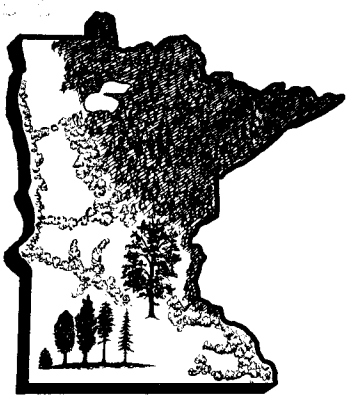

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CESSATION OF DORMANCY IN WHITE SPRUCE 1/

Lawson L. Winton 2/

Successful early-forcing of spruce pollen depends on an understanding of the initiation, duration, and time of cessation of dormancy (Winton, 1964a, 1964b, 1964c). In the fall of 1962, no male buds were available on white spruce trees at St. Paul. However, on material collected November 9 from 25 trees, one vegetative bud was swollen on one branch, and on another branch one vegetative bud began to elongate after 52 days forcing (December 31).

In 1963, male buds were recognized by mid-August; and regular collections from ten white spruce trees were started August 30. Daily collections were made from trees #6 and #10 shortly before and after the first frost of the season (the early morning of October 29). Also, within 10 hours after the first frost, collections were made from all ten trees. For each collection, male-bud bearing branches were placed in the greenhouse for forcing, where the base of each cutting was placed in water. From August to September, 1963, greenhouse temperatures ranged from 70°-85° F. (occasionally 98° F.), and the relative humidity varied from 20-50 percent. After October 29, daytime temperatures in the greenhouse dropped to 60°-75° F., and the relative humidity to 10-30 percent. An intermittant mist-spray was used during the day to increase the relative humidity near the cuttings.

On December 6, 1963, pollen was shed from two male strobili which had been collected 38 days earlier (October 29) from tree #15. In vitro tests showed an average of 71 percent germination after 48 hours in a 5% dextrose solution at 80° F. In length, the long pollen tubes were 4-7 times the diameter of the pollen grains. Pollen was also shed from male strobili collected from other trees on and after October 29. On the same branches, female strobili were erect and open for several days prior to the release of pollen; but vegetative buds did not begin to elongate until 3-4 weeks later. (For most material collected during this study, vegetative growth began within a few days after pollen release.) Although a few male and female buds did swell slightly on material collected October 28, there was no active development on branches collected before the morning of October 29.

In 1962, the first frost occurred at St. Paul September 29, and vegetative dormancy for white spruce was broken 41 days later when branches were collected November 9 and successfully forced in the greenhouse. In contrast, the first frost occurred one month later than usual in 1963, on October 29. Physiological dormancy in male, female, and vegetative buds was broken on the same day.

These results indicate that mature white spruce trees enter a period of physiological dormancy (imposed by agents within the plant) at some time between the cessation of current growth in summer and the occurrence of cold weather in fall. A cold treatment is evidently required to break physiological dormancy. However,

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2/ Research Assistant, School of Forestry, University of Minnesota.

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during the unusually mild fall of 1963, growth was resumed after a very brief exposure to freezing temperatures; and probably even during years having normal weather conditions, the chilling requirement for white spruce may be small. Elsewhere (Winton, 1964a, 1964c) results were presented leading to the hypothesis that male, female, and vegetative buds of white and black spruce as well as their F_1 hybrid have a minimum heat requirement before growth resumes in spring. On the basis of this hypothesis, it is reasonable to assume that after the cessation of physiological dormancy in fall, spruce is maintained throughout the winter under an imposed dormancy controlled by low temperatures.

The broad problem of initiation and cessation of dormancy in woody and herbaceous plants is still in a state of flux (Romberger, 1964). It is pointless, therefore, to speculate on possible types of physiological dormancy which may operate in spruce: whether of the "summer" or "winter" type. There also appears to be a great deal of confusion as to what actually constitutes each type of dormancy. However, a few observations may be in order which may help shed some light on dormancy mechanisms as they operate in spruce.

In 1960, the author observed two and three flushes of growth, respectively, on three year and two year old transplants of white and black spruce in the Blandin Nursery at Grand Rapids, Minnesota. Only one flush was made in May on nearby mature white spruce trees; but as late as August 24, occasional new growth was observed on one year old seedlings in the nursery. Also, four and five year old transplants of white and black spruce were kept in the greenhouse at St. Paul from May 1962 to October 1963. Two and three flushes of growth were observed the first summer, but no terminal growth was made in 1963.

These results suggest that juvenile plants of white and black spruce are less susceptible to dormancy mechanisms the younger they are, but that mature trees are prevented from resuming growth in late summer even though exposed to the same external environment. Perhaps juvenile foliage has a different physiological make-up which is not as sensitive to the environment as mature trees. Or, on the other hand, the larger amount of foliage on older trees may be associated with a quantitative internal inhibition system which is lacking in juvenile plants. Thus, the use of juvenile response is not recommended to infer dormancy mechanisms in mature trees.

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