SURVEY OF TWENTY-SIX HYBRID POPLAR LINES FOR POPLAR BORER

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Abstract—An insect survey was completed on 26 lines of hybrid poplar (*Populus nigra* x *P. maximowiczii*) that had the Roundup® Ready and Bt (*Bacillus thuringiensis*) genes. The survey was conducted in Kentucky in cooperation with MeadWestvaco. A total of 260 trees were evaluated. Survival rate averaged 74.2 percent among the lines. Poplar borer [*Saperda calcarata* (Say) Coleoptera: Cerambycidae] infested 22.2 percent of the trees. Other insects were present but to a lesser degree. Resistance to insect attack appeared evident in some lines but not in all. Experimental hybrid lines have not been approved for release, and this study adds to the information concerning herbivory on genetically modified material.

INTRODUCTION

Populus species are the fastest growing trees planted commercially in North America with expectations of becoming the new pulp and energy fiber for the future. In the northwestern United States, 50,000 acres of poplar plantations have been planted (DeBell and others 1998, Stanton and others 2002). *Populus* plantation management is very similar to conventional agriculture in that insect control is one of the main challenges. Uniform age and size of the plantation creates a monoculture setting that results in a less complex system than that of a natural forest stand. Because of the monoculture habitat, natural checks and balances that decrease pest populations are reduced (Reichenbacker and others 1996). With advances in science and technology, researchers are testing genetically modified *Populus* clones which have genes tolerant to glyphosate (active ingredient in Roundup® herbicide) developed by Monsanto and a rebuilt Cry3A *Bacillus thuringiensis* toxin gene provided by Mycogen for resistance to the cottonwood leaf beetle (*Chrysomela scripta* F.).

METHODS

Insect Survey and Data Analysis

This survey was conducted on October 4-6, 2002, in a 3-year-old *Populus* plantation grown on MeadWestvaco land in Kentucky. The plantation was an experimental study using hybrid poplar (*Populus nigra* x *P. maximowiczii*) provided by Richard Meilan, Oregon State University. The hybrid poplars with the Roundup® Ready and Bt genes used in this study have not been approved for release. In any field trial, it is important to know the impact of insects. The cottonwood leaf beetle was not present in study plots; however, the poplar borer [*Saperda calcarata* (Say) Coleoptera: Cerambycidae] (fig. 1) was present and is the subject of this study. There was a total of 520 trees in the study area with 26 hybrid poplar transgenetic lines represented by 4 treatments replicated 5 times. The treatments were part of an earlier MeadWestvaco study. We conducted a 50 percent survey that included 2 treatments in each of the 5 replications for a total of 260 trees. At each tree, we sight identified and tallied all insect damage. Calipers were used to measure basal diameter (diameter at ground level) and d.b.h. (diameter at breast height). A Suunto® compass was used to determine the directional pattern of attacks. Tree height was measured using a Haglof® Vertex III hypsometer.

Trees with and without poplar borer were analyzed using analysis of variance (ANOVA), Fisher's PLSD, and X^2 (SAS Institute 2000), with d.b.h., basal diameter, tree height,

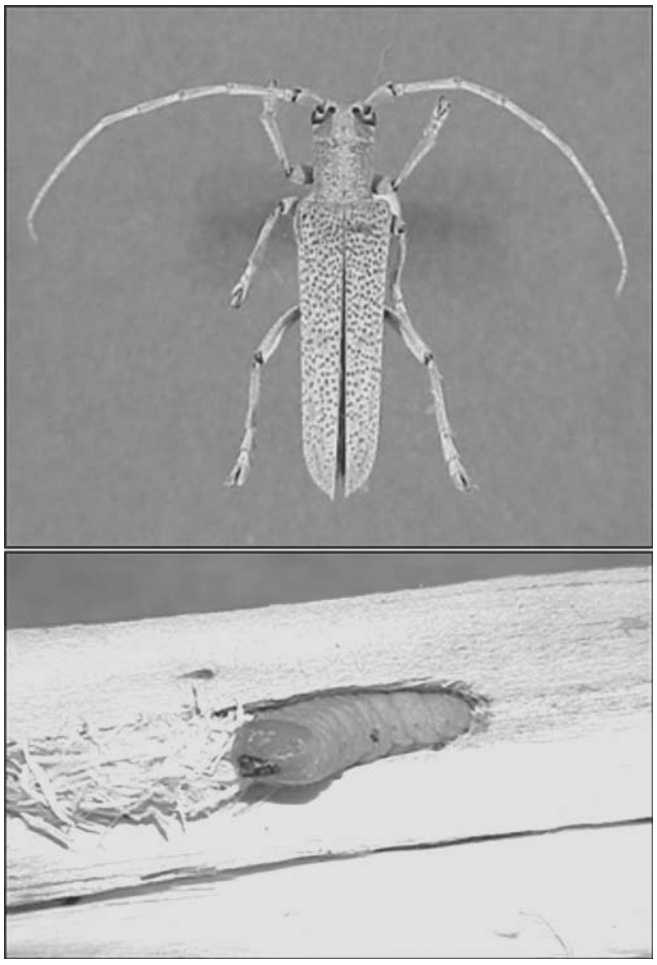

Figure 1— Mature adult and larva of the poplar borer. Photos taken by Doug Stone, February 2003.

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direction of poplar borer attacks, and mean number of poplar borers tested ($\alpha = 0.05$).

RESULTS

The *Populus* lines with the Bt gene had no signs of CLB damage, as expected. Survival rate of lines averaged 74.2 percent (193 present/260 possible) (fig. 2). Poplar borers were present, and the data showed that some genetic lines had significantly more mean poplar borers than others. Poplar borers accounted for most of the insect activity with 22.2 percent (43 trees) infested. Fisher's PLSD T-test was used to compare the three variables (d.b.h., height, and basal diameter) among trees with or without poplar borers. Trees with or without poplar borers did not differ significantly in d.b.h. and basal diameter at $\alpha = 0.05$. Trees with poplar borers had an average diameter of 2.33 ± 0.15 inches and basal diameter of 5.02 ± 0.21 inches. Trees without poplar borers had an average diameter of 2.23 ± 0.09 inches and basal diameter of 4.59 ± 0.16 inches. There was no significant difference in height of infested and uninfested trees.

Mean Poplar Borer Present

Fisher's PLSD T-test was used to compare mean poplar borer attacks among the different lines (fig. 3). The only significant differences were for lines 18 and 21, with no poplar borer attacks as compared to line 6. Because of the small sample size, further surveys with larger sample sizes need to be conducted to determine if any differences exists among the other lines. Lines 1, 3, 19, 25, and 26 are not included because they had < 20 percent survival, while lines 2, 5, 6, 13, 17, and 24 had 100 percent survival. The best lines appear to be 18 and 21, with no poplar borer attacks and 80 and 90 percent survival, respectfully.

Directional Pattern of Attacks

Chi-square test was used to determine if there was any significant directional difference in poplar borer activity. If the poplar borer had randomly bored into the tree, the statistical percentage for the 8 directions would have been 12.5 percent overall. There was significant difference from the hypothesized 12.5 percent among all directions. Out of 90 poplar borers (fig. 4), highest number of attacks was on the south side of the tree, which was almost double the number of attacks on north side. The lowest percent occurred on the northwest and southwest sides of the tree. Further studies will be required to determine if a preference does exist.

DISCUSSION

Earlier studies on the impact of the poplar borer showed that they can contribute to breakage and degradation of natural and plantation grown eastern cottonwoods in stands 3-years-old and older (Abrahamson and Newsome 1972, Nebeker and others 1985). During high winds and after thinnings, trees infested with poplar borer are more likely to break, which reduces total stand volume. A 22.2 percent infestation rate in this 3-year-old stand was much higher than in previous studies

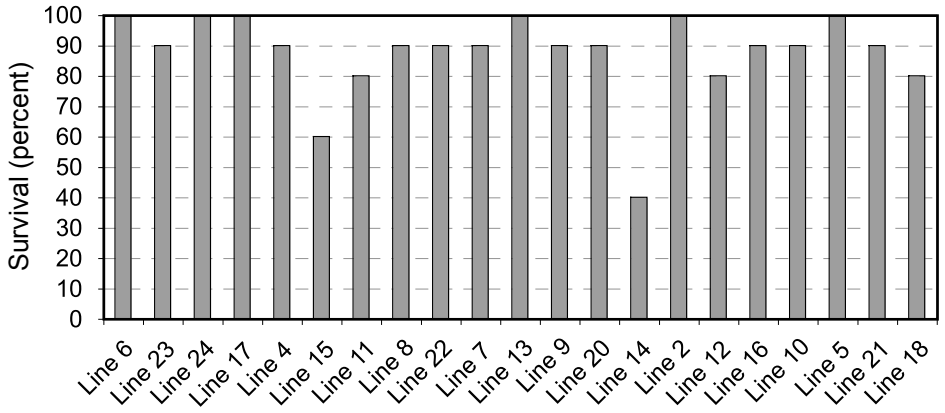

Figure 2—Survival rate of sampled clone lines.

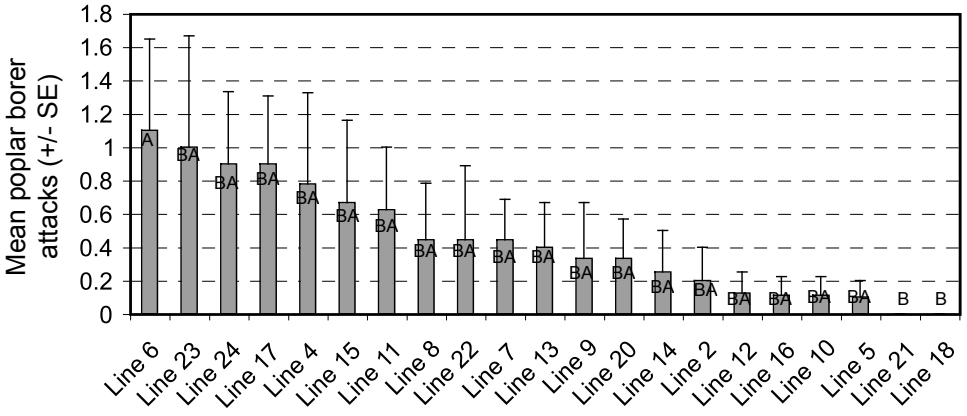

Figure 3—Mean poplar borers attacks among each sampled clone line.

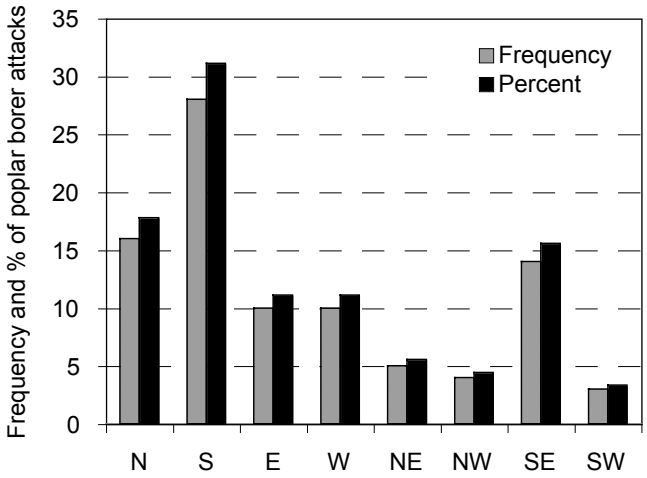

Figure 4—Frequency and percent of the eight cardinal directions with respect to poplar borer attacks on the bole of the cottonwood.

(Abrahamson and Newsome 1972, Nebeker and others 1985). In addition, previous studies demonstrated an increase in poplar borer activity with respect to tree age. One might conclude that poplar borer activity would have continued to increase at this site if it had not been cut. This study provided a preliminary look at line susceptibility to poplar borer attack.

Improvements in genetics are an important part of overall tree health and culture. By maximizing tree health, growth will improve which will increase yields and shorten rotation age. With increased demands on wood products, it is crucial that research continue in the area of tree improvement. Also, it is very important that the impact of insects is not overlooked so nurseries can release the best possible genetic lines for use.

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