PALLET PHYTOSANITARY PROJECT BULLETIN

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THE APPLICATION OF VACUUM TO CONTROL INSECTS IN RAW WOOD PACKAGING MATERIALS[1]

This bulletin summarizes the results of the above titled research project funded under the Competitive Grants Program of the Pallet Phytosanitary Project.

INTRODUCTION

The objective of this research was to evaluate low-pressure vacuum technology to control insects in wood packaging material, as an alternative to the currently approved treatments: heat and methyl bromide. Advantages of this technology are that it requires little energy, does not use ozone-depleting chemicals such as methyl bromide, and has the potential to treat wood that, because of the intended use, is temperature resistive or is sensitive to chemical treatment.

Low pressure, achieved by applying a vacuum to a system, reduces the volume of air and imposes a controlled atmosphere. These atmospheres can induce dehydration and death of larva within timeframes of hours to days. A Lethal Vacuum Time (LVT) may be empirically established for the life stages of larvae.

Larvae of the old house borer, *Hylotrupes bajulus,* and the Asian longhorned beetle, *Anoplophora glabipennis,* are known to survive in low moisture content environments typical of wood packaging material in use. The Asian longhorned beetle, in particular, has been targeted by the US as a serious pest, originating in China, whose entry into the US has serious economic and ecological implications. There is no empirical data on the effective use of low pressure vacuum in controlling insects infesting dimension lumber, although some data exists on using this method to control closely related insects infesting stored-food packaging.

[1] The project researchers were Zhangjing Chen, Marshall S. White, and W. H. Robinson. Their titles and affiliations are respectively, Research Associate and Professor, Department of Wood Science & Forest Products, Virginia Polytechnic Institute and State University, Blacksburg, VA; and, President, Urban Pest Control Research and Consulting, Christiansburg, VA.

METHODOLOGY

For the purposes of this evaluation, larvae of *Hylotrupes bajulus* were used, because the Asian longhorned beetle is not available in laboratory colonies in the US. *H. bajulus* larvae are about the same size (15-25mm in length) and weight as the Asian longhorned beetle and are tolerant of low wood moisture, high and low temperatures, and other unfavorable environmental conditions.

Experimental wood samples were green red oak, dry yellow-poplar at 7% MC (moisture content) and southern yellow pine at MC of 12% and 22%. Larvae of *H. bajulus* were placed in holes drilled in the wood samples, which were then securely plugged with wooden dowels. Tests were conducted within 1 hour of larvae placement, with pressure pulled and maintained at 20 mm Hg and 20°C. Immediately following treatment, larvae were removed from the holes and mortality checked at room temperature. This process was repeated at regular time intervals. Mortality was determined by observing the movement of larvae after removal from the wood. If larvae were alive after treatment, they were placed back in the wood and vacuum treatment continued.

RESULTS

Five separate experiments were included in the evaluation:

- Experiment 1: Larva in green red oak – after 120 hours of treatment all larvae remained alive. The wood decreased between 2.2% and 14.3% in MC.

- Experiment 2: Larva in a metal pipe – after 5 hours of treatment all larvae were dead.

- Experiment 3: Larva in 7% MC yellow-poplar – after 24 hours of treatment all larvae were found dead. Also, there was no change in moisture content of the wood.

- Experiment 4: Larva in 12% MC pine sample – after 48 hours of treatment all larvae were dead. Also, there was no change in moisture content of the wood.

- Experiment 5: Larva in 22% MC pine sample – after 55 hours all larvae were dead. The wood decreased between 1.3% and 4.8% in MC.

DISCUSSION

Experimental results indicated that the old house borer can be killed with a vacuum treatment when MC is less than 23%. In experiments 2 thru 5, mortality was directly correlated with significant body weight loss, although no consistent or predictable Lethal Percent Weight Loss (LPWL) was evident. In experiment 2, the LPWL was about 20% and in other cases more than 60%. However, the researchers observed that most larvae were starting to die when body weight loss began to exceed 30%.

In the experimental cases where the wood MC was less than 23%, the vacuum treatment killed all larvae. Based on the experimental results, the Lethal Vacuum Time increases with increasing MC and decreases with increased larvae weight. The researchers believe that mortality of larvae exposed to low pressure was a result of dehydration due to exposure to low pressure created under vacuum.

In experiment 1 the larvae did not lose enough weight to be dehydrated, thereby leading to mortality. The larvae did experience some loss in body weight, but were presumably able to absorb sufficient levels of water to remain alive inside the wood. The lack of oxygen in the vacuum conditions was not sufficient to kill the larvae in the timeframes tested.

Because the conditions in experiment 1, with green red oak, are common in the pallet industry, the researchers recognize that additional work must be done to determine the efficacy of low-pressure vacuum treatment on the mortality of wood occupying insects under these conditions. The researchers indicate that other empirical studies using increased temperatures have shown increased larval mortality in shorter time periods. They suggest that future research should concentrate on selecting combinations of time, temperature, and pressure that can effectively treat wood in the green condition, as is typical of wood packaging material.