

Effects of gut-associated microbes on the growth of the eastern spruce budworm *Choristoneura fumiferana*

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Introduction

- Spruce budworm (SBW) is an important forest pest in eastern Canada
- 52 million ha defoliated during last outbreak between 1975 and 1992 (Burton et al., 2015)
- Microbes are often important to host health by aiding in nutrient availability and providing protection against pathogens (Engel and Moran, 2013)



<https://tidcf.nrcan.gc.ca/en/insects/factsheet/12018>

Objectives

- Test if gut-associated microbes influence growth of SBW
 - Investigate how the interaction between diet type and antibiotics influences SBW growth
- Investigate how antibiotics affect the SBW gut microbiome
 - Quantify changes in microbial diversity among treatments
 - Quantify changes in microbial community composition

Methods

- Insects reared under controlled conditions until sixth instar
- Two treatment levels and their interactions:
 - Diet: Balsam fir vs black spruce
 - Antibiotics (AB): AB vs no AB
- Measured growth every 2 days

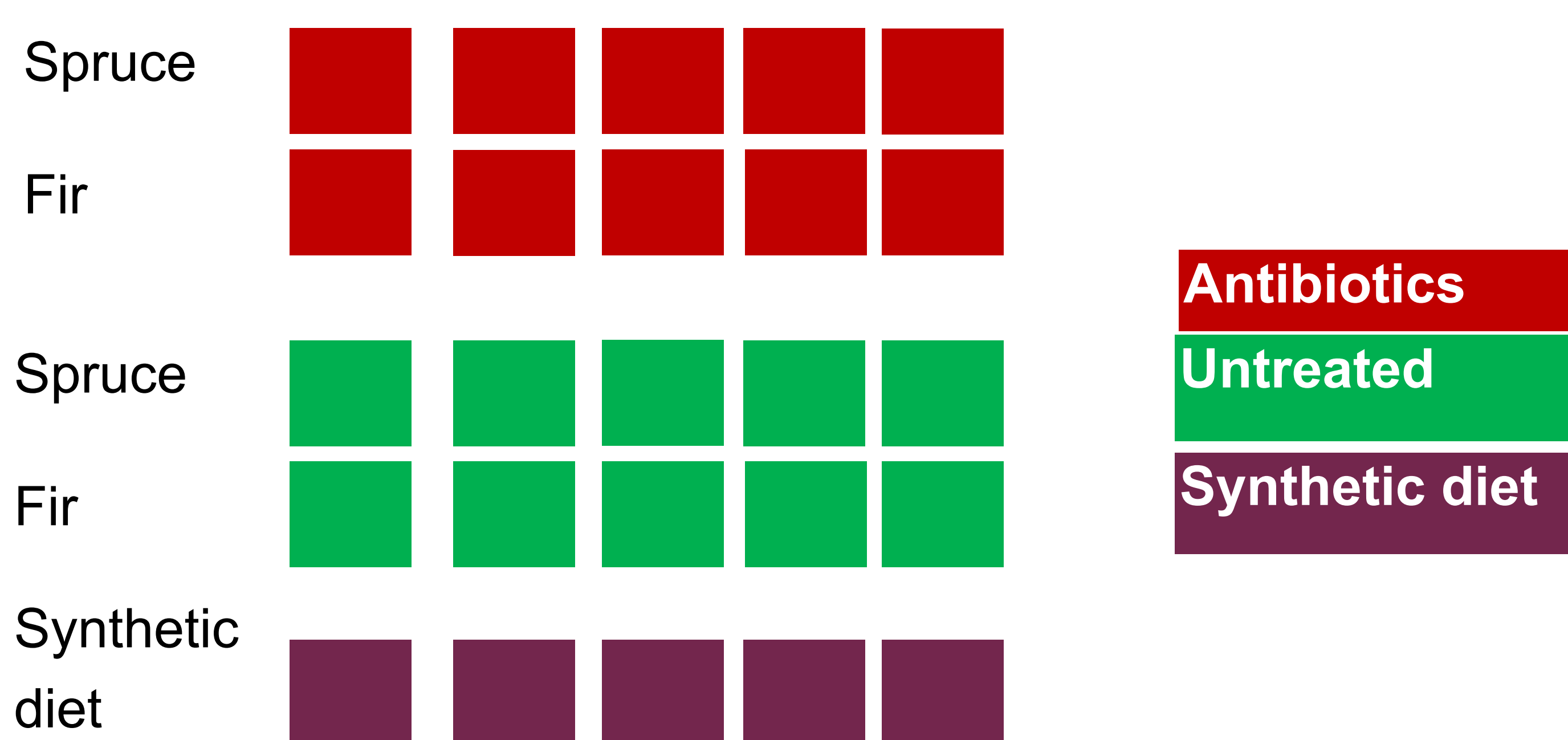
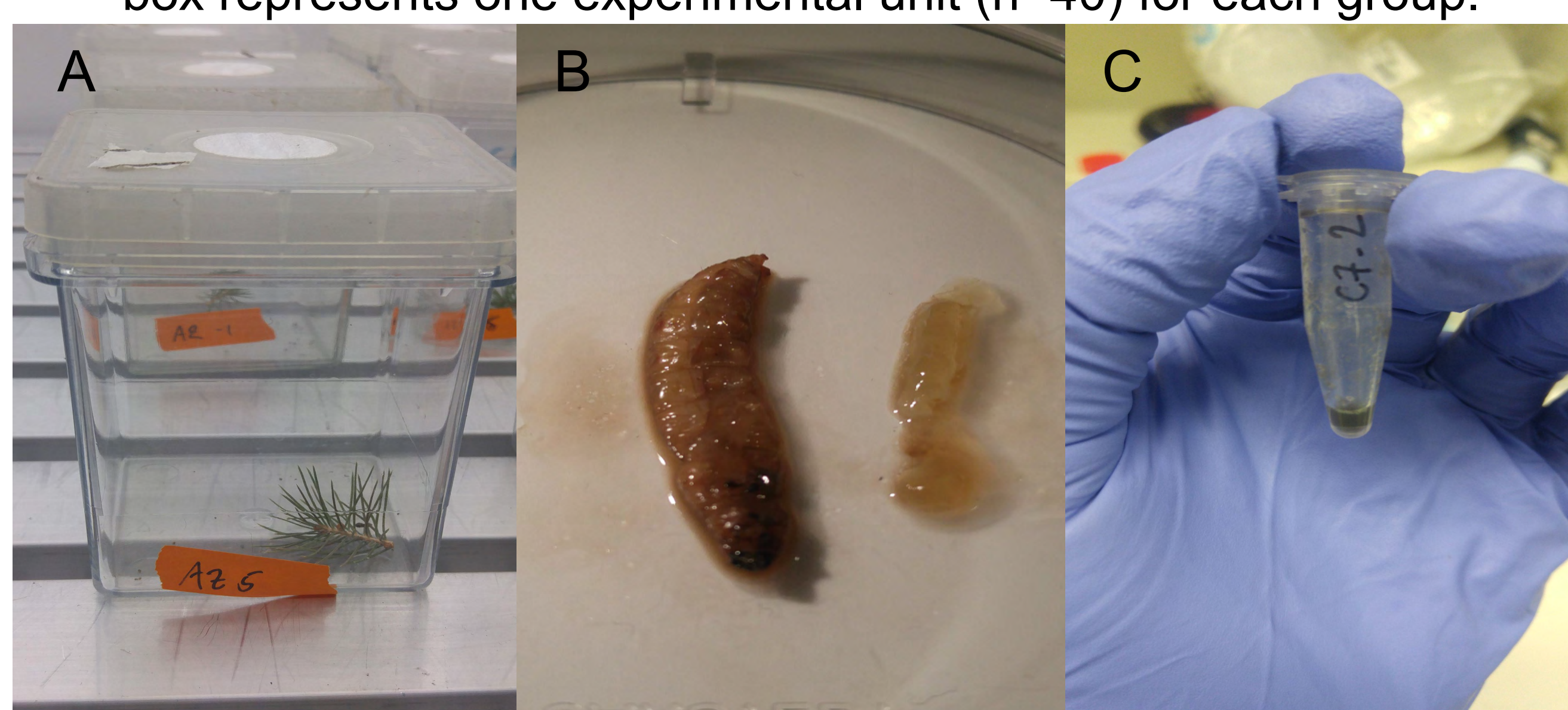


Figure 1. Schematic representation of experimental design. Each box represents one experimental unit (n=40) for each group.



A: Magenta box used for sterile rearing of SBW larvae.
 B: Sixth instar SBW larvae (left) and its gut (right).
 C: Spruce budworm midgut homogenized in 100ul of sterile water.

Results

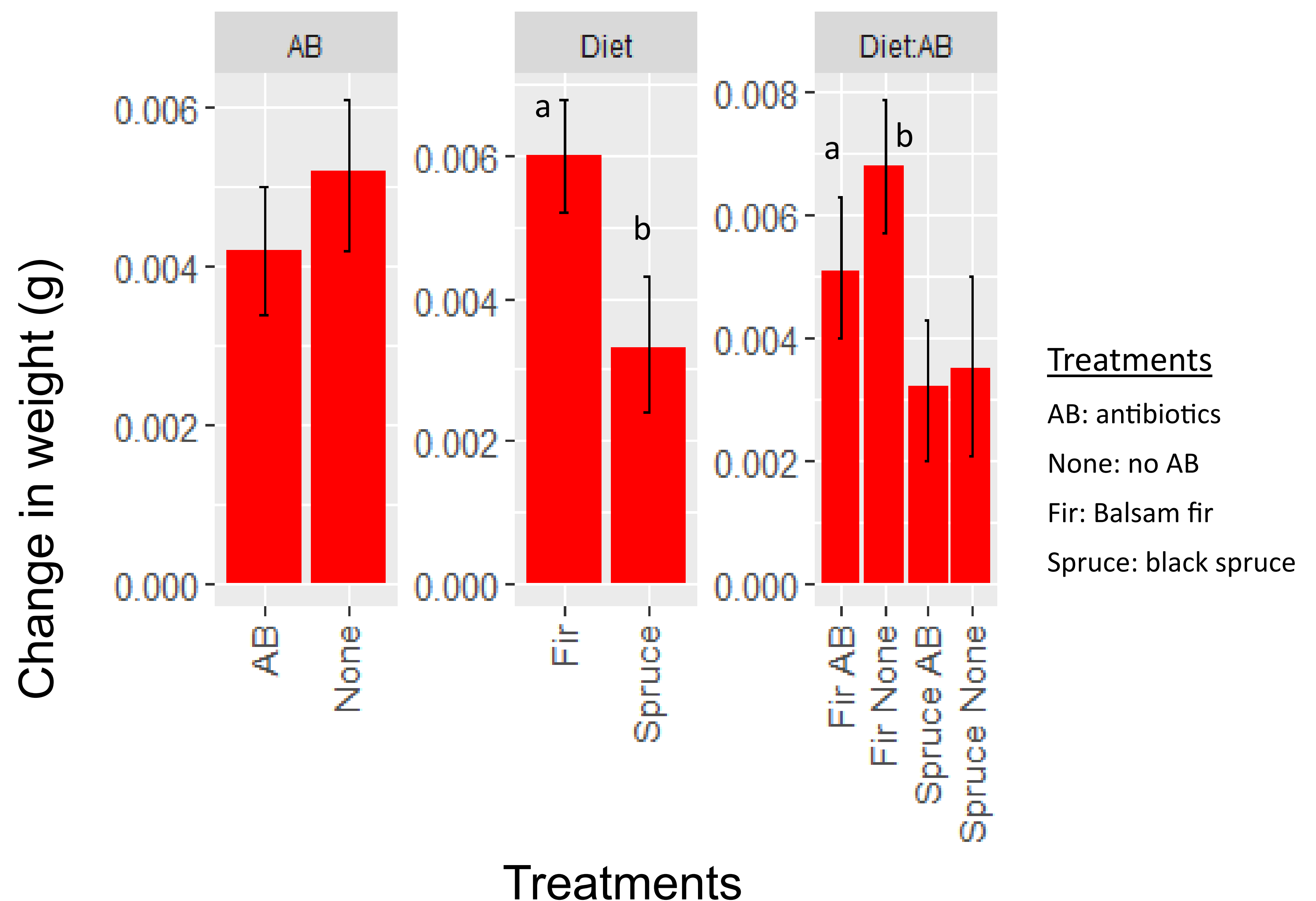


Figure 2. Least square means \pm SE of spruce budworm larval weights among treatments derived from a linear mixed-effects model. Lowercase letters above the bars represent statistical significance based on ANOVA ($\alpha < 0.05$).

- Diet type had the largest effect on SBW growth ($p < 0.001$)
- Antibiotics had no overall effect on SBW growth
- SBW larvae feeding on Balsam fir with antibiotics grew significantly less than on untreated diet ($p = 0.0356$)

Conclusions

- Diet is the most important factor influencing SBW growth
- Interaction between AB and diet suggests that there are microbes beneficial to SBW which live on fir but not on spruce

Future work

- Quantify microbial diversity and the relative percent contribution of each microbial taxa to the community among treatments
- Test if any microbial taxa are over or under represented in a given treatment
- Test the significance of diet, antibiotics, and their interaction on the growth of SBW larvae

References:

- Burton PJ, Svoboda M, Kneeshaw D, Gottschalk KW. (2015). Options for Promoting the Recovery and Rehabilitation of Forests Affected by Severe Insect Outbreaks. *Restor Boreal Temp For* 495–517.
- Engel P, Moran NA. (2013). The gut microbiota of insects - diversity in structure and function. *FEMS Microbiol Rev* 37: 699–735.