Bark Beetle: Fungus Interactions in Declining Hickory Trees
Bobbi Zenner
Dept. of Plant Pathology, University of Minnesota – St. Paul, Minnesota

Introduction

- *Carya cordiformis* (bitternut hickory) has suffered from extensive decline that often resulted in mortality in several north central and northeastern states of the USA in the last decade (USDA Forest Service 2004) (Figure 1).
- *Scolytus quadrispinosus* (hickory bark beetle) has historically been considered the cause of such decline and mortality by forming coalescing galleries that girdle the tree cambium following mass attacks by the beetle during periods of drought (USDA Forest Service 1985).
- A newly described fungus, *Ceratocystis smalleyi*, causes cankers on stems and infects the sapwood of hickories attacked by hickory bark beetles (Park, 2010) (Figure 2), thus contributing to the decline.
- The fungus has been isolated from hickory bark beetles attacking trees in late summer and the finding suggests that the bark beetle may serve as a vector for the fungus.

Study Objective

The objective of this study is to determine whether *C. smalleyi* is commonly carried by hickory bark beetles when they emerge from beetle infested, declining bitternut hickory in late spring. The findings will help answer the question of whether the beetle is an important vector of *C. smalleyi*.

Materials and Methods

Field Site and Selection of Study Trees

- The mature hardwood stands where chosen at Stockbridge-Munsee Indian Reservation in Bowler, Wisconsin because of the high presence of hickory decline and mortality along with the presence of the hickory bark beetle and *C. smalleyi*.
- Two bitternut hickory trees (7.5 and 11.3 cm in diameter) exhibiting decline (50 to 80% crown affected) were selected.

Sampling from Study Trees

- Trees were felled with a chainsaw and closely examined for entry holes of the hickory bark beetle (Figure 3).
- The bark surrounding the entry holes was stripped with a drawknife to expose galleries and capture any hickory bark beetles (Figure 4).
- Beetles were carefully removed with forceps and placed singly into sterile micro-centrifuge tubes.
- Each tube was labeled and stored in plastic bags at -4 Celsius freezer until further processed.

Sample Processing in the Laboratory

- Beetles were sexed and 1.5 ml of sterile water was added to the micro-centerfuge tube.
- Following brief sonication, a dilution series was set-up and 1.5 ml of each suspension was plated onto 2% malt yeast extract agar amended with 100 ppm streptomycin sulfate.
- Plates were placed in a plastic bag and incubated at room temperature.
- *C. smalleyi* was identified based on perithecia presence and morphology of colonies.

Data Summarization

- For each beetle positive with *C. smalleyi*, colonies of the fungus were counted and numbers of colony-forming-units (CFUs) were calculated.

Results

- From a total of 41 hickory bark beetles assayed, 3 beetles were positive in showing the presence of *C. smalleyi*.
- An average of 13.7 CFU’s were determined through calculation with 26.7 present on one beetle from tree 1 and 6.7 from each positive beetle from tree 2 (Table 1).

<table>
<thead>
<tr>
<th>Tree No.</th>
<th>No. Assayed</th>
<th>No. Positive</th>
<th>Ave. CFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>1</td>
<td>26.7</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41</strong></td>
<td><strong>3</strong></td>
<td><strong>13.7</strong></td>
</tr>
</tbody>
</table>

Table 1. Frequencies of *Ceratocystis smalleyi* occurrence and fungus propagule numbers (CFUs) found on emerging hickory bark beetles.

Summary

- Three beetles (7.3%) that were emerging from declining bitternut hickory were determined to carry *C. smalleyi* on their bodies. The average numbers of propagules present on each beetle ranged from 6.7 to 26.7 colony-forming-units.
- These preliminary results support the hypothesis that the hickory bark beetle serves as a vector of *C. smalleyi*.

On-going work

These results will be added to those of additional assays of beetles from the same site as well as from a second Wisconsin location.

Acknowledgements

- Dr. J. Juzwik for being my advisor and giving me great guidance and assistance, Paul Castillo and Kat Sweeney for their assistance with field work, and Carmen Collazo for her assistance with laboratory procedures.
- Bert Davis and Brett Stempa for providing access to bitternut hickory trees and assistance in the field.
- Undergraduate Research Opportunities Program (UROP), University of Minnesota, for making this project possible through their funding.

Literature Cited