Can You Identify Spores of Fungal Species on Coleoptera With Hyperspectral Interferometry?

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Abstract

Bark-feeding beetles and weevils continue to play a major part in tree health and decline, vectoring fungi and introducing pathogens into tree tissues. These fungal pathogens occlude xylem and stain wood, reducing lumber value, and killing trees prematurely. Based on previous work, hyperspectral interferometry has been shown to be able to locate and size microscale features on the surface of these beetles, with oscillations created by the reflected light spectra. This paves a way for the hypothesis that we can determine spore loads on these insects and other fungal carriers. The next step would be to determine this claim's validity and if it is possible to identify fungal spores to genus-species based on their reflectance.

Loblolly Pine in the Southeast

- Heavily cultivated due to its tolerance and fast growth.
- Trees are harvested after decades of growth.
- Used in toilet paper, deodorant, furniture, homes, boxes, etc.
- Stained wood has little value.

Hypothesis

We will be able to identify the fungal spores we see on these beetles to genus-species based on their associated wavelengths.

Fig.2: *Hylastes* vector beetles of *Leptographium* and *Grosmannia* spores.

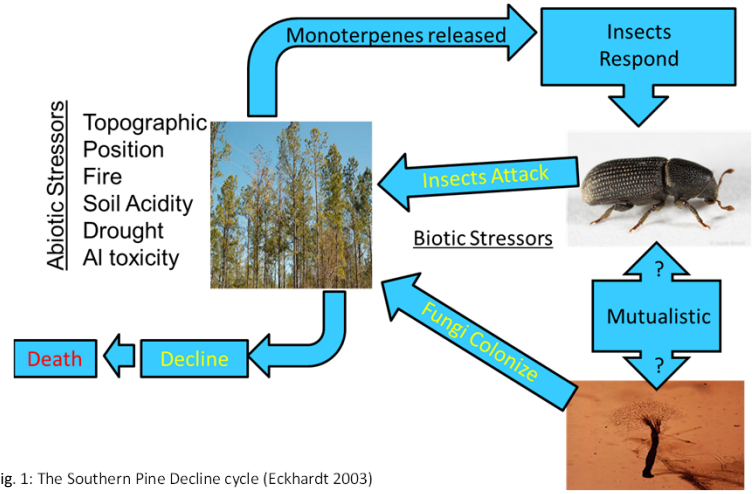

Fig. 1: The Southern Pine Decline cycle (Eckhardt 2003)

Southern Pine Decline

- Affects several pine species including loblolly in a decline cycle (Fig.1).
- Associated with *Leptographium* and *Grosmannia* species that occlude xylem and stain wood blue or black.
- Vectors of these fungi include *Hylastes, Hylobius*, and *Pachylobius* species (Fig. 2)→ feed on the roots.
- Damage occurs at the roots; therefore, damage is already done by the time aboveground symptoms are noted.
- Identification of SPD currently involves growing fungal spores on media – this can take weeks.

Materials and Methods

- CytoViva microscope
- Fungal cultures of *Leptographium procerum, L. terebrantis, Grosmannia huntii*, and *G. alacris* from the Forest Health Dynamics Laboratory's stock.
- Wild-caught *Hylastes, Hylobius*, and *Pachylobius* species.

Hyperspectral Interferometry and Insects To Date

- Previous work by Beach et al. 2015 showed that spores can be seen on beetles' bodies (Fig. 3).

Research Impacts

- Determine a more time and money efficient method to determining the presence of Southern Pine Decline associated spores in sampled areas.

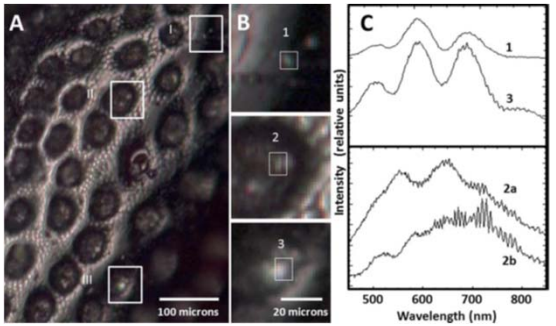

Fig. 3. (A) Image from elytra showing regions (rectangles I, II, and III) containing adherent spores inside rounded pits and on ridges between pits. (B) Closeup view of regions I, II, and III with spores 1, 2, and 3 identified inside boxes. (C) Stacked plots of oscillations obtained from spores 1, 2, and 3. In addition to the low frequency signature from spores, a high frequency oscillation is present in 2 (strongest in 2b) and 3 (weak). The low frequency is predictive of the size of the spore from the model, while high frequencies such as these predict dimensions of several tens of microns (Beach et al. 2015).

Literature Cited

Beach, J.M., J.L. Uertz, and L.G. Eckhardt, 2015. Hyperspectral Interferometry: Sizing Microscale Surface Features in the Pine Bark Beetle. Microscopy Research and Technique 78.10: 873-85.

Acknowledgements

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