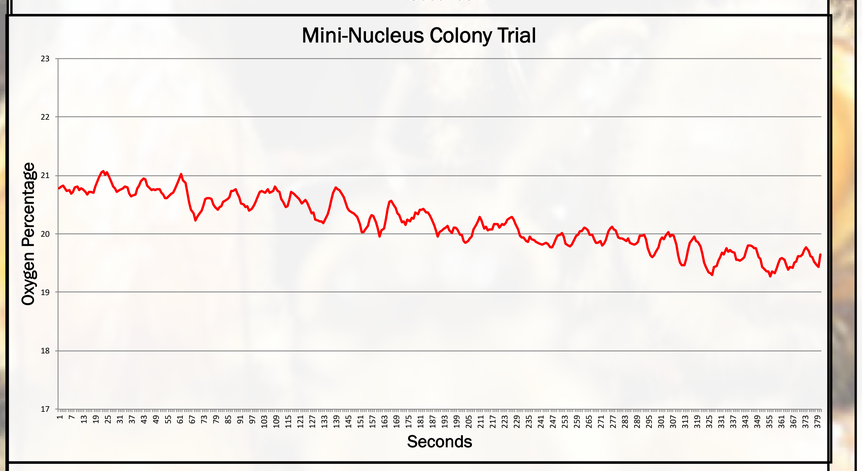
Honey bee mini-nucleus colony

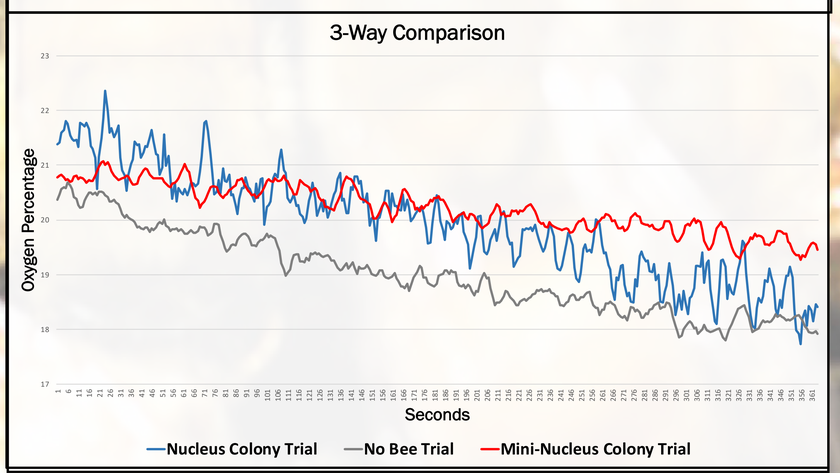
Results

Nucleus Colonies, Mini-Nucleus Colonies, and No Honey Bee Trials all show decline in oxygen percentages.









Conclusion

As shown by the data in the results section, most of the data are noisy, which can be expected, but some are even inaccurate. The oxygen decreases over time on the graphs, including the measurements on no bees.

In conclusion, using the current method of this oxygen sensing apparatus, it cannot be used to quantify stress in honey bee hives through acrylic. Therefore, the hypothesis is rejected.

Future

The following are ways to improve this project in the future.

- Use a different kind of oxygen or carbon dioxide sensing machine.
- Smaller shrouds for nucs and mini-nucs can be more easily maneuvered and have lesser volume. This allows for less unintentional calibration disruption of the oxygen sensor and faster measurements on smaller entities.
- The whole hive still requires a large shroud. An idea for this is to build a shroud which opens on the side and allows a whole hive to be rolled into it.
- The goal will be the same as before, to be able to quantify stress in full honey bee hives. This next time we hope to have ease of access so anyone can use the system individually.
- The Neofox® will be tested on glass to see if it is still reading properly.

A frame of honey bees used in a nucleus colony trial.

References

Oceanoptics.com

Acknowledgements

We would like to thank George Yocum for helping with many technical issues with the Neofox and the shroud, Arun Rajamohan for helping with data analysis, and everyone at the USDA who helped to lift the shroud for experiments.