# THE EFFECT OF LAMMAS SHOOT GROWTH ON THE STEM FORM OF YOUNG SCOTCH PINE [1]

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## INTRODUCTION

Foresters, Christmas tree growers, and horticulturists have, from time to time, observed unusual growth occurring in trees which does not fit within the normal pattern of seasonal growth. Such a type of abnormal growth is the elongation of terminal and lateral stems which takes place after the apparent termination of the yearly growth in height. One or more of the buds set on the ends of these stems will break, begin to grow, and produce a new shoot of variable length. Since this occurs in the later part of the growing season from late July through early September, the resulting new growth is called second or summer shoots, and has been given the name lamas shoots or lammas

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formation. A tree has produced lammas shoots if at least one member of a terminal bud cluster commenced growth later in the same season and formed a new shoot which in turn set a terminal bud cluster of at least two buds (Fig. 1). A bud which exhibited mid- or late-season elongation without producing a terminal cluster is not considered as having lammas growth.

Fig. 1.--Lammas shoot formation on terminal of Scotch pine.

## OCCURRENCE OF LAMMAS SHOOTS

The formation of lammas shoots can occur in both hardwoods and softwoods. However, most of the interest and work done on laminas shoots has been centered on the softwoods, and pine in particular (1,3,4, 5,6, 7, 9, 12). The basic questions of investigation deal with the cause and effect of this abnormal type of growth.

The occurrence of lammas shoot formation has been noted on Scotch pine (pinus sylvestris L.). This species is well known for its great diversity and variation of characteristics and tree properties, including growth habit. These factors are important since Scotch pine has been planted widely in the Northeastern and Lake States, and is a leading species in the production of Christmas trees in the nation, contributing 27 percent of the total in 1964 (8).

A previous study was made by West and Ledig of the incidence of lammas shoot formation which had occurred during three successive years in three experimental plantations of Scotch pine in New Jersey. In a total of 2,895 trees in the three plantations, 21.6 percent had produced lamas shoots in 1960, and 27.6 percent in 1961 (12). In 1962, 28.2 percent of the trees exhibited lammas growth. This rather surprisingly high incidence of lammas shoot formation would be chiefly of academic interest if it had no permanent effect on the tree. However, if marked changes in the normal tree characteristics, such as in branching, crown configuration, or stem form, were found to be caused by lammas growth, then it becomes of concern. These attributes are particularly important in producing and marketing Christmas trees as reflected in the USDA standards for Christmas tree grades (10).

## PURPOSE OF STUDY

The objective of this study was to determine what effect, if any, lammas formation had on the stem form of Scotch pine two years after the initial lammassing had occurred.

## DESCRIPTION OF PLANTATIONS

Three experimental plantations of Scotch pine were established in New Jersey in 1959, as part of a regional study. Each plantation included the progeny of 35 different sources of Scotch pine obtained from selected mother trees in New York, Pennsylvania, and New Jersey, planted as two-year-old seedlings, and randomized within 30 blocks in each plantation. Characteristics of the plantations are given in Table 1. The plantations were mowed and sprayed for insect control, but no shearing or other cultural work was done since the natural expression of tree characteristics was desired.

Table 1. -- Characteristics of Research Plantations

| Plantation | Physiographic province | Elevation (ft.) | Average length freeze-free period (days)* |
|---|---|---|---|
| Beemerville | New Jersey Highlands | 800 | 127 |
| Cranbury | Inner Coastal Plain | 115 | 185 |
| Green Bank | Coastal Plain | 10 | 189 |

* Data from nearest station in County (2).

## PROCEDURE

Stem form measurements were taken on all trees in the three experimental plantations. Only the portion of the stem between the end of the normal 1962 height growth and the end of the normal 1963 terminal growth was considered since it is this section which would be affected by any lemmas shoot formation occurring in 1962, as shown in Figure 2. These field examinations were conducted in the fall of 1964, two years after the initial formation of the 1962 lammas shoots. Only trees which had not been damaged by insects or other causes were included in the measurements.

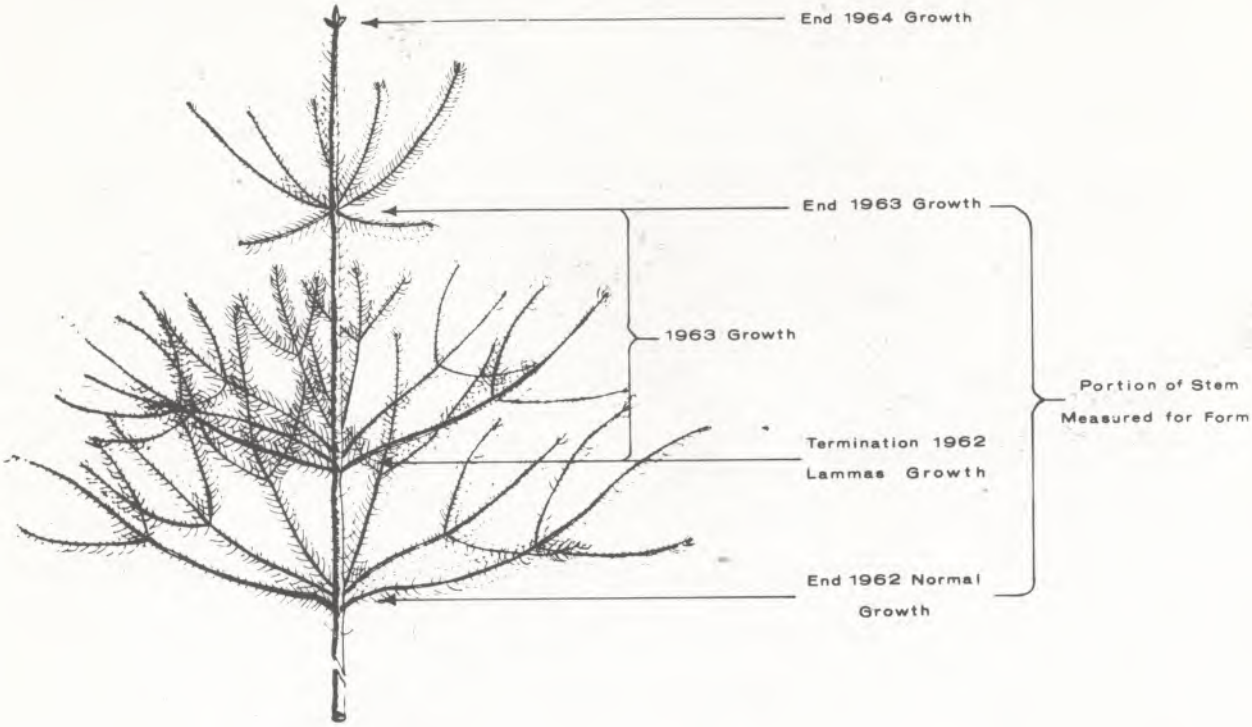


Fig. 2.--Diagram showing portion of the stem examined for effect of lammas growth on stem form.

The 1963 portion of the stem was classified into the following four types and each stem was given a single designation:

1. Straight -- stem did not deviate more than its diameter when aligned with a straight stick held alongside.

2. Sweep -- stem which deviated uniformly from its base to top by more than its diameter, with maximum deviation at the midpoint, when compared with a straight stick.

3. Crook -- same as sweep except having a maximum deviation other than at the center, such deviation being more abrupt and localized.

4. Fork -- a branching of the main stem into two or more separate stems.

## RESULTS AND DISCUSSION

A summary of the results is presented in Table 2.

Although the incidence of both sweep and crook was slightly higher in trees not having lamas growth, this difference was not significant. Sweep was quite common (28.4 percent of the 2,334 trees) but generally slight. The incidence of crook was 5.4 percent.

Table 2. -- Comparison of Form of 1963 Portion of Stem in Normal Trees and Trees which had Produced Lammas Growth, Two Years after Occurrence.

| Stem form | Green Bank | | Cranbury | | Beemerville | |
|---|---|---|---|---|---|---|
| | Lammassed n = 419 | Normal n = 370 | Lammassed n = 235 | Normal n = 602 | Lammassed n = 162 | Normal n= 546 |
| | Percent | | Percent | | Percent | |
| Straight | 68.0 | 69.0 | 44.7 | 51.5 | 49.4 | 54.8 |
| Sweep | 16.0 | 17.8 | 30.2 | 35.5 | 33.3 | 35.0 |
| Crook | 4.3 | 6.7 | 2.1 | 3.8 | 6.8 | 8.1 |
| Fork | 11.7 | 6.5 | 23.0 | 9.2 | 10.5 | 2.1 |

No attempt was made to further classify the forked stems as to their straightness per se. It is to be expected that at least some of the forked stems would also contain sweep or crook, and since trees having lammas growth produced more forked trees than those without, the difference in total number of trees containing sweep and crook would be small between trees with and without lammas growth. Thus it is concluded that the presence of lammas growth did not affect the straightness (including sweep and crook) of the stems.

The incidence of forking was positively affected by lammas growth in all three plantations. Statistical analysis indicated the differences to be highly significant (99 percent level of probability) in each case. Overall, almost 15 percent of those trees which had produced lammas growth in 1962 developed a distinct fork of the stem in the succeeding year as compared to only 6 percent of forking which occurred in trees not having lammas formation.

Lammas shoot growth from the terminal bud cluster produces additional stems at the top of the tree, and these in turn will usually outstrip the normal buds in growth during the following season. This disruption in the normal dominance of the terminal leader will produce initial forking, as shown in Figure 3. However, this does not necessarily result in a subsequent permanent fork in the stem. We had noticed that lammassed trees seemed to exhibit some tendency to "outgrow" the apparent distortions and terminal forking of the stem in the following year.

The temporary effect of lammassing on stem form had been noted by several researchers. Walters and Soos (11) working with Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] in plantations concluded that lammas growth "only infrequently has a permanent effect on the form of seedlings." In jack pine (*Pinus banksiana* Lamb.), Rudolph (7) found that in many cases the forked condition was not evident after two or three growing seasons and was thus largely temporary. He quantitatively estimated that "in approximately one in fifteen trees with prolepsis (lemmas) in 1957, what appeared destined to be a permanent fork in the stem was found in 1958." Although six percent forking resulting from trees that produced lammas shoots seems low, the question of how this differed from forking in trees of normal growth remained unanswered.

Fig. 3.--Initial terminal fork as result of previous lammas shoot formation. (Rutgers University photo.)

Fig. 4.--Permanent fork in stem 2 years after lammas shoot formation. (Rutgers University photo.)

Carvell (1) indicated that in a six-year-old plantation of red pine (*Pinus resinosa* Ait.) in West Virginia, 19 percent of the trees had summer shoots and after one subsequent growing season, 76 percent of these trees "had two or more strong leaders which would produce a permanent fork in the stem." However, he offered no subsequent evidence that strong leaders do produce a permanent fork in the stem in later years.

In order to make certain that initial forking of the terminal leader did in fact produce a permanent forking of the stem (Fig. 4), at least within the rotation of Christmas trees, a two-year interval of observation was employed in our study.

Work by Perry in 1960 (6) revealed the major role of genetics in the development of straight or crooked loblolly pine (*Pinus taeda* L.) trees. He excluded forked trees in his analysis for crookedness "because observers could not agree on whether forking in any given case was due to past damage or was an expression of crookedness." It is recognized that forking can be caused by both external and internal factors. Causal factors other than laminas growth were not investigated in the present study.

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