United States
Department of
Agriculture

Forest Service

Research
Paper NE-483

1981

White-pine Weevil Attack

Susceptibility of Western White Pine in the Northeast

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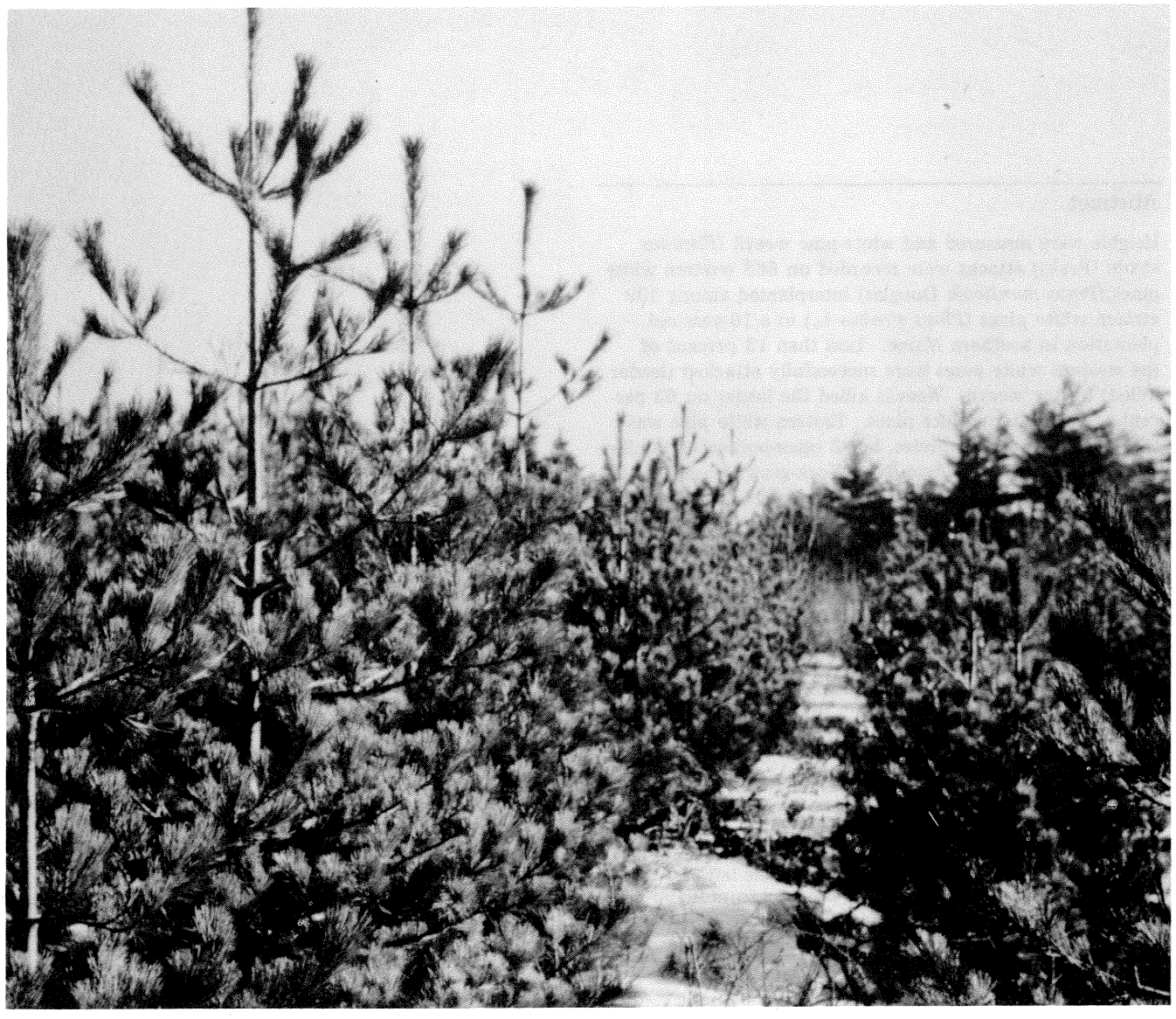

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MANUSCRIPT RECEIVED FOR PUBLICATION
14 NOVEMBER 1980

Abstract

Heights were measured and white-pine weevil *(Pissodes strobi* (Peck)) attacks were recorded on 668 western white pines *(Pinus monticola* Douglas) interplanted among 109 eastern white pines *(Pinus strobus* L.) in a 10-year-old plantation in southern Maine. Less than 13 percent of the western white pines were successfully attacked (leader killed) by the weevil. Weevils killed the leader on 63 percent of the eastern white pines. Eastern white pine was the taller of the two species, but 3 open-pollinated families of western white pine from New York-grown parents and 1 of 12 familes from Idaho-Montana parents were nearly equal to or surpassed eastern white pine in height. Selection and seed collections from the proper seed sources or parent trees of western white pine could produce trees that grow rapidly and are low or moderate in susceptibility to weevil attack. These could be planted instead of eastern white pine in areas of the Northeast with high weevil populations.

Cover Photo: Fast growing unweeviled western white pine progeny from New York State parents on the left and much slower growing western white pine progeny from Idaho-Montana parents on the right.

Eastern white pine *(Pinus strobus* L.) has lost prominence as a lumber producing species in the Northeast because of its extreme susceptibility to damage by the white-pine weevil *(Pissodes strobi* (Peck)). Attempts to locate resistant races or individuals have been unsuccessful but are continuing. For the present, the best possibility of producing a weevil-resistant white pine may be to use another species or hybrids.

Resistance to white-pine weevil attack has been reported in the closely related but geographically distant western white pine *(Pinus monticola* Douglas). This was first noted by Wright and Gabriel (1959). They examined plantations of western white pine in New York that were surrounded by heavily weeviled eastern white pines, but the western white pines were almost free of attack. Garrett (1970) and Soles and others (1970) reported examples in New England and New York where the attack rate was only 10 to 35 percent as heavy on western as it was on eastern white pine. In western North America, where the preferred hosts of *Pissodes strobi* are Engelmann spruce *(Picea engelmannii* Parry) and Sitka spruce *(Picea sitchensis* (Bong) Carr), western white pine is apparently not susceptible to attack (Vandersar 1978).

In spite of these promising reports, western white pine has not been widely tested for susceptibility to weevil attack or adaptability to growing conditions in the northeastern United States. In this study I have evaluated weevil damage and height growth rate of western and eastern white pines and possible hybrids located in a 10-year-old plantation in southern Maine. The western white pines were attacked infrequently by the weevil despite the presence of high weevil populations in the area. Also, some of the western white pine families and numerous individual trees grew as rapidly as eastern white pine.

Materials and Methods

The trees tested were: (a) 10 full-sib familes of western white pine — grown from seed supplied by Richard T. Bingham, Intermountain Forest Experiment Station, Moscow, Idaho — from matings among selections that were free of blister rust *(Cronartium ribicola* J.C. Fisch. ex Rabenh) in natural stands in Idaho and Montana, and 2 open-pollinated controls from the same area; (b) 7 open-pollinated familes from planted western white pine located near Maryland, New York, in Otsego County; some of which may contain hybrids with eastern white pines; and (c) eastern white pines of unknown origin obtained from the New Hampshire State Nursery at Boscawen.

The trees were planted as 3-0 stock on the Massabesic Experimental Forest near Alfred, Maine, in 1971. There

was no replication in the experiment. Instead, each family was planted in 1 to 3 adjacent rows in a 31-row plantation. There were 25 to 39 trees in each row. Eastern white pines were planted in every fifth row, including the first and the last. Spacing was 6 x 6 feet. Surrounding stands of eastern white pine of various ages assured that a substantial population of weevils was present at the planting site.

In 1976, and again in 1980 when the plantation was 10 years old (13 years from seed), height, survival, and incidence of weevil attack were measured. Weevil damage sustained by each species and western white pine family, as well as their growth rates, were compared to determine the potential for planting western white pine in the Northeast.

Results and Discussion

Height growth and weevil attacks on both species are summarized in Table 1. Average survival in the plantation was higher for western white pine (88 percent) than for eastern white pine (62 percent). Through the sixth year after planting, all of the western white pines were comparatively slow growing, which upholds their reputation for slow early growth in other experiments. Only 11 percent of the western white pines were as tall as the average white pine. By the 10th year, however, 1 of the 12 families grown from Idaho-Montana parents and 3 of the 7 families grown from New York parents were nearly equal to or surpassed eastern white pine in height.

The first successful weevil attack (leader death) was in 1974 on an eastern white pine. From then through the summer of 1980, there were 183 successful weevil attacks on 153 different trees in the plantation. The proportions of trees attacked were 63 percent for eastern white pine, 6 percent for Idaho-Montana western white pine, and 20 percent for the western white pines grown from New York parents. No western white pine was successfully attacked more than once. Five eastern white pines had their leaders killed in three different years, and 20 trees were successfully attacked twice. The low incidence of weevil attack on young western white pines compares favorably with the low incidence of weeviling on older trees reported by Soles and others (1970) and Wright and Gabriel (1959).

Tree height is one factor involved in the likelihood of attack on individual trees of eastern white pine. In general, taller trees with stout leaders are attacked more frequently than shorter trees of the same age. In this study, the mean height of eastern white pine was greater than that of western white pine. To determine whether stature was a major factor in the relative numbers of attacks on the two species, I made two analyses. First, the mean height of the 69 weeviled eastern white pine trees was 232 cm in 1980, and 130 of the 668 western white pine were taller than 232 cm, but only 16 (12 percent) of those tall trees were weeviled. Second, in the five western white pine families with mean heights ranging from 202 to 234 cm (versus 233 cm for eastern white pine), only 46 of 221 trees (21 percent) were weeviled. Thus, both analyses indicate that the low susceptibility of western white pine to weevil attack is due to factors other than growth rate alone.

No other basis for the disproportionate susceptibility of the two pine species to weevil attack was readily apparent. After conducting feeding-preference tests with caged weevils on eastern and western white pines, Soles and others (1970) suggested that the resistance mechanisms of western white pine, under natural conditions, must either inhibit the weevils from traveling to the trees, or induce them to leave after landing. Forced-feeding experiments by Vandersar (1978) demonstrated that western white

Table 1.—Heights of eastern and western white pines and weevil attacks in a 10-year-old plantation in southern Maine

Species	Number of trees	Height			Number of weevil attacks	Number of weeviled trees	Percent of trees weeviled
		Mean	Range	Range of family means			
		cm					
Eastern white pine	109	233	130-347	—	99	69	63
Western white pine from:							
Idaho and Montana	368	166	53-342	66-213	23	23	6
New York	300	211	55-421	126-234	61	61	20

pine is an acceptable host species for weevil feeding, but that a separate releasing stimulus for oviposition, necessary for successful attack, is absent from western white pine. My data could support the existence of each mechanism in western white pine. The ratios of total attack incidence to successful attack were 2:1 for western white pine and 1.2:1 for eastern white pine. Weevil attacks on the former species, therefore, are less likely to be successful. Since only 22 percent of western white pines were attacked while 77 percent of eastern white pines were attacked, it is clear that the latter species is also the preferred host for initial attack, whether or not that attack is successful.

Although tree height does not appear to be the principal factor in differential susceptibility to weevil attack between species, the low incidence of successful weevil attack on families of western white pine from Idaho-Montana may be due, in part, to their slow rate of growth. The much taller progeny from New York parents were attacked more than three times as often.

Families of the Otsego County western white pine may contain hybrids between eastern and western white pines. Such hybrids are easily made and the plantation of parent trees is adjacent to a plantation of eastern white pine; a potential pollen source. Hybridity may at least partially explain the more rapid early growth and greater susceptibility to weevil attack of the offspring of New York parents. However, selection of the fastest growing individuals when seed collections were made from a provenance (Kaniksu National Forest, Idaho) that is apparently well adapted to soil and climatic conditions in the northeastern United States — western white pines in the Otsego County plantation were as tall as eastern white pine in 1967 when the plantations were 30 years old — could also account for the 27 percent difference in height growth between New York and Idaho-Montana progeny.

The susceptibility of western white pine to diseases and insect pests other than the white-pine weevil in the Northeast will require further study. Western white pine within its natural range is very susceptible to white pine blister rust, but none of the trees in the 10-year-old plantation have been infected. Blister rust is currently uncommon in southern Maine, and nothing is known about how the tested trees would fare in areas where rust is prevalent. At present, necrotic lesions on branches, resembling the symptoms of infection by the ascomycetous fungi *Caliciopis* (Funk 1963), of several western white pines in the test plantation may represent a potentially more serious problem. Soles and others (1970) reported infestations of *Caliciopsis pinea* Peck on western white pine in New York state. Attempts to culture *Caliciopsis* from infected western white pines in two different years were unsuccessful; only the usually saprophytic but sometimes pathogenic fungus *Pullularia pullulans* was isolated and identified. *Pullularia* may be the cause of the branch damage, but *Caliciopsis* cannot be ruled out.

On the basis of the data presented here and in earlier reports, it is evident that western white pine or hybrids with eastern white pine would be a worthwhile alternative species to eastern white pine if planted in areas of the Northeast with a history of producing low quality eastern white pine due to heavy weevil attack. Less severe weeviling than would normally occur on eastern white pine is almost guaranteed, and depending upon the source of seed, growth rates also look promising.

Planting of western white pine provenance tests on various sites in the Northeast to increase our knowledge of the geographic ecotypes and soil adaptability of this species before it is more widely introduced has long been recommended. Steps have been taken recently to establish at least one such test with replicates in Vermont and New Hampshire. The results from provenance tests, however, require considerable time to become useful. In the meantime, the Ostego County, New York, plantation, which furnished part of the seed for this experiment, and several other existing northeastern plantations of western white pine could be considered the nuclei of a series of seed orchards or seed production areas that could produce trees almost as fast-growing as eastern white pine and a great deal less susceptible to white-pine weevil attack.

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White-pine weevils killed the leaders of western white pines only 13 percent as frequently as they killed the leaders of eastern white pine in the same 10-year-old test plantation. Eastern white pine was the taller of the two species, but four families of western white pine of low to moderate susceptibility to weevil attack were almost as tall or taller than eastern white pine.

232.1:174.7 *Pinus monticola* Douglas: 453—145.719 *Pissodes strobi* Peck

Keywords: Height growth.

☆U.S. GOVERNMENT PRINTING OFFICE: 1981-703-011/15