The Dial Gauge Dendrometer as a Tool in Silvicultural Research

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The use of the dial gauge dendrometer in silvicultural research permits the investigator to assess growth trends following a cutting operation with unusual accuracy and in a short period of time; thus speeding up markedly the progress of the research program.

THE dial gauge dendrometer, developed by Reineke[2] and improved by Daubenmire,[3] has been in use for the past two years in the Harvard Forest as a tool for measuring the effect of silvicultural treatments on the growth of the residual stand. Its use gives promise of greatly speeding up silvicultural research by permitting the observer to evaluate the growth produced by treatment years before it would be possible to do so by conventional diameter breast high measurements.

The dendrometer consists of a standard dial micrometer gauge, such as is manufactured by L. S. Starrett Company of Athol, Massachusetts (No. 655-FI″), and the B. C. Ames Company of Waltham, Massachusetts (No. 382), mounted in a small frame so that the body of the instrument can be laid against three brass screws set into a tree being measured, while the spindle records the distance from the plane established by the heads of the three screws to a point on the bark directly beneath. The screws are set deeply into the wood so that they are not affected by current growth. The instrument is accurate to 0.001 inch, which is sufficient to measure daily growth during the height of the growing season. Only one dial gauge is needed to measure an unlimited number of trees. Each tree being studied need only be provided with a permanent set of three screws and a small metal plate glued to the bark to prevent wear from the contact of the spindle. An extensive experiment may be set up, therefore, for a cost of about $25 in materials.

The value of the device lies not only in its inexpensiveness and accuracy, but also in the fact that the same point of the tree is measured at each inspection, and that the measurements may be made with extreme rapidity. From experience at the Harvard Forest, it is estimated that from 50 to 100 readings may be made per hour to an accuracy of one-thousandth of an inch.

In the conventional study of silvicultural operations by periodic remeasurement of sample plots, ten to twenty years must frequently elapse before the treatment can be accurately evaluated. This is chiefly due to the infrequent plot remeasurement, and to the low accuracy of even careful diameter measurements. The use of the dial gauge dendrometer, however, permits the accumulation of a large number of closely correlated and controlled accurate measurements within a relatively few years which permit the observer to determine growth trends at the earliest possible date, and change his silvicultural practices accordingly. Furthermore, the dendrometer approach supplies data on problems which are passed over in normal sample plot research such as the measurement of the immediate physiological impact of a thinning upon residual trees.

The dial gauge dendrometer studies under way at the Harvard Forest are indicative of the value of this instrument in speeding up silvicultural research. They may be divided into three experiments: A. A study of release from thinning in mixed pine and spruce plantations; B. a study of thinning impact in a red pine plantation; and C. a study of the effect of pruning live branches on the growth of red pine. Only the first of these has been carried to a point where the effect of treatment on growth has been measured, but the others are also discussed briefly because of the methods of study involved.

Release of White Spruce by Thinning

For the first trial of the dial gauge dendrometer, three mixed pine and white spruce plantations growing in the same area were chosen. All three had been planted in the same year, 1924, with stock from the school nursery, and all had received the first thinning in 1943 or 1944.

Plantation 24-A is an alternate row plantation

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[2]Reineke, L. H. A precision dendrometer. Jour. Forestry 30:692-97. 1932.

[3]Daubenmire, R. F. An improved precision dendrometer. Ecology 26:97-98. 1945.

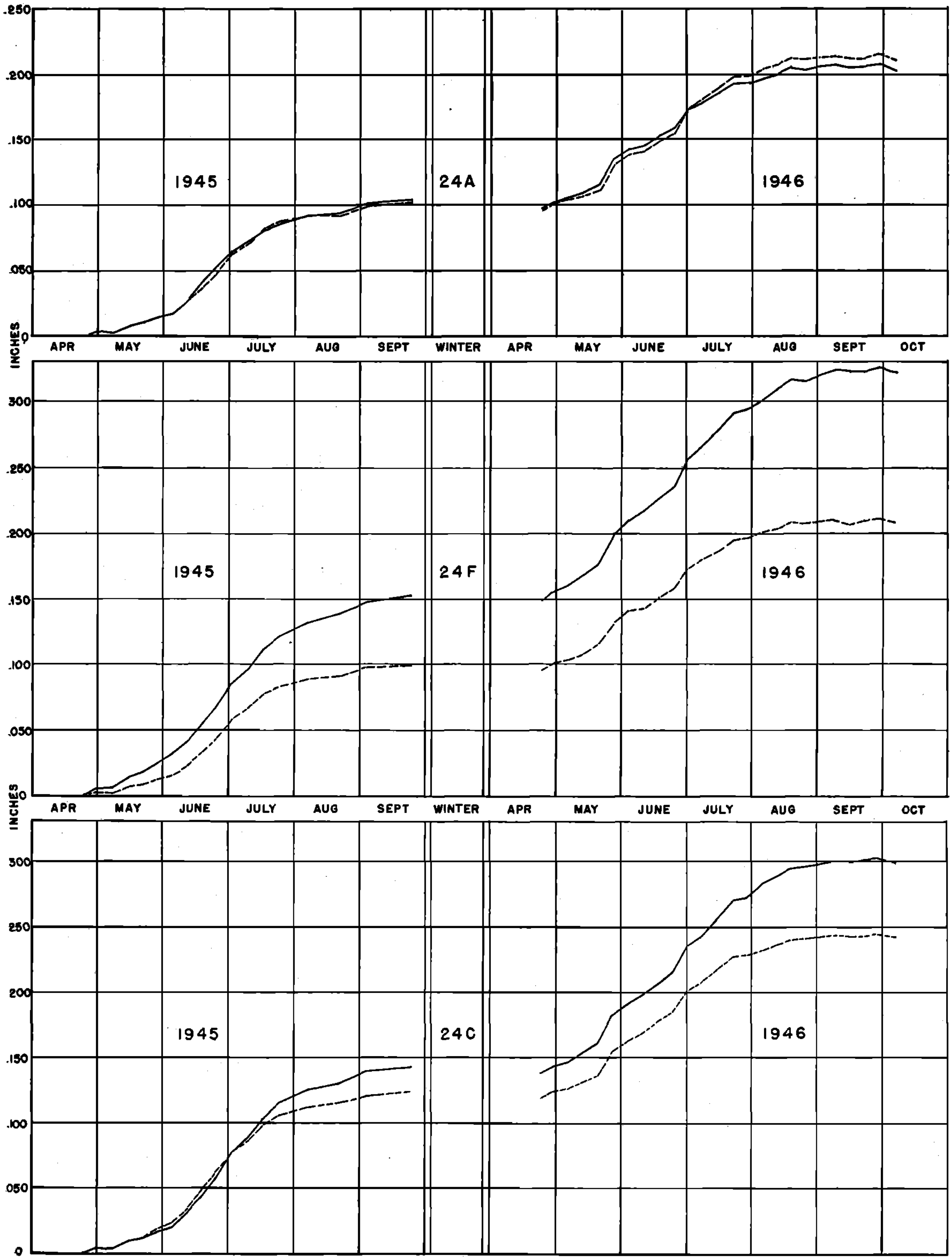

Fig. 1.—Cumulative average radial growth per tree in three experimental plantations. Thinned plot indicated by solid line; control plot by dashed line.

of two rows of white spruce between single rows of white pine. The pine was severely weeviled, and averaged five feet lower than the spruce at the time of thinning, the spruce having a mean height of 26 feet. A control plot was left. In the remainder of the stand, the thinning was of the row type, all the pine being cut and all the spruce being left.

Plantation 24-C is a checkerboard planting of white pine and white spruce, each species being planted in blocks of 16 trees. In the selective crown thinning, the better formed pine and the larger spruce were freed by removal of 44 percent of the badly weeviled and scrubby pine, and 21 percent of the spruce. The average height of the spruce was 26 feet and the pine 24 feet.

Plantation 24-F is an alternate row plantation of three rows of white spruce to one row of Scotch pine. The 22 feet high Scotch pine were of very poor quality and were removed by a row thinning. The spruce had a mean height of 22 feet.

In all three plantations, dendrometer screws were set in April, 1945, in ten dominant and codominant spruces in the thinned area and ten similar trees in the unthinned area. Trees were chosen at random. Dendrometer measurements have been taken at weekly intervals throughout two growing seasons.

The results of the first two years of measurement have demonstrated clearly the diverse effects of the various thinnings (Fig. 1). In plantation 24-A, the removal of the bushy but shorter white pine has not resulted in an increase of diameter growth in the spruce. In plantation 24-C, the heavy selective thinning has resulted in substantial growth increases; yet the growth of the released trees did not surpass that of the controls until July 2 of the 1945 growing season. In plantation 24-F, the removal of the dominant Scotch pine has resulted in a pronounced growth increase. Here, the trees in the thinned plot have grown 54 percent more than those in the unthinned plot over the two-year period.

Other generalizations may already be made. For instance, the 1946 growing period in all plantations was longer than that in 1945. In the earlier year, rapid growth was confined to about a two-month period, but in the later year, it continued for approximately three months. Also, the growth stimulation from thinning was apparently greatest in the latter part of the growing season in all three stands. This is shown in Figure 1.

This experiment must be continued for several more years before final conclusions may be reached. Nevertheless, the constancy and the uniformity of the trends demonstrated over the first two years are such as to permit adequate evaluation of the treatments. Two of the treatments have produced marked growth stimulation: one was completely unsuccessful in accomplishing this. After a period of only two years, it is possible to modify thinning techniques in similar stands on the basis of accurate statistical data.

Thinning Impact in Red Pine

This experiment, begun in 1946, differs from the first in that the dendrometer stations were established throughout the plantation and measurements taken for a full year before the thinning is carried out. Next year, in the middle of the growng season, half the stand will be thinned and the other half left as a control. This will permit us to compare the growth following thinning with the growth of the same trees prior to thinning, and also to study the physiological impact of the thinning operation as measured by the daily variation in radial growth immediately after the cutting.

Effect of Pruning Live Branches

This third trial of the dendrometer indicates still another aspect of silvicultural study. In another red pine plantation, thirty dendrometer stations have been established on dominant and codominant trees and measurements taken throughout the first growing season. In the middle of the next growing season, one live whorl of branches will be removed in pruning ten of these trees, two live whorls will be removed on another ten, while the third ten will be kept as controls. As in the experiment above, this procedure will permit the growth of the trees following treatment to be compared with the growth of the same trees before treatment; and it will permit a detailed study of the growth response to the treatment.