Enhanced monitoring efficacy for *Xylosandrus crassiusculus* (Coleoptera:Curculionidae:Scolytinae) using conophthorin with ethanol-baited lures

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Introduction

- The granulate ambrosia beetle, *Xylosandrus crassiusculus* (Fig. 1 and Fig. 2), is the most abundant and aggressive exotic ambrosia beetle in the U.S.
- It is capable of attacking over 200 tree and shrub species.
- *X. crassiusculus* vectors two genera of wood-staining, pathogenic fungi, *Fusarium* and *Ambrosiella* spp. (Fig. 3).
- Both adults and larvae feed on the introduced fungal mycelium.
- Sprayed insecticides are ineffective at controlling *X. crassiusculus* because beetles are physically protected by galleries created in the sapwood.
- However, the use of semiochemicals holds promise for controlling ambrosia beetles.
- Ethanol is a general attractant for wood-boring insects and can synergize activity of semiochemical lures. It acts as an attractant for *X. crassiusculus* and *X. germanus*.
- Moreover, conophthorin is a bark volatile produced from deciduous trees and is used as a repellent against bark beetles that feed on conifers. However, it acts as an attractant for *X. germanus*.
- The anti-aggregation pheromone, verbenone, is produced from bark beetles that feed on conifers and acts as a repellent for *X. germanus*.

Fig. 1: *X. crassiusculus*

Fig. 2: Pupating *X. Crassiusculus* in gallery

Fig. 3: Galleries in sapwood and wood-staining fungi

Objective

In this study, we test the hypothesis that conophthorin acts as an attractant and verbenone acts as a repellent to *X. crassiusculus*.

Furthermore, we hypothesize that ethanol synergizes the attractivity to conophthorin baited-traps for *X. crassiusculus*.

Methods

- The experiment was conducted from June 15 – August 8, 2011 at Martell Forest and the Purdue Wildlife Area (Tippecanoe Co., IN).
- Three transects with five different lures were placed in mixed-aged hardwood forests.
- Traps were made from inverted soda bottles (Fig. 4) and placed at a height of 1.5m on L-shaped PVC stands.
- Fluon, a non-stick substance, was applied to the inside of the traps to prevent insects from gaining a foothold.
- Traps were baited with the following lures;
  - Blank (control)
  - 70% Ethanol
    Release rate: 100ug/day (Polyethylene sachet)
  - Conophthorin
    Release rate: 4mg/day (Microcentrifuge tubes, Contech, Inc)
  - Verbenone
    Release rate: 50mg/day (Pouch, Contech, Inc.)
  - Conophthorin with ethanol (in separate containers)
- Samples were collected twice a week and insects were identified to species.
- Traps were rotated one position down the transect so that each trap occupied each position in the transect for the same amount of time throughout the experiment.

Fig. 4: Inverted soda bottle traps with fluon coating

Data Analysis

- Trap-catch data were analyzed by blocking for date and site.
- Only days that captured two or more beetles were included in the analysis.
- A CMH chi-squared test was performed to determine if there was a significant difference between treatments.
- If treatment effect was significant, the data were analyzed with the non-parametric mean separation test (REGWQ).

Results

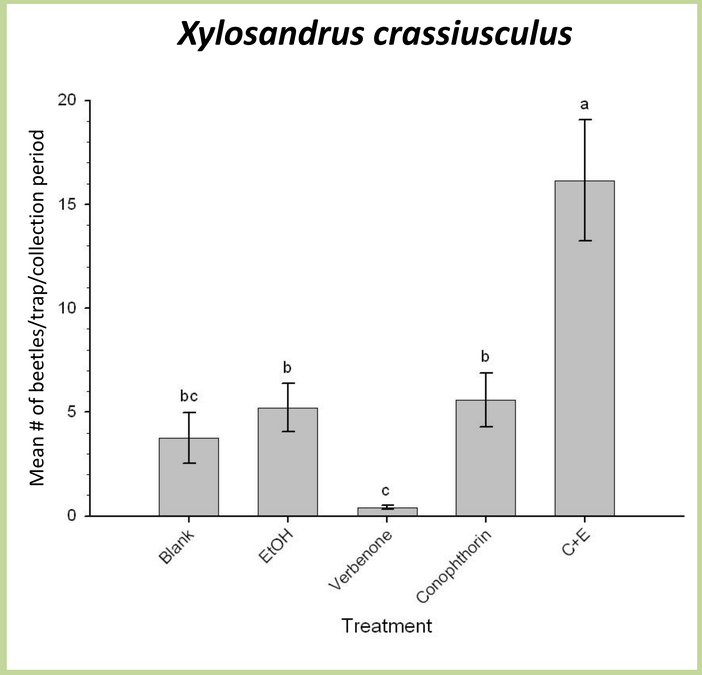

Fig. 5: Mean (± SE) number of beetles collected (per trap and collection period). Means with different letters are statistically significant (REGWQ mean-separation test: $P<0.05$).

Conclusion

- *X. crassiusculus* responded synergistically to traps baited with the combination of ethanol and conophthorin (Fig. 5) (*Friedman's* $Q_{4,210}=84.84$, $P< 0.0001$).
- Furthermore, *X. crassiusculus* was significantly repelled by the verbenone lure.

Future Directions

- Lures will be used in a push-pull system, involving the verbenone repellent and conophthorin with ethanol attractant, to protect high-value plantings.

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