Determining When the Peak Growth Rate of Asian Longhorned Beetles Occurs Using a Feeding Trial

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INTRODUCTION

- The Asian Longhorned Beetle (ALB), *Anoplophora Glabripennis* Motschulsky, (Coleoptera: Cerambycidae) is endemic to southeast Asia and is now a highly destructive invasive species within the U.S.
- First established colony appeared in New York City, New York (1996) likely through solid wood packing material used in international shipping.
- Ongoing eradication efforts in Massachusetts (2008) and Ohio (2011).

Fig. 1: Asian Longhorned Beetle emerging through exit hole

Fig. 2: Asian longhorned beetle

- ALB females lay their eggs within hardwood tree species. Larvae hatch and bore into the tree to feed on the heartwood until pupation. Repetition of boring into the wood from many generations causes a significant amount of damage and eventually kills the host tree.

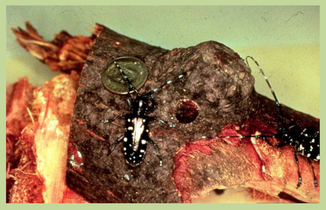

Fig. 3: ALB larva and ALB exit holes

Fig. 4: ALB exit holes

- As of 2019, ALB has “caused the loss of over 180,000 trees in Ohio, Massachusetts, New York, New Jersey, and Illinois.”
- Estimated value loss from damage $669 billion, tree mortality 30%, and reduction of total canopy cover 35%.
- Trees use a variety of chemical (e.g. tannins) and physical (e.g. lignin, latex, trichomes) defenses against insect herbivores. In order to better study the effects of these defenses on wood borers, a standard laboratory assay needs to be developed.

OBJECTIVES

Determine the time interval where the growth rate of ALB larvae is the highest while minimizing variability

RATIONALE

- The effects of tree chemical defenses on the growth and development of Asian longhorned beetle larvae is poorly understood.
- Knowledge of these interactions can aid in developing management strategies used to control ALB.

METHODS

- Lab reared early (n=9) and late (n=7) instar ALB larvae (weighing .02g-.16g and 1.2g-1.9g respectively) were obtained from the colony kept at the USDA APHIS lab in Buzzards Bay, Massachusetts.
- Larvae were kept individually in disposable plastic cups, housed at constant temp/humidity and fed on artificial diet for four weeks in the Forest Entomology Lab located at Purdue University, West Lafayette, Indiana.
- To track changes in biomass, larvae were weighed approximately 5x/week.
- Two of the early instar larvae were unhealthy, therefore they were omitted from the study.
- We standardized for differences in the initial larval weights by converting growth rate from change in grams to change in percentage of biomass.
- Compared mean total growth rates between late and early instar larvae across a four-week time interval using two sample t-tests.
- Compared the mean growth rates of early instar larvae at each one-week time interval using orthogonal paired two sample t-tests.

Fig. 4: ALB Larvae

RESULTS AND DISCUSSION

- Larval biomass increases significantly more for early instars (634.79%) than late instars (7.50%) ($t_{(df=12)}$=-3.591, p=0.00185).
- Early instar larvae had the fastest growth rate during the beginning of the study and declined throughout the trial (Fig 6). The results of pairwise t-tests between weekly growth rates are displayed in Table 1.

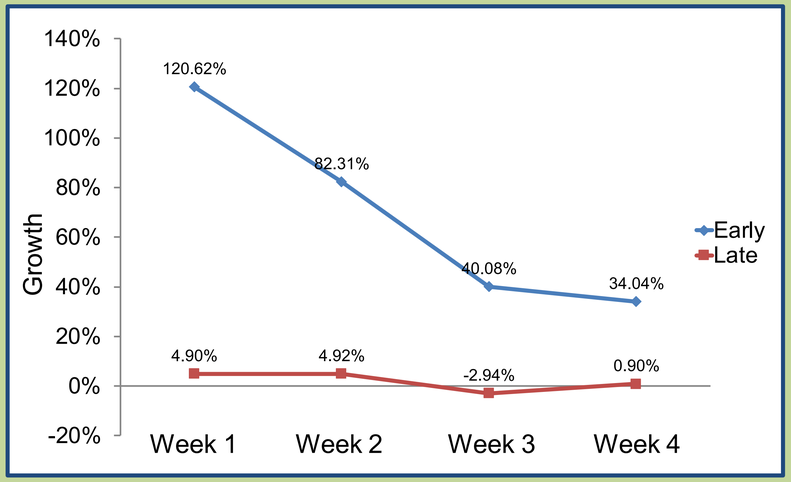

Fig. 6: Mean percent change in biomass for early and late instar larvae

	Week 1	Week 2	Week 3	Week 4
Week 1				
Week 2	0.158			
Week 3	0.009	0.077		
Week 4	0.019	0.010	0.403	

Table 1: p-values for pairwise t-tests comparing mean weekly percent growth for early instar larvae over a four-week period.

CONCLUSIONS

- For optimal growth, feeding assays should be conducted using the earliest instar larvae available.

FUTURE DIRECTIONS

Use new feeding assays to test for differences in growth when larvae are fed diet augmented with red, sugar, silver maple, chinquapin, northern red oak shavings.