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Regional Differences in Two Mountain Pine Beetle Population Fitness Parameters

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Throughout the range of the mountain pine beetle (*Dendroctonus ponderosae* Hopkins), observed differences in several population fitness parameters such as development time, brood production, cold hardiness, and adult and larval size have been attributed to the host species brood develop within. Alternatively, observed differences may be largely due to the environment in which the broods develop, varying significantly across geographic regions irrespective of the host type. It is important to understand what factors are responsible for observed differences in population fitness parameters and ultimately the success of a population. If there are true differences among mountain pine beetle populations that are based on either host type or geographic region, it may be necessary to develop individual management strategies and population prediction and risk models for each region and/or host type. We investigated the role of host type and geographic region on mountain pine beetle population performance using 2 fitness parameters: 1) development time from the egg to adult, and 2) adult size. F_0 brood included: lodgepole pine (Sawtooth National Recreation Area near Stanley, ID), ponderosa pine (Dixie National Forest near Cedar City, UT) and western white pine (Spotted Bear Ranger District, Flathead National Forest). F_2 brood developed in either lodgepole pine or ponderosa pine. Development time and adult pronotal size of F_2 brood were measured. If the F_0 source host has a greater effect on F_2 brood development time and adult size than does the host F_2 brood were reared in, we hypothesized that some heritable factor related to the F_0 parents was responsible for observed differences.

Conclusions

1. F_0 parent beetles had a greater effect on F_2 brood development time and adult size than did the host brood developed in. In all treatments, F_1 parents were reared in the same host. Although F_0 parent beetles were from both different hosts and different geographic regions, the effect of geographic region was much stronger ($\chi^2 = 4.94$ for brood host effects as compared to $\chi^2 = 1291.0$ for source effect).

   - These results suggest that mountain pine beetle populations in different geographic regions have heritable traits that are maintained despite the brood host, at least through two generations.

2. F_2 brood adults from F_0 source beetles from central Idaho always developed the fastest despite the host brood were raised in. These beetles were also always the smallest. In contrast, F_2 brood adults from F_0 source beetles from southern Utah always developed the slowest, yet these beetles were always the largest.

   - These results suggest that a strong local selection pressure such as microclimate may be influencing mountain pine beetle populations in different geographic regions. Temperatures in southern Utah are much warmer than temperatures in central Idaho (Bentz and Mullins 1999). Selection pressure in the colder environment would maintain a faster development time, whereas in the warmer climate, where the season for

development is longer, selection for a larger size would be stronger. Model analysis (Logan and Bentz 2000) of mountain pine beetle seasonality also anticipated this observation.

3. Variation in the response of mountain pine beetle populations to field-applied semiochemicals may also be explained by geographically-mediated heritable traits. The application of semiochemicals for population manipulation, as well as, population and risk models which drive management decisions may need to be tailored to each geographic region.

Literature Cited

Bentz, B.J., and D.E. Mullins. 1999. Ecology of mountain pine beetle cold hardening in the Intermountain West. Environmental Entomology 28(4):577-587.

Logan, J.A. and B.J. Bentz. 1999. Model analysis of mountain pine beetle seasonality. Environmental Entomology. 28(6).

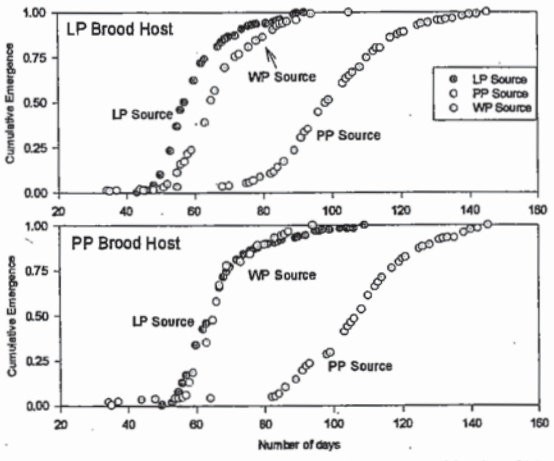

Figure 2. Development time for F_2 brood adults reared in LP and PP by F_0 source.

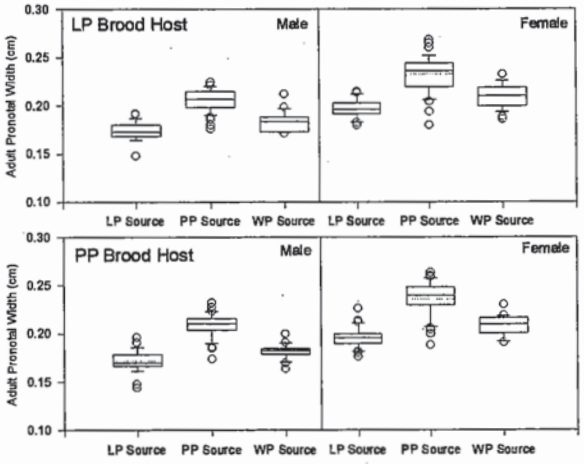

Figure 4. Box plots showing the effect of F_2 brood host on F_2 brood adult pronotal width, by F_0 source.