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IMPACT OF THE POPLAR-GALL SAPERDA, *SAPERDA INORNATA* (COLEOPTERA: CERAMBYCIDAE) ON A HYBRID *POPULUS* PLANTATION IN MICHIGAN

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ABSTRACT

Saperda inornata attacks on hybrid *Populus* were monitored in a stand for four years after planting. More than 60% of the whips were attacked the first year, resulting in a mean of 1.6 galls/tree (range 0–8). Branch attacks superseded stem attacks in the third and fourth years. Saperda injury significantly reduced height because of leader breakage after the second-year attacks, but the injured trees grew rapidly and recovered much of the height in the third and fourth years. Saperdas killed 4% of the trees during the study, but this was no more than would be expected in a newly established stand. Saperda, at the population levels studied, does not seem to greatly affect hybrid *Populus* growth or to reduce biomass.

The poplar-gall saperda, *Saperda inornata* Say, is a common pest of young aspens, *Populus* spp., in North America. Larval boring causes a globose gall to form around the injured tissues. Infested trees are weakened so that the stems or branches may break from their own weight or from ice, snow, or wind (Graham et al. 1963, McLeod and Wong 1967, Wong and McLeod 1965). Further, the wounds made by the adult female serve as infection courts for canker fungi such as *Hypoxylon mammatum* (Wahl.) Miller and *Cytospora* sp. (Anderson et al. 1979, Harrison 1979).

This gall maker has been sporadic in importance in recent years in hybrid *Populus* clonal outplantings owned by Packaging Corporation of America (PCA) in central Lower Michigan. In 1979, however, saperdas became particularly abundant in one mixed-hybrid outplanting established for studying stand growth (Moore and Wilson 1983). We observed the infestation level of saperda in this plantation and the subsequent impact on the trees from 1979 to 1982. During the study period we also observed incidental injury from other agents.

MATERIALS AND METHODS

The study was conducted in a mixed-hybrid *Populus* plantation in Mason County, Michigan (T19N, R15W, S30). The planted area was surrounded by saperda-infested native aspens, *P. tremuloides* Michx. and *P. grandidentata* Michx. The plantation was established in the spring of 1979 with 1.5-m-tall whips of a random mixture of four unknown clones spaced 2.4 m apart within rows and 3.0 m between rows. Two study plots were set up in the spring of 1980. Plot 1 was 34 by 54 m and contained 182 trees; plot 2 was 34 by 64 m and contained 209 trees.

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Table 1. Poplar-gall saperda galls on hybrid *Populus* stems and branches, 1979–1982.

	Saperda galls by year							
	1979		1980		1981		1982	
Location	No.	%	No.	%	No.	%	No.	%
Mainstem	641	99.2	549	71.4	97	32.0	142	42.4
Branches	5	0.8	220	28.6	206	68.0	198	57.6
Total	646	100.0	769	100.0	303	100.0	335	100.0

In May 1980 we examined the trees in each plot for the presence of *S. inornata* galls and injury to stems and branches from the 1979 attacks. We determined the number and location of the galls on the trees and recorded any injury or lack of it as follows: (1) tree killed to base, (2) top of tree killed above gall, and (3) no apparent injury. Additional data were taken when injury or death occurred from other insects or diseases. Tree heights were measured in June 1981 for 1980 growth; subsequent height measurements were taken in October 1981 and 1982. Impact was analyzed by comparing height growth between injured and uninjured trees for each of the three years after establishment (i.e. 1980–1982). Trees injured by agents other than saperdas were not used in the impact analyses. Seven trees were cut in 1984, sawed longitudinally, and examined to determine the impact and recovery of the galls within the stem.

RESULTS AND DISCUSSION

The poplar-gall saperda severely attacked whips in the year they were planted, and then maintained a moderate to high infestation level throughout the study (Table 1). In 1979, the year the whips were planted, saperdas induced 646 galls to form on the 399 plot trees (mean 1.6/tree, range 0–8/tree). This extraordinarily high number of first-year attacks occurred only because the planting stock was considerably oversize (1.5 m tall) and had diameters large enough to support larvae. Knight (1963) noted the average diameter of limbs of current attacks, measured just below the gall, was 1.1 cm (range 0.9–2.0 cm). Nord et al. (1972) reported that saperdas attacked portions of aspen suckers 1–5 years old where diameters at the egg-laying sites were 5–15 cm, although the larger diameter twigs and stems usually had the most egg niches. The 1.5-m whips in our study plantation, because of their robust size, provided the trees a one-year head start on height, diameter, and branching. Whips that grow from standard cuttings only have a few small branches the first growing season, which are too small for saperda development. Some branches of the whips in this study grew large enough to attract and support a small percentage (0.8%) of the insects (Table 1). As additional branches developed, the insects increasingly preferred the branches over stems, and the number of insects on the branches surpassed those on the stems in both 1981 and in 1982 (Table 1). A gall on a branch can kill only a part or all of the branch, but a gall on the mainstem can destroy all of the tree above the attack, so it is the stem galls that mostly affect tree height. Abundant branches reduce the probability of stem injury because they attract the insects away from attacks on the mainstem.

The location of saperda attacks during our four-year study indicated the insects preferred certain branch and stem sizes. In 1979, all galls formed on the lower two-thirds of the whips and on a few of the largest branches. In 1980 and thereafter, saperda adults chose egg-laying sites higher on the stem and farther out on the lower branches. By 1982 the lower 3.5 m of the stem was unacceptable to saperda attack. Hussain (1972) suggested

Table 2. Cumulative impact of the poplar-gall saperda and other agents in a hybrid *Populus* plantation, 1979–1982.

Tree class	Cumulative yearly impact							
	1979		1980		1981		1982	
	No.	%	No.	%	No.	%	No.	%
Killed by saperda	10	3	15	4	17	4	17	4
Top-killed by saperda	29	7	37	10	40	10	44	11
Saperda galls but no apparent damage	234	60	259	67	253	65	251	65
Uninjured	74	19	17	4	10	3	8	2
Injured by other agents	41	11	60	15	68	18	68	18
Total	388	100	388	100	388	100	388	100

the attack site may also be determined by the amount of sunlight, and the lower bole is shaded the most.

By the end of the 1979 growing season, 70% of the young trees had galls; by the fall of 1982, only 2% were still without galls (Table 2). Saperdas killed 4% of the trees and top-killed an additional 11% after four years. Most saperda attacks resulted in galls that caused hypertrophic growth of the tissues at the attack site, but did not cause any apparent loss of height or biomass. A few trees had as many as 12 galls on the mainstem without any apparent height loss.

Trees unbroken but with galls showed no significant height differences in any year when compared to trees without galls (t-test, $P > 0.05$) (Fig. 1). Top-killed trees, however, were generally shorter than uninjured trees. The top-killed trees were significantly shorter in 1980 ($P > 0.1$), but seemed to be recovering by 1981 and 1982 (significant at $\alpha = 0.25$) (Fig. 1).

Grimble et al. (1970) reported severe saperda infestations only in slow-growing, off-site aspen stands in their study. Hussain (1972) concluded that fast-growing dense stands resist saperdas because the beetles tend to avoid closed-in sites. He also surmised that the larval incubation period is lengthened from lack of sunlight and that cambial growth often overcomes the larvae. Trees in our study grew rapidly on an excellent site for *Populus*, but this did not deter the insect. Attacks were abundant every year of the study although the population tapered off after the third and fourth years. The trees were just beginning to close-in during the fourth year.

Nord et al. (1972) recorded a minimum of 5.4% infestation in one of their study areas, but reported higher infestations in hybrid aspen test plantings, along the edges of natural stands, and in small aspen clumps, all areas that are generally well lit and particularly accessible to the adults. Wong and McLeod (1965) reported that saperda preferred small trees and shrubs (of *Salix* spp.) growing in the open or along the fringe of forest stands. Our study trees were also exceptionally vulnerable to the insect because the small stand was surrounded by large saperda-infested aspens.

Nord et al. (1972) concluded that saperda injury has little or no effect on the final crop-tree production and thought that saperdas might be beneficial in dense sucker stands. Saperdas were not a seriously destructive agent in our study either, even though the populations each year were at least moderate. Mortality was only 4% after four years and the first 3% occurred during the first year as the whips were setting root. Also, with more than 60% of the whips attacked in the first year, a 3% loss could be expected in any newly established planting and should have little effect on future biomass production.

Trees began to overgrow the galls in the year following attack, and thereafter the entire gall remained intact within the stem (Fig. 2A). Each year's growth concealed more

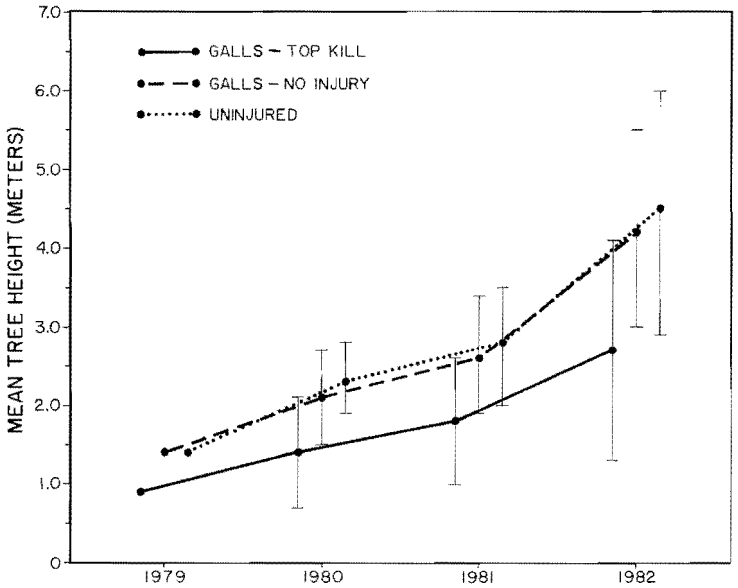

Fig. 1. Cumulative height growth for hybrid *Populus* trees attacked by *Saperda inornata* compared to uninjured trees, 1979–1982. Vertical bar bars represent ± 1 S.D.

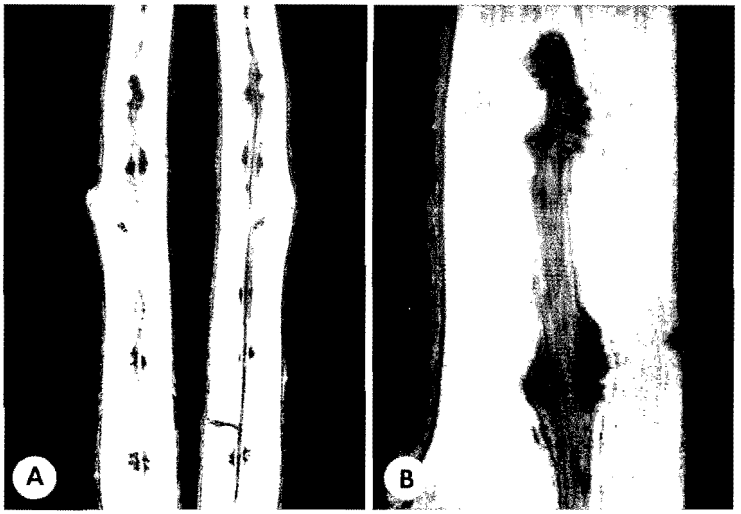

Fig. 2. Mainstem injury from *Saperda inornata* in hybrid *Populus* six years after attack (1984). Longitudinal mid-sections of (A) bole showing evidence of six saperda galls produced in 1979 (B) closeup of first three galls showing gall and callous tissue.

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evidence of the gall so that within 3–4 years most galls were undetectable externally (Fig. 2B). Perala (1984) noted that saperda injuries to aspen healed rapidly and most galls were completely hidden within a few years. Also, after the first year's overgrowth, the tissues are strengthened enough to prevent future breakage. A small amount of wood loss occurs, however, during the pulp or matchstick production process because the tissues comprising the galls are unfit for use.

The trees injured by other agents in this study attest to the vulnerability of *Populus* to other organisms and the probability of greater injury. Agents such as other insects, mice, deer, and rabbits accounted for 11% additional injury in 1979 and non-saperda injury rose to 18% by the fourth year (Table 2). The most significant injury was caused by the snowy tree cricket, *Oecanthus fultoni* Walker, which injures new shoots by oviposition. Leaders were frequently chosen for egg-laying and the longer and heavier ones often broke over. Breakage at cricket oviposition sites, however, was less serious than at saperda sites because the cricket attacked mostly the new terminal shoots and lateral shoots replaced them rapidly.

Diseases had not affected the trees by the end of the fourth year, even though Cytospora and Hypoxylon canker were abundant in the vicinity of the study plots. Saperda wounds increase the risk of infection by diseases, and several *Hypoxylon mammatum* infections have been associated with saperda egg niches (Anderson et al. 1979). Hybrid *Populus* generally is less susceptible to Hypoxylon canker than aspen, but Cytospora can be virulent on certain hybrid clones especially if under stress.

We conclude that saperda, even at relatively high population levels does not greatly affect hybrid *Populus* growth or subsequently reduce biomass.

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