NOTES ON RELEASE OF WHITE PINE IN HARVARD FOREST, PETERSHAM, MASSACHUSETTS

By J. Nelson Spaeth [1]

Assistant to the Director

There are extensive areas of abandoned agricultural and pasture land in central New England on which inferior hardwoods such as grey birch, aspen, and red maple start simultaneously with white pine. Although there are generally at the start more than sufficient pines per acre to make a fully-stocked stand at maturity, on the majority of sites these are eliminated, almost completely, by the hardwood during the first 30 years in the life of the stand.

On the Harvard Forest disengagement cuttings which remove the hardwood, thus freeing the pine, have been carried out for 12 years. The results show that the operation is decidedly worth while from a financial standpoint. In order that some concrete facts might be presented to substantiate this statement a permanent sample plot was established in the spring of 1915. Two contiguous quarter-acre plots were staked out in a representative stand of young pine and inferior hardwood (mostly grey birch and red maple). This stand was on an average site—a fairly high Quality II for both pine and hardwood. Each tree was numbered with white paint and a brief description written from a careful study of the individual. The total height, average breast-high diameter, health and crown classes were recorded together with remarks as to the growing space, injury by whipping, etc. Under health class the following sub-divisions were recognized and are designated in the tables, by the accompanying symbols. N = normal, healthy or thrifty crown now making good growth, needles long and of blue-green color; N− = sub-normal, only slightly less thrifty than N; W− = slightly weak, needles somewhat shorter than in above and tending to be yellowish-green; W = weak, slow growth, short needles; W+ = very weak, little better than stunted or much suppressed; St = stunted or much suppressed, little growth, probably not able to recover if released.

[1] The author is indebted to Professor Richard T. Fisher for advice and suggestions.

The total number of living pines on one plot was found to be 97 and on the other 107, while the percentages of normally healthy, that is, N and N–, trees were 51 per cent and 39 per cent respectively. The plot of which the percentage of healthy trees was lower was selected for release, that on which the trees were in the best condition being left undisturbed as a control. All of the hardwood in the release plot was cut, due care being exercised not to injure the pines. The product of the cutting, 2¼ cords of wood on the plot or at the rate of 9 cords per acre, was worked up into cordwood and sold for fuel. Subsequent to this cutting nothing had been done either on the release plot or on the control. After five growing seasons, that is, in January, 1921, an examination in which each individual tree was studied and data noted as in the original record, showed the following significant result:

Changes in Percentages of Trees in the Various Health Classes During the Period from 1915 to 1921.

Health class	Release plot		Control plot	
	1915	1921	1915	1921
	Per cent	*Per cent*	*Per cent*	*Per cent*
N	24	29	34	11
N—	15	16	17	11
W—	14	8	10	4
W	27	12	24	8
W+	6	6	4	0
ST	19	22	11	35
Dead	0	3	0	29
Missing	1	4	1	2
Total	100	100	100	100

It will be noted that on the release plot the percentages of trees in the classes N, N–, and W– shows but slight increase in 1921 as against 1915. This is to be expected since if the stand had been free to begin with there would have been a considerable decrease in number. The number left in these classes is sufficient to make a well-stocked stand at the end of 60 years, which is the accepted rotation for white pine on the Harvard Forest. On the control plot, however, the number of trees in these classes shows a considerable decrease and the present number is far too few ever to make a stand of normal density even though all the pines on the area could be released and recover. The critical point in the history of the stand when disengagement cuttings are effective has passed.

A summary of changes in health condition of the trees on the release plot is shown in the following table:

Health Conditions in 1921 as Compared with 1915.[a]

	State of health		
	Improved	Same	Lower
	Per cent	*Per cent*	*Per cent*
Release plot	28	44	28
Control plot	3	14	83

[a] *Example*—If a tree were classed as W in 1915 and in 1921 the same individual were classed as N— it would fall in the category of "state of health improved." If in both inspections it should appear as W it would be classed as "state of health the same." Whether the change be from one class to the one immediately above or below or whether it be through several health classs was not taken into account.

The injury inflicted on pine by grey birch, and to some extent by other hardwoods, is largely one of arrested growth due to whipping off of the terminal and lateral buds, thus limiting or wholly checking the development of the crown, rather than suppression by the cutting off of insolation. The greater injury occurs in winter when the hardwoods are devoid of foliage, often coated with ice, and weave too and fro in the wind. In the case of aspen, due to the more rigid character of the bole which tends to lessen the whipping action, and especially in dense growth of root suckers, the injury is much less by whipping in winter and largely one of supression when in foliage. The injury which occurs when red maple is the principal hardwood is one of whipping in winter and shading in summer, both rather severe.

The biologically most favorable age or height for freeing pine is determined by the intensity of the struggle between the two elements in the stand, which in turn is greatly influenced by edaphic factors of site. On rich, loamy soils which are of high quality for the growth of hardwoods, the pine, though numerically superior in early life and very thrifty will, if no cutting is made, be eliminated almost completely by the hardwood. On sandy sites unfavorable to hardwood and suitable for pine the latter may persist until the maturity of grey birch subsequently forming a pure stand.

On an average site on which this mixed type exists in Central New England, one disengagement cutting made at the "critical age," that is, the age at which the pine is able still to recover and permanently keep ahead of the birch, will make certain a yield of at least 30,000 board feet of pine per acre at the end of a rotation of 60 years, and possibly 10 cords of wood in the disengagement cutting. If no such cutting is made an acre will have produced, at the end of 60 years, three crops of inferior cordwood on a 20-year rotation with a yield of 18 cords in each crop or total 54 cords of wood.

A study by Minuse [2] in 1914 was made with the purpose of determining the minimum age at which a single cutting would permanently free the pine. The method used was to inspect areas on which disengagement cuttings had been made in past years and from these to construct curves showing the growth of hardwood sprouts (height on age) and other curves showing the growth of released pine. Then by trial and error plotting of both curves on the same ordinate and abcissa an original height for pine was found at which if the hardwood were cut the pine would be permanently freed, the height growth of the resulting sprouts being insufficient for them to again reach the dominant crown class. The conclusions drawn from the study were that "there is a practical height for the white pine at which, if the hardwoods are removed, the released pine will not need further attention. If the overstory of hardwood is removed before the pine has attained this height a second removal cutting is necessary. The practical height for upland pasture pine, Quality II site, is when the pines average 15 feet if grey birch is the principal species in mixture, or when they are 12 feet high if red maple predominates." Grey birch sprouts show more rapid height growth than red maple. The heights for pine as determined by Minuse apply only to the quality of site for which the study was made. However, the majority of the mixed stands in the region are of this quality. An inspection in 1921 of a sample plot established by Minuse in 1914 showed his predictions of the growth of hardwood sprouts and of released pine on the area to be correct.

The most favorable age biologically may come before the pine has attained sufficient height to insure a permanent dominance over the hardwood element after the cutting, or before the hardwood is of sufficient size to be merchantable. If made at such a time the cost of

[2] A Study of the Effect on White Pine of Removing the Inferior Hardwood Overstory. Minuse, Harvard Forest, Petersham, Mass. (Unpublished.)

the disengagement cutting would have to be carried as an investment at compound interest until the time of maturity of the stand. If, however, the cutting be delayed until the product is merchantable for fuel wood, it can often be disposed of at a price which will cover the cost of the operation, thus obviating the necessity of carrying an investment charge. Not infrequently there may be a nominal profit in the sale of the hardwood. It is evident that there is a definite period of years in which, and in which alone, a benefit to the stand will result from such a cutting and in practice the one most favorable age will, in most instances, be determined by the financial return. For average conditions in central New England the period during which disengagement cuttings are possible is roughly from the tenth to the twenty-fifth year in the life of the stand and the most profitable age is the lowest age at which the hardwood product is merchantable, between the eighteenth and twentieth years on average sites.