# STATION BULLETIN 501. CULTURAL PRACTICES, FERTILIZING AND FOLIAR ANALYSIS OF BALSAM FIR CHRISTMAS TREES

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Trieste

*COVER PHOTOGRAPH:* *Balsam fir fertilized with low level ammonium nitrate in the spring of 1966. Note response in 1967 leader growth and development of internodal branches. Near Joe's Pond, Vermont, on Growers' Plots. Photo taken June 3, 1968.*

## SUMMARY:

An initial shearing in the spring to shape a heretofore uncultured balsam fir Christmas tree followed by spring clipping in subsequent years (to develop greater numbers of lateral tips) was the cultural sequence that made for best improvement in overall grade. Leader control if needed is best accomplished with spring tip pruning with a 90° cut favored. Trees were 4 to 5 feet in height at the beginning of the three year experiment.

Spring applications of a complete (N-P-K) fertilizer in ratio .23-.27-.26 lbs. elemental nutrient applied per tree, or a nitrogen fertilizer contributing .23 lbs elemental nitrogen per tree, result in marked color improvement that maintains itself over a two year period. Growth improvement also follows, with evidence that rapid leader growth is compensated for by more vigorous internodal bud and branch development. The number of internodal buds per inch of leader growth was maintained with increased leader growth. Fertilizing is therefore a method of reducing the rotation period as well as improving the color characteristics of balsam fir.

Efforts to correlate foliar chemical analyses with soil analyses for a variety of nutrients were unsuccessful. However, foliar analysis results are presented in tables indicating the variation encountered for typical healthly young balsam fir trees when samples were collected in the fall. The season of sampling, age of needles, and vertical location of samples on a tree are important variables affecting the results of chemical analyses.

## INTRODUCTION:

The following work describes the results of a study of balsam fir Christmas tree culture developed in 1963 with initial field work undertaken in 1964, and continued through 1966.

The purpose initially was to test some alternatives that would improve tree form, color, and ultimately the grade of both wild and plantation grown trees of this species in northern New England.

The experiment, entitled "A Study of Cultural Practices for Balsam Fir Christmas Tree Production" was financed through McIntire-Stennis funds and the New Hampshire Agricultural Experiment Station and designated as Project MS-1 of the Station.

The author, who was project leader, acknowledges the work of David R. Noyes, Forester, who was associated with the earlier stages of the project, and the field and office assistance of Harry Berquist and of numerous former students, in particular John B. Cote and Donald A. Wilson. The cooperation, understanding and patience of the members of the New Hampshire-Vermont Christmas Tree Growers Association is appreciated. Gratitude is expressed to Willard E. Urban, Jr., Station Statistician, for his part in setting up the statistical design and in following through on most of the statistical analysis. Dorothy Josselyn and Henry A. Davis of the Analytical Services Laboratory, and Clarence L. Grant of the Center for Industrial and Institutional Development accomplished the soil and foliar analyses.

This manuscript is in three parts. Part I deals with the "Main Plots", a study of cultural practices primarily at three northern New Hampshire locations on lands of commercial Christmas tree growers. Part II is called the "Growers' Plots", and analyses the findings after application of a variety of fertilizers at ten locations in New Hampshire and Vermont. Part III presents results of foliar analyses of balsam fir Christmas trees.

## Part I. MAIN PLOTS

This section reports on applications of various combinations of cultural practices known to govern the form of young balsam fir to be marketed as Christmas trees. The primary objective of treatment was to test alternatives in both leader and lateral branch growth control, in attempts to produce a more saleable tree. The trees used in the study were native balsam fir, initially averaging four feet in height, in both natural (volunteer) and planted stands at three locations in New Hampshire (Coos, Grafton and Merrimack counties). At each location 225 trees were treated employing a factorial arrangement of 9 leader treatments x 5 lateral treatments, followed in 1966 with 5 fertilizer treatments. The work was initiated in the spring of 1964 with annual measurements terminated in the fall of 1966. Both lateral and terminal treatments were imposed in the spring and the fall. Thus there was a complex interaction of three general categories of treatments (leader treatment; lateral treatment; and fertilizer), replicated at the three locations in a randomized block design.

### A. Explanation of Treatments

The treatments applied included most that appeared promising from informal field experimentation and local practice such as tip pruning to control terminal length to forestall "spindly" tree appearance. This experiment did not, however, test basal pruning to slow terminal growth because of the small size of the trees. Spring treatments were applied in late June or early July (during succulent growth) while fall treatments were applied in September or October after growth had "hardened off". Treatments are summarized as follows:

Terminal treatments
- Tip prune, both at 45° and at 90°, either in the spring or fall.
- Maleic hydrazide (a growth inhibitor), either spring or fall.
- Root prune, either spring or fall.
- Control (no treatment).

Lateral treatments
- Clip, either spring or fall.
- Shear, either spring or fall.
- Control.

Fertilizer application (delayed until the spring of the third year)
- Nitrogen = N
- Phosphorus = P
- Potassium = K
- Complete = NPK
- Control.

In order to interpret and apply results, a few definitions of terms and explanation of treatment techniques are needed. Figure 1, a schematic diagram for denoting annual growth of a balsam fir tree should assist in this explanation.

Terminal treatment of which tip pruning was one treatment, consisted of shortening the current leader growth by cutting it back to near the point where lateral branches (the topmost whorl of branches) meet the leader when these laterals are bent up to meet the leader. The leader was cut off about ¼ inch above an internodal bud at or near this point. The 90° cut was made perpendicular to the stem axis, and the 45° cut at that angle to the axis. Such terminal treatment is based on the premise that reduced internodal length would result in an increased tree density, as the lateral whorls would then be less widely spaced. Cutting angles and season of application were expected to have an effect on subsequent terminal bud development. Since random selection of trees was the rule, a few trees having short terminals did not require and therefore did not receive a tip pruning.

Maleic hydrazide is a chemical that was applied to a terminal bud either in the spring or the fall, in a 0.1 percent water solution. It was hoped that maleic hydrazide would inhibit leader growth by altering hormone balance without adversely affecting tree form.

Another terminal treatment, root pruning, was done through four cuts into the soil outward from the tree stem, two thirds of the distance to the crown drip line. Each cut was made straight into the ground to the full depth (12 inches) of a No. 2 round pointed shovel blade. The intent is to reduce terminal growth by reducing the root area of a tree.

Lateral treatments consisted of clipping and shearing lateral branches and were intended (as were terminal treatments) to be applied annually either in spring or fall. Clipping was originally interpreted to be removal of the primary lateral-terminal growth that had been added to the tree branches during the previous year (see Figure 1). Clipping was confined to one year old wood in the 1964 first annual treatment and performed on the entire tree except for the top or current year's whorl. The practice was intended to produce a fuller tree by having the lateral-lateral growth contribute more "tips" to the periphery of the tree (refer to Figure 1). In theory, for every "lateral tip" which is cut off (clipped) there should be two lateral-laterals producing tips the following growing season. (Results indicate that this happened to a large degree). In applying the treatments, whenever secondary lateral-terminal growth contributed to filling in the outer surface of the crown, it was also removed.

In practice, clippings subsequent to the initial 1964 treatment were changed in that only bud clusters on primary lateral terminals were removed and wood was left intact. This variation for 1965 and 1966 resulted in trees of fuller appearance and accomplished the purpose in clipping.

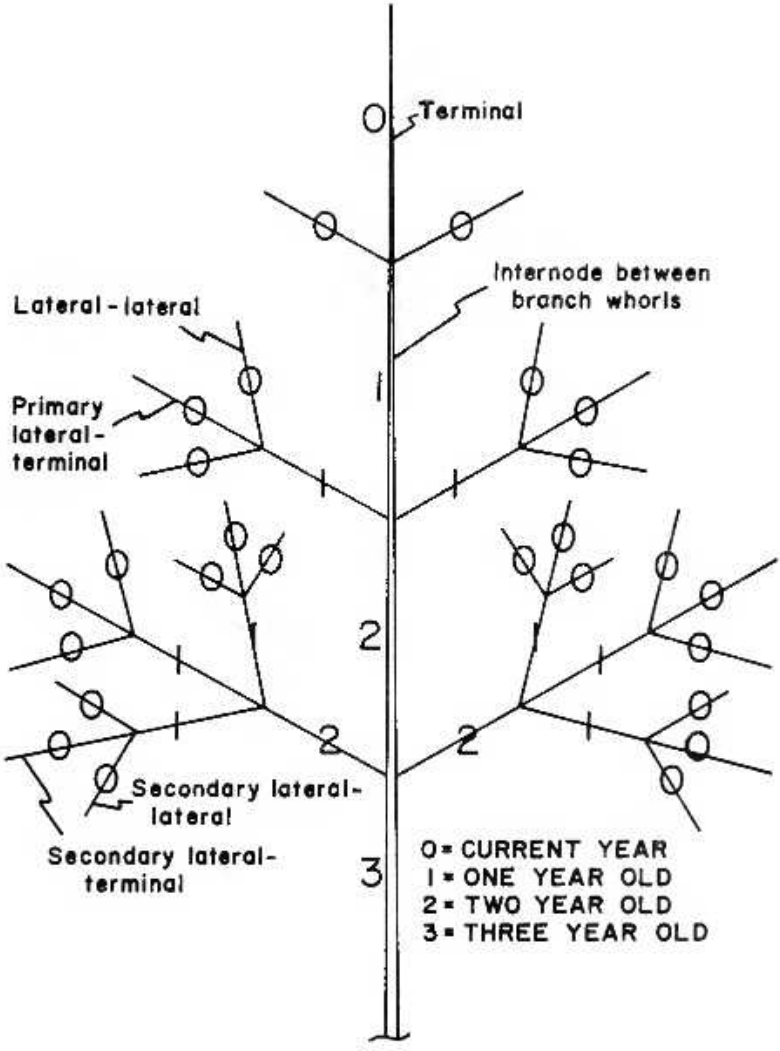


Figure 1. Branching terminology and code for denoting annual growth.

*Shearing* shapes a tree by cutting two years of lateral-terminal growth from each branch which has at least three years of growth on it. For example, in the schematic diagram (Figure 1), only N and N-1 primary lateral-terminal growth would be sheared from whorl N-3 during the year N, and the younger whorls above left untouched (older whorls below would be sheared as was the N-3 whorl).

It was originally thought that shearing two years growth from available primary lateral terminals would be followed annually. However, the effect of shearing the first year was analogous to the commercial practice of "shaping" a tree the first time, obtaining a more symmetrical form. It became apparent that a similar treatment in a subsequent year was not needed, and in fact would leave a tree looking decimated. Therefore, beginning in the spring of 1965, shearing assumed a form similar to the original definition of clipping; that is, primary lateral terminals were cut to the base of the previous year's growth.

*Fertilizer* was applied around a tree in a circular band extending 8 inches from the stem out to the "drip line" of the crown. N,P, and K applications were computed as "moderate" levels based on known experience and resulted in roughly equivalent weights for each element. The N-P-K or "complete" fertilizer was a total composite. The amount applied per tree is indicated in Table 1.

**Main Plots — Fertilizer Dosages**

| *Element* | *Composition and Percent of Element* | *Total Fertilizer Weight per tree* *Pounds* | *Grams* | *Elemental Equivalent* *Pounds* | *Grams* |
|---|---|---|---|---|---|
| Nitrogen | $NH_4NO_3$—35.5% N | .4 | 182 | .14 | 65 |
| Phosphorus | Superphosphate—19% $P_2O_5$ | .8 | 364 | .15 | 69 |
| Potassium | KCl 61% $K_2O$ | .25 | 114 | .15 | 69 |
| Complete | Combination of above | 1.45 | 660 | .44 | 203 |

Annual measurements and observations of treatment trees included total height change, number of "good" or usable whorls from the standpoint of developing a Christmas tree, numbers of lateral tips in the top three whorls (in the 0, -1 and -2 years with 1963 being zero, with measurement of tips developed in new whorls thereafter), number of branches which developed in the new whorls, internodal lengths and crown diameter.

An overall grading of the tree as a Christmas tree was also made on a scale from 1 (very poor) to 7 (excellent) at the beginning and end of the experiment. Needle color of each tree was recorded (Munsell system) at these times, but was not a criterion in arriving at tree grade in this study.

Data were analysed by use of analysis of variance (see Table 2). In the heading, the table also contains the objective and partially subjective criteria used in evaluating the various cultural practices at the end of the three year study. When the terms "significant" or "significantly" are used in this writing, they are used in the statistical sense on the 0.05 level.