DECAY RESISTANCE VARIATIONS WITHIN NORTHEASTERN FOREST TREE SPECIES

Robert A. Zabel

State University of New York College of Forestry

Users of wood have long been aware of major differences in the durability or decay resistance of trees of different species. Durable woods are generally well-known within local regions and are used where decay hazards are high. Particularly durable woods in the Northeast are black locust, catalpa, northern white-cedar, eastern red cedar, and white oak. Important durability differences also occur in trees within a species and, in some species, within the bole of the individual tree.

In the search for superior trees for the future, in addition to growth rate, tree form, wood quality, resistance to disease and insect attack, and other important traits, durability should be considered.

The purpose of this paper is to indicate the substantial durability differences occurring within several of our northeastern species, to emphasize the potential importance of wood durability in tree improvement programs, and to suggest related areas needing research.

Durability and Its Variations

Decay resistance or durability, considered as synonyms in this discussion, may be defined as the natural resistance of a wood to the decay activities of wood-destroying fungi. The term "durability" is primarily used for resistance of wood in the log, bolt, or product form to decay but also includes the resistance of living trees to heartrot.

It this point I would like to emphasize the distinction between resistance to heartrot in a living tree and durability in a wood product. They are not the same necessarily and are commonly confused. Highly durable woods in products form are rot necessarily equally resistant to heartrot in the living tree. Highly durable woods such as baldcypress, redwood, black locust, and northern white-cedar are frequently subject to severe heartrot in the living tree. In developing objectives for tree improvement programs, we should recognize durability in the living tree and decay resistance in the wood product as distinct characteristics not necessarily closely related.

The heartwood of different species varies greatly in durability whereas the sapwood. of most species is uniformly susceptible to decay. The work of Hawley, Fleck, and Richards (2) established that the toxic hot-water extractives are responsible for wood durability. In many woods, such as redwood, oaks, and the cedars, the specific toxic chemicals in the hot-water extractives have been identified (7).

Wide variations have been observed in durability in trees within a species (4,5,6,8). These durability differences in most cases have not been considered from genetical viewpoints, and it is not known whether these differences are reflections Primarily of genetical variations or of environmental effects.

In northeastern species, studies of durability in white oak demonstrated that more decay developed in test blocks from decay-susceptible trees than from a resistant tree (8).

In a durability study of strains of black locust, Scheffer et al., have demonstrated appreciable durability differences in the strains (4). They have suggested durability to be a "rigidly controlled" wood characteristic in trees of clonal origin regardless of site variations. This is important work and offers one of the first insights into the relative role of genetical and site differences in durability variations. Scheffer et al., working with oak and locust, have suggested that the range of durability differences in these woods may make possible oak or black locust of greatly improved decay resistance by propagating superior strains (4,5).

Durability varies in many species with vertical and horizontal position in the stem. In woods such as black locust, white oaks, western redcedar, Douglas-fir, European larch, and ponderosa pine the outermost portions of heartwood have proven to be most durable. Knowledge of durability variations within trees according to wood position are useful for wise utilization practices and necessary in a search for durable strains within a species.

The methods of durability measurement are similar to methods used in evaluation or comparison of wood preservatives, and include soil-block decay tests, exposure of test stakes in soil, and toxicity measurements on the hot-water extractives (4,6,8).

Importance of Durability in Tree Improvement Programs

Consideration of the durability characteristics of forest trees in tree improvement programs may lead to significant improvement in wood characteristics and a decrease in heartrot losses.

Heartrot losses. Heartrot is well recognized as a major forest tree disease problem. We are aware that cull figures of 30 percent or over are not unusual for large timbered areas. Aged, sound trees have been observed occasionally in most timber types. These aged, sound trees suggest more than escape from infection, or the reflection of unusual specific environments. It may be that our forests contain certain trees with unusual resistance to heartrot. Hansbrough (1) suggests the probability that in all our timber trees there is a genetic variation in susceptibility to decay. The mass selection of such trees by careful thinning and cutting practice, or selection and propagation, may be a future way of minimizing major heartrot problems in some species.

Decay of wood in service. The annual loss resulting from wood decaying in service is estimated at approximately 10 percent of the annual cut. Steps which would gradually increase the decay resistance of wood in service and decrease this drain are important.

From a negative viewpoint, overlooking durability in the selection of trees for superior traits may result in selection by chance of particularly decay-susceptible strains for intensive propagation.

Research Problems in Durability Improvement Programs

Some areas needing research in the field of wood durability in relation to tree improvement are as follows:

1. Studies of major tree species to determine if there are field tree characteristics indicating unusual resistance to heartrot. Such criteria would be useful in the selection of heartrot-resistant trees in thinning and other selective cuttings.

2. Determination for major timber species of the relative role of genetical and environmental differences in the durability variations within a species.

3. Determination of relationships between resistance to decay in the living tree and in the wood Product.

A major problem in such studies is the time period needed to grow trees with heartwood.

The variability of fungi presents a potential threat to tree improvement programs and should be mentioned. Experience with chemical controls for fungi bacteria, and other related microorganisms important in disease and deterioration, suggests the possibility that as we improve the decay resistance in trees over periods of time, the fungi may also change and be able to attack the improved trees.

Work in Progress

At the suggestion of Dr. J. R. Hansbrough, Chairman of the Northeastern Tree Improvement Conference Commitee on Inheritance of Resistence to Disease, research has been started on durability variations in eastern white pine. This work, in cooperation with the Northeastern Forest Experiment Station, is being conducted at the State University of New York College of Forestry by Dr. S. B. Silverborg and myself.

Objectives. The objectives of the study are as follows:

1. To study variations in durability of eastern white pine trees from the Pack Demonstration Forest, Warrensburg, N. Y.

2. To search relationships between resistance to heartrot end tree characteristics, and to determine the effects of factors such as age, growth rate, form, site, and position of wood in the stem on wood durability.

3. To determine the relationships between the natural incidence of red rot in eastern white pine and heartwood. durability.

4. To determine the identity of fungi associated with common heartrots in eastern white pine.

Methods. A cooperative study involving the State University College of Forestry, the Northeastern Forest Experiment Station, and the Northeastern Lumbermen's Association, on relationships between tree, log, and mill grades presented an excellent opportunity for obtaining samples. Detailed information was taken by these groups on trees, logs, end rough and surfaced lumber for approximately 100 trees of eastern white pine. Cross sections were removed from the top and bottom of logs selected for the durability studies. Test blocks were sawed from three radial positions (outer, middle, inner) for each cross section. The test blocks are being exposed to the decaying action of Fomes pini and Lenzites trabea. Preliminary tests are in proces and differences in durability within trees and between trees in blocks exposed to L. trabea are apparent. The significance of these differences is not known. In summary, several of the northeastern species vary considerably in durability. The durability properties of these woods may be of considerable potential importance and should be considered in conjunction with other characteristics in long-range tree improvement programs.

Literature Cited

1. Hansbrough, J. R. 1953. Genetic variation in disease resistance of native forest tre species. Proceedings Northeastern Tree Improvement Conference. Northeastern For. Res. Advisory Council.

2. Hawley, L. F., L, C. Fleck, and C. A. Richards. 1924. The relation between durability and chemical composition in wood. Indus. and Engin. Chem. 16: 669-670.

3. Hopp, Henry. 1941. Growth-form variation in black locust and its importance in farm planting. Jour. Forestry 39: 40-46.

4. Scheffer, T. C., and Henry Hopp. 1949. Decay resistance of black locust heartwood. U. S. Dept. Agric. Tech. Bull. 948.

5. Scheffer, T. C., G. H. Englerth, and Catherine G. Duncan. 1949. Decay resistance of seven native oaks. Jour.Agric. Res. 78: 129-152.

6. Scheffer, T. C., and G. H. Englerth. 1952. Decay resistance in second-growth Douglas fir. Jour. Forestry 60: 439-442.

7. Wise, L. E., and E. C. Jahn.192.   Wood chemistry. Reinhold Pub. Corp. 2nd Edition. Chapt. 15 and 27.

8. Zabel, Robert A. 1948. Variations in the decay resistance of white oak. New York State College of Forestry Tech. Bull. No. 68.

DISCUSSION

Ehrhart Is there any difference in durability of "red" and "white" beech timber?

Zabel "Redheart" beech is reported to be very difficult to treat when compared with normal or so-called white beech. I do not know of any published work establishing significant durability differences between the so-called red and white beech. It has been theorized that the red-heart beech may result from wet wood or bacterial infections in living trees.