BORER DAMAGE IN GREEN ASH TREES FROM DIFFERENT PROVENANCES

by Frank S. Santamour, Jr. and Kim C. Steiner

Abstract. Young trees of green ash *(Fraxinus pennsylvanica)* from 43 geographic origins throughout the species' range were heavily attacked (81%) by the ash borer *(Podosesia syringae)* or its sibling species *P. aureocincta*, with no differences among provenances. Faster growing trees were attacked more often than weak trees. The few fast-growing, borer-free trees remaining are being vegetatively propagated and used in controlled crosses to develop populations for further testing.

Borers of the genus *Podosesia* are the most destructive insect pests of ash *(Fraxinus)* species planted in urban landscapes. The adults of these insects are clearwing moths whose adult life span may be only about 5 days, but the larvae may cause serious damage by mining in the cambial zone and tunneling in the wood of young trees. The most common borer is *P. syringae* (Harris), commonly called the lilac borer, which has a period of adult emergence from May through July in Ohio and Maryland (2, 4). The lesser known species is *P. aureocincta* Purrington and Nielsen (4), which is morphologically similar to *P. syringae* but whose adults emerge from late August through September (2, 4). One additional aspect of tree damage by *P. syringae* was noted by Solomon (7), who found very young larvae responsible for the death of succulent terminal shoots, which results in forked trees.

It is interesting to note that a 1956 article in the *Journal of Forestry* (5) on grubs in green ash *(Fraxinus pennsylvanica)* failed to identify the insects as ash borers even though the size of the galleries in the wood was indicative of their presence. The first well-documented reports on ash borer infestations were made on trees planted in farm windbreaks. Tunnock and Tagestad (9) surveyed 96 North Dakota windbreak plantings in 1972, and of 4,096 green ash trees examined only 3.5% were attacked by the ash borer. A 1976 survey of trees in 116 shelterbelts showed that 3.8% of the green ash were infested. Attack by ash borers predominated in trees up to 16 years old, but the carpenterworm *(Prionoxystus robiniae)*, a far more serious pest in these plantings, was found mostly in trees older than 16 years.

Apparently, trees planted in urban areas are more heavily attacked. Peterson (3) estimated that 50% of the green ash in the cities of the Canadian Prairies were attacked, and a 1977 survey showed 33% infestation of boulevard trees in Grand Forks, North Dakota (1).

These meager data suggested that there might be sufficient variation in susceptibility to allow for the selection of resistant trees. Natural resistance to borers in green ash would be preferable to the difficulty of chemical control in urban areas, and a comparison of genotypes growing in a borer-prone environment would offer an excellent means of screening for such resistance. The opportunity to observe a large number of trees from diverse geographic origins prompted the National Arboretum to participate in a provenance test of this species.

Materials and Methods

The green ash provenance test was directed by the junior author and details of the seed collections areas, handling of seedlings, and cooperative test plantings in Iowa, Maine, Maryland, Michigan, Nebraska, New Hampshire, New York, Pennsylvania, Vermont, and West Virginia have been published (8). When growth and survival data at the end of the 1983 growing season were being assembled, each cooperator was asked if he had noted any borer damage. No other cooperator had. Thus it appeared that our borer problems in Maryland might represent a "worst case" situation, and should be reported.

The National Arboretum's test planting of green ash was established in Beltsville, Maryland, in the spring of 1978 with bare-root, 2-year-old seedling stock that had been grown in a nursery in

Pennsylvania. The seedlings were planted 10 ft apart in rows 10 ft apart in 2 replicates on quite different sites separated by about 100 yds. Replicate 2 was on a much drier site than the other replicate. Each replicate consisted of 4-tree row plots of each of 41 native provenances representing seed collections from 10 states and 5 Canadian Provinces from Alberta to Quebec south to Tennessee and Arkansas. Two provenances were planted in only a single replicate. In addition, 2 provenances of white ash, *F. americana,* from Ohio and Illinois, were included in both replicates.

The original intent of the range sampling was to collect seed from 4 mother-trees in each locality (provenance), but this was not always possible, and poor germination further reduced the numbers of trees in some progenies. Thus, the number of families per provenance in the Maryland plantation ranged from 1 to 4, with a total representation of 141 mother-trees. Each provenance replicate as supplied for the test, might contain as few as 1, or as many as 4, seedlings from each mother tree. This design provided maximum genetic diversity but precluded any meaningful interpretation of variation among families, expecially with only 2 replications.

Our first survey for borers was made in November, 1981, when the trees were 6 years old from seed and had been outplanted for 4 years. The number and position of borer wounds were noted for each tree. As described and illustrated by Solomon (6), 2 holes result from each successful insect attack, an irregularly shaped entrance and a 4-5 mm perfectly round exit. After the holes are overgrown, the entrance would resemble an L-shaped scar and the exit a circular scar. Another survey was made in November, 1984, when the trees were 9 years old.

Following our 1981 survey, we attempted to determine the relative borer populations in the 2 test replicates. Two pheromone traps (Pherocon 1c™ trap with clearwing Borer Lure by CONREL®) were set out in each area during the periods April 16-May 15, June 7-June 22, and August 15-September 15, 1982.

Results and Discussion

Results of sex lure trapping of male moths during the 2 trapping periods from April through June, 1982, indicated that both plots had roughly the same borer density: Rep. 1 (36 + 22 = 58); Rep. 2 (34 + 33 = 67). We also observed pupal cases protruding from exit holes during May and June. We did not trap any *Podosesia* during the August-September period, nor did we observe any pupal cases at that time. However, the commercial lure used in the traps is not a reliable attractant for *P. aureocincta,* which emerges in late summer. Trapping in 1983 with a sex attractant more specific to *P. aureocincta* did reveal its presence in the planting area, but *P. syringae* is still considered the major source of borer damage.

The 1981 borer survey showed that 63% of all (333) trees in both replicates had been attacked by borers, 76% in Replicate 1 and 52% in Replicate 2. The difference between replicates was clearly attributable to poorer growth in Replicate 2. The faster-growing trees were preferentially attacked, with 71% infestation of seedlings with a caliper greater than 1 inch and only 43% infestation of seedlings with a lesser caliper. By 1984, the overall attack rate was 81%, with 91% in Replicate 1 and 72% in Replicate 2. Slower-growing trees were still less likely to be attacked, and many were declining for unknown reasons. In additions, 69% (11/16) of the white ash trees had been attacked, and they were generally smaller than the green ash.

There were no significant differences among provenances in the incidence of borer attack: the distribution of infestation fit the binomial distribution expected from random attack. Progenies of far northern origins were as likely to be attacked as the southernmost sources. In no provenance were fewer than 4 (of 8) trees infested, and even when the incidence was that low it could usually be attributed to the presence of slow-growing trees. The few (less than 20) trees of acceptable growth rate and form that were still free of borer damage were scattered at random throughout several provenances, with a few outstanding trees from Illinois, Maryland, and Missouri.

The results are disappointing but informative.

Provenance selection clearly offers little or no potential for improving resistance to *P. syringae,* and, in fact, true genetic resistance to the insect may be rare or nonexistent in green ash. However, possible individual tree differences cannot be ruled out. Some of the non-infested trees are now flowering and controlled crosses will be made, among both attacked and nonattacked trees, to obtain progenies for further testing. Also, we are vegetatively propagating a few select trees by budding for further evaluation.

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Abstract

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A rule of thumb in the nursery business is that 30 percent of the tops of bare-root trees should be removed at planting time. Since a tree's fibrous root system is reduced to a few woody stubs during digging, it seems appropriate to reduce the top in some proportion before replanting. However, for almost 100 years, good evidence has existed that dormant pruning may not be beneficial for all bare-root trees. The Department of Horticulture at Colorado State University, Fort Collins, has studied branch thinning with two species that are commonly planted bare-root (Newport plum and Sargent crabapple). One of the surprising results of these experiments was that the variability in new root production was high. Regardless of pruning treatment, the difference in new root development between trees within each group was large enough that no effect of top pruning on root production could be found. Most top pruning on these species might profitably be delayed until the second or third year when more growth is produced. Except for removing major structural defects (such as twin leaders) or balancing the length of major branches, this research indicates that first-year pruning appears largely ineffective in determining structural development or total growth.