INFLUENCE OF ASPEN DEFOILIATION BY THE FOREST TENT CATERPILLAR IN MINNESOTA OF THE RADIAL GROWTH OF ASSOCIATED BALSAM FIR (1)

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A preliminary study (3) of the reduction in aspen (Populus tremuloides) growth following defoliation by the forest tent caterpillar (Malacosoma disstria) showed potential losses in fully-stocked stands of from two to six cords per acre over a four year period. Further investigation during 1954, indicates that basal area growth was reduced about 16 per cent by light defoliation, about 72 per cent by one year of heavy defoliation and about 87 per cent in the second of two successive years of heavy defoliation. The suggestion has been made, however, that such losses might be offset in considerable degree by increased growth and seedling establishment or survival among understory conifers.

To determine the effect of overstory defoliation on understory conifer growth, the 1954 study in defoliated aspen stands was directed in part toward ascertaining radial growth responses of associated pole-sized balsam fir (Abies balsamea). Thirty-seven stands of suitable composition were located, in each of which increment cores were extracted from five dominant aspens and five associated balsam firs. Annual radial growth during the period 1947-1954 was measured for each tree to the nearest ten thousandth of an inch using a binocular microscope containing an eyepiece micrometer. Averages were computed on each plot based on five trees for each of the two species except where decay or wetwood prevented accurate measurement. No average was based on less than three cores.

<table>
<thead>
<tr>
<th>Species</th>
<th>Av. radial growth before defoliation</th>
<th>Av. radial growth during defoliation</th>
<th>Per cent change in rate increase/decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>6.1</td>
<td>2.0</td>
<td>67**</td>
</tr>
<tr>
<td>Balsam Fir</td>
<td>5.9</td>
<td>7.1</td>
<td>20**</td>
</tr>
</tbody>
</table>

1/ In thousandths of inches. **Significant at the .01 probability level.

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Under the conditions of the study, average radial growth of aspen during the years of heavy defoliation was reduced nearly 70 per cent from what it was the year prior to defoliation whereas balsam fir radial growth at the same time was increased 20 per cent as shown in the table.

Correlation analysis between the growth of fir and aspen for the 1945-1949 period prior to defoliation showed no significance at the .05 level. A significant negative correlation at the .01 level, however, was found between the growth of aspen and that of fir during the defoliation period, 1950-1954. In other words, as the rate of aspen growth decreases because of defoliation the rate of growth for balsam fir increases.

Further substantiation was provided by classifying the stands according to their probable defoliation histories, arrived at on the basis of nearby known stand histories supported by a study of aspen annual ring width. Fifteen stands were found to have been heavily defoliated in 1952, seven in 1953 and six in both 1952 and 1953. The figure shows that balsam fir increased in growth the same year that aspen was heavily defoliated. Since increased growth occurs in different years, it does not appear to be the result of climatic conditions.

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**YEARS**

Relation between balsam fir and aspen radial growth during three different defoliation histories.

Of the approximately six million acres of aspen in Minnesota, about 12 percent carry enough conifers in the understory to be completely converted to a coniferous (10 percent) or coniferous-hardwood (two percent) type by the end of the present rotation. Of the coniferous understory, over 85 percent is spruce-fir type, largely balsam fir. About seven percent carry lesser but important amounts of coniferous understory (4). It is apparent that aspen volume losses following defoliation far exceeds possible coniferous gains since only 19 per cent of the total aspen area contains an understory of conifers and the volume and growth rate of this understory is far below that of the associated aspen. Further, the increased radial growth in the predominant understory species is less than one-third of the decrease in aspen growth.

(4) Heinselman, Miron L. 1951. The extent of natural conversion to other species in the Lake States aspen-birch type. Major report, School of Forestry, University of Minnesota.