Final report (2008-2009 fiscal year)

Characterization and Development of Cone-derived Infrared Radiation and Wavelengths of Visible Light for Attraction of Western Conifer Seed Bugs, *Leptoglossus occidentalis*

Progress

1. In electroretinogram recordings that subjected eyes of males or females to 31 Light Emitting Diodes (LED) emitting light at peak wavelengths in the range of 370 to 670 nm, wavelengths in the blue and green range gave the relatively strongest retinal responses.

2. Within the UV, violet, blue, green and yellow wavelength range, the following LEDs elicited the relatively strongest retinal responses: 390 nm (UV), 433 nm (violet), 470 nm (violet/blue), 480 nm (blue), 567 nm (green), 592 nm (green), and 621 nm (yellow). Responses to these “key” wavelengths suggest that WCSB are multichroic.

3. Dorsal, equatorial and ventral regions of the eyes of females and males responded similarly to these key wavelengths of light, suggesting that all regions of the eye contain the same types of photoreceptors.

4. The retinal response increased with increasing light intensity.

5. In laboratory two-choice (T-tube) experiments, 2nd instar nymphs showed no preference for specific light stimuli.

6. In laboratory, two choice (T-tube) experiments, adults significantly preferred green over red light and green over no-light stimuli. These responses, however, were statistically significant not in all experiments, possibly suggesting that light stimuli need to coupled with other (IR?) stimuli.

7. Taking thermographs and photographs of cones of different lodgepole pine clones with an AGEMA Thermo vision camera (sensitive in the 3-5 µm range), a Fluke TI-20 thermal imager (sensitive in the 8-20 µm range) and a Nikon D70 camera, revealed differences in IR radiation from different clones, possibly linked to the attractiveness of specific clones to WCSBs. This study will be expanded in 2009.

8. Taking thermographic images of white pine cones and foliage every hour for 24 hours with the AGEMA camera, cones were distinguishable from foliage for the entire 24-hour period. Using the Fluke TI thermal imager instead, cones were distinguishable from foliage between 7:00 and 20:30. Using a Kodak digital camera without flashlight, cones were not visible in photographs between 21:00 and 06:00 hours.

9. In the 24-hour recording period of white pine cones and foliage, cones were warmer than foliage between 7:00 and 18:30 or between 9:00 and 18:30 (depending on the sampling protocol). The greatest temperature difference between cones and foliage (9.6°C or 22.1°C, depending on the sampling protocol) occurred at 11:30. Cones were generally colder (up to 1.1°C) than foliage between 18:30 and 08:00, but there were some instances where cones were slightly warmer.

10. Taking thermographic images of Douglas fir cones and foliage every hour for 24 hours with the AGEMA camera, cones were distinguishable from foliage between 5:30 and 23:30. Using the Fluke TI thermal imager instead, cones were distinguishable between 5:30 and 21:30. Using a Kodak digital camera without flashlight, cones were not visible in the photographs between 21:00 and 6:00.

11. In the 24-hour recording period of Douglas fir cones and foliage, cones were warmer than foliage between 09:00 and 18:30 or between 09:30 and 19:30 (depending on the sampling protocol). The greatest temperature difference between cones and foliage (4.7°C or 9°C, depending on the sampling protocol) occurred at 16:30. Cones were colder than foliage (0.1-0.6°C, depending on the sampling protocol) between 18:30 (or 20:30) and 23:30, and between 05:30 and 08:00 (or 8:30).

Research Challenge

Several light-related aspects of last year's proposed research have hinged upon the OneLight instrument that we had purchased with financial support from the Forest Genetics Council and another granting agency. Much to our disappointment, however, the instrument was delivered with an 8-months delay in December 2008 when WCSB had already gone into diapause. Wherever possible, LEDs substituted for the OneLight but various experiments could not be executed as planned. We will catch up with these experiments in this year's field season.

Predictions

We predict that:

(1) specific wavelengths of visible light reflected from cones constitute foraging cues for seed bugs;

(2) IR, visible-light wavelength(s) and specific cone (trap) size are synergistic cues for attracting seed bugs; and

(3) optimal trap size must not greatly exceed natural cone size.

Research Objectives

We plan to:

1. determine whether preference by WCSBs for specific conifer clones is based, in part, on contrasting IR signatures (see point 7 in progress);

2. determine behavioral responses of WCSBs to key wavelengths of visible lights;

3. investigate interactions between IR radiation and specific wavelengths of visible light for attraction of WCSBs; and

4. determine optimal trap size or type for WCSBs.

Overall Goal

Our overall objective is to develop an effective trap for (mass) trapping WCSBs in seed orchards.

Budget

All research accounts that have been charged with expenses related to this project will be reimbursed by April 31 (2009), with no funds remaining in the account for this project at that date.