Seed Sowing. Once stratification is complete, the seed is surface dried in preparation for sowing. The bareroot nurseries use a "Wind River Seed Drill" to sow the seed in eight equally spaced rows in a 48 in. wide seed bed.

Sowing is scheduled any time after May 1st when the weather permits seed bed preparation. The seed is sown in densities ranging from 20 to 50 seedling per sq. ft. depending upon the fate of the seedling after two years in the seedbeds. Seedlings to be shipped for planting in the field at the end of the two years are grown at the 20 to 30 per sq. ft. densities and the higher density seedlings will be transplanted back into the nursery for another year to obtain larger seedlings that may be necessary in areas where there is high brush competition or heavy big-game browsing.

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TERMINAL BUD ABORTION IN COLORADO BLUE SPRUCE

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Trees of Colorado blue spruce (*Picea pungens 'Glauca'*) have for many years exhibited a condition in which the primary terminal bud fails to grow normally in the spring. The severity of the condition also appears to differ from year to year. Since thousands of these trees are propagated and shipped yearly, this malady constitutes a major economic problem to the ornamentals industry of the Pacific Northwest.

Native habitat: The natural range of this tree (1) is from southern New Mexico and Arizona through the Rocky Mountains of Colorado, Utah, Wyoming, eastern Idaho, and possibly southwestern Montana. The trees are usually found in or near stream beds particularly in the more arid areas of its range. It grows at elevations of 6000 to 9000 ft. in the north and 7000 to 10,000 ft. in the southern parts. Soils are often of calcareous nature with a pH of 6.8 to 7.2. As might be expected, mean annual temperatures have an extremely broad range.

Symptoms: Bud abortion symptoms differ slightly from plant to plant but are generally restricted to the primary terminal bud and on occasion to terminals of lateral branches. The symptoms range from complete death of the bud to slight elongation of usually no more than 1 in. The central pith area of the stem immediately below the bud usually turns brown — a characteristic indicative of boron or calcium deficiency in many plants.

Abortion of the terminal buds is usually accompanied by normal elongation of other lateral buds produced immediately below the terminals. This results in the production of trees with several leaders. In extreme cases, where abortion has occurred repeatedly to terminals and lateral branches, the resulting trees can be wider than they are tall. No insect or disease has been consistently isolated from damaged tissues.

Areas of investigation: Our first investigation led us to believe that we may be dealing with a nutritional problem. Brown pith tissue, which is indicative of boron or calcium deficiency, along with high native soil pH, strongly suggested these elements may be involved. This was of further importance because spruce are usually produced in soils of pH 5.2 to 5.8 in the Willamette Valley of Oregon. Soils were tested in many nurseries that produced both container and field-grown stock. Our initial studies indicated that trees produced with the highest amounts of calcium generally exhibited the least amount of bud abortion. Although several growers applied lime this past winter, it will probably be several years before convincing data will be available.

The other major area of investigation will be to look closely at seed source. It is well known that trees native to southern latitudes have a greater cold requirement to break dormancy than trees of the same species but native to more northern latitudes. If it is found that lateral buds (below the main terminal) have a lesser cold requirement than the terminals, our problems may be corrected by selecting seed only from the most northern sources.

The observed facts tend to bear out the above in that lateral shoots usually develop normally and the entire abortion pattern differs from year to year but is generally consistant throughout all of our growing areas.

With the above in mind, I would like to request that anyone with access to seed from native stands of Colorado blue spruce please help. I would appreciate receiving samples (about 1 oz) from throughout the natural range. I will produce seedlings in a single location. After 2 years in seed beds, the

seedlings will be distributed to nurseries throughout the area and evaluated yearly. Problems of this type often require diligent effort by growers and researchers alike.

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IMPORTANCE OF SEED SELECTION FOR CHRISTMAS TREE PRODUCTION

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Equally as important to successful Christmas tree growers as it is to the timber industry is the selection of seed for plantation Christmas trees.

In the early days of Christmas tree farming, in the early 1960's, growers began to see a marked difference among trees with seed origin from different geographic areas.

This prompted provenance tests using the most popular Christmas tree species, namely *Pseudotsuga menziesii*, (Douglas-fir), *Abies procera* (noble fir), *Abies grandis* (grand fir), *Abies magnifica* var. *shastensis* (Shasta fir), *Pinus contorta* (shore pine), and *Pinus nigra* (Austrian pine).

These provenance tests were laid out, managed, and evaluated by member growers of the Northwest Christmas Tree Association, in conjunction with Oregon State University, United States Forest Service, Oregon State Department of Forestry, and Washington State Department of Natural Resources.

These provenance tests were established from northern Washington to southern Oregon to give a wide range of climatic conditions as well as inherited traits in selected sources.

Trees were evaluated for color, branch arrangement, number of buds, disease resistance, climate adaptability, form and most important, overall development rate. After all, Christmas trees are intended to be a crop to make money. The quicker the turn-over in a marketable tree the better.

For **color,** customers always prefer a dark green to blue green. A golden color is accepted in the nursery industry but not in Christmas trees.