# Effects of Harvest Date, Storage Temperature, and Moisture Status on Postharvest Needle Retention of Fraser Fir[1]

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## Abstract

Fraser Fir (*Abies fraseri* (Pursh) Poir.) branches harvested Oct. 3 and Nov. 28, 1984 were stored with and without water at 9, 16, 23 and 30°C (48, 61, 73 and 86°F) for 6 weeks. Branches set in water exhibited minimal needle loss at all temperatures except 30°C (86°F) where 60 to 75% of the foliage detached. Branches without water retained needles better at lower temperatures where the drying rate was slower. Branches without water which were harvested Nov. 28 exhibited less needle loss than those harvested Oct. 3, but storage temperature had more effect than harvest date. Branches with water maintained a moisture content of 120 to 140% (dry weight basis) except those at 30°C (86°F) which decreased to 66% moisture content after 2 weeks. Later harvest date and lower storage temperatures improved postharvest needle retention of Fraser fir.

**Index words:** Christmas trees



## Introduction

Fraser fir [*Abies fraseri* (Pursh) Poir.] is the principle tree species grown in North Carolina for use as a Christmas tree. As acreage increases, the potential for regional and national marketing becomes greater. A major criterion of postharvest quality for Christmas trees is needle retention. Early harvest and improper postharvest handling can result in excessive needle drop which reduces consumer acceptance. Evidence suggests that adequate cold hardening is important for good postharvest needle retention (7, 9). An earlier study with Fraser fir investigated postharvest moisture status and needle retention for a single harvest date in late November, and was conducted at one temperature regime (9). The objective of the present study was to examine the interactive effects of harvest date, storage temperature, and moisture status on postharvest needle retention of Fraser fir.

## Materials and Methods

On Oct. 3, 1984, six Fraser fir Christmas trees of uniform size and vigor [height = 2 to 2.3 m (6.6 to 7.5 ft)] were

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selected in a commercial plantation in western North Carolina (lat. 36°20′N, long. 81°39′W; elevation = 1,360 m, 4460 ft; eastern aspect). On this date and again on Nov. 28, 1984, eight branches per tree were harvested. The same trees were sampled on each date to minimize variation. The first date (Oct. 3) was judged to be too early for good postharvest needle retention, and the last (Nov. 28) sufficiently late to ensure good needle retention (9). Branches, rather than whole trees, were used due to space limitations and to allow for better control of ambient conditions in growth chambers. Harvested branches were terminal portions of major lateral branches (secondary axes) located between the 50th and 80th percentile of height. Each branch was 40 to 50 cm (16 to 20 in) in length and consisted of the one-year-old tip, 3 to 5 one-year-old laterals (tertiary axes) subtending the tip, and a section of older branch to act as a stem. Trees were not sheared in 1984 to maximize one-year-old tissues on branch tips and improve branch uniformity. Proximal ends of branches were immediately placed into water after cutting and transported to Raleigh within 6 hr.

In the NCSU phytotron (Southeastern Plant Environment Laboratory), 8 needles were collected from each branch, combined and weighed, dried to constant weight at 60°C (140°F), and moisture content (dry weight basis) determined. Each branch was trimmed to a length of 30 to 40 cm (12 to 16 in), and foliage older than one year was removed. Two branches per tree were randomly allocated to each of four temperature chambers: 9, 16, 23 and 30°C (48, 61, 73 and 86°F). One branch in each pair was recut under water and set in distilled water (hereafter referred to as a wet branch); the other was set in a dry flask (hereafter referred to as a dry branch). Fluorescent and incandescent lamps provided light between 0800 and 2000 HR daily (PPFD = 45 to 60 $\mu$mol $m^{-2}s^{-1}$, 300 fc), and relative humidity was approximately 70%.

At weekly intervals over a 6-week period, a sample of 10 needles per branch was collected for moisture content determination (dry weight basis). Branches were checked weekly for needle loss by lightly rubbing the foliage to detach loose needles. Each week, branches in distilled water were recut under water and set in fresh water. After 6 weeks, needle color was evaluated (13), and the remaining foliage was removed from each branch, dried and reweighed. Cumulative percent needle loss for each branch was calculated as follows: (cumulative dry weight of dropped needles / total needle dry weight for the branch) × 100.

## Results and Discussion

The percentage of needles which detached from dry branches was greater for branches harvested on Oct. 3 than on Nov. 28, except at 30°C (86°F) where few needles abscised for either harvest date (Fig. 1). For both harvest dates, the greatest needle loss in dry branches occurred at 16°C (61°F), while the lowest occurred at 9° (48°F). The effect of harvest date was most evident at 23° (73°F), where dry branches harvested Oct. 3 lost 25% of their foliage, compared to 5% for those harvested on Nov. 28. Wet branches lost few needles at 9, 16, and 23°C (48, 61 and 73°F) for both harvest dates, whereas those stored at 30° (86°F) experienced 60 to 75% needle drop (Fig. 1).

After 6 weeks of postharvest storage, wet branches at 9, 16, and 23°C (48, 61 and 73°F) remained dark green (Munsell Color 7.5GY 3/4, 5GY 4/4) and fresh to the touch. At 30° (86°F), needles on wet branches remained green until shortly before abscising at which time they yellowed (Munsell Color 2.5GY 6/4) or browned (Munsell Color 2.5Y 5/4). Dry branches retained their green color longer when harvested at the later date and stored at lower temperature. Needles on dry branches stored at 30° (86°F) quickly yellowed, then browned and became very stiff and brittle. After 6 weeks, needles of most dry branches at 9° (48°F) were slightly yellowed (Munsell Color 5GY 4/4), firmly attached and flacid.

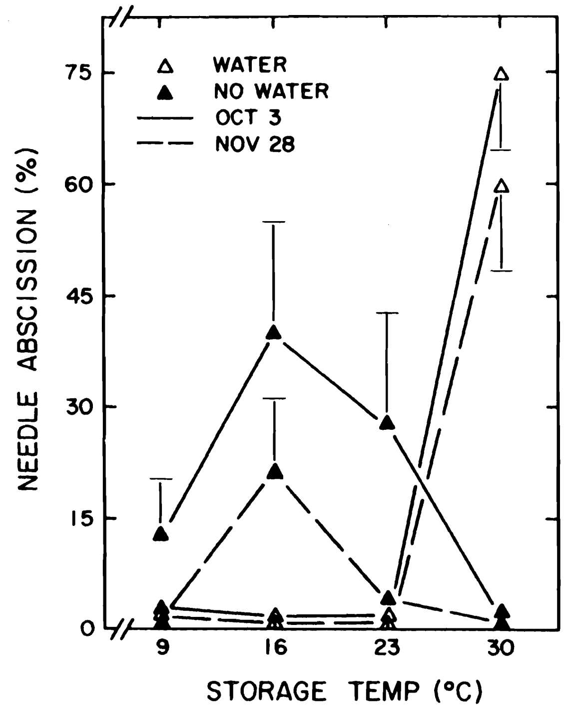


**Fig. 1. Percent needle drop from cut Fraser fir branches harvested Oct. 3 and Nov. 28 and held with and without water for 6 weeks at 9, 16, 23, and 30°C (48, 61, 73 and 86°F). Each data point is the mean of 6 trees (1 branch/tree). Vertical bars represent SE. SE not shown were ≤ 1.70%.**

Needle moisture content was initially 120% (dry weight basis) and increased after branch ends were placed in water (Fig. 2). Moisture content of wet branches remained relatively constant at 120 to 140% throughout the postharvest period regardless of harvest date. Branches held at warmer temperatures attained a slightly higher moisture content (Fig. 2). Wet branches at 30°C (86°F) rose to 140% moisture content after 2 weeks of postharvest storage, and then decreased steadily to an average moisture content of 66%. Heavy needle loss from these branches began during the 3rd week of storage. Dry branches lost moisture faster at higher storage temperatures (Fig. 3).

Postharvest needle retention of Fraser fir reflects an interaction among factors including harvest date, postharvest temperature, and postharvest moisture status. Therefore, one must use care in generalizing about any of these factors alone. Where water was not provided following harvest, needle retention at all temperatures except 30°C (86°F) was better for branches harvested late in the fall (Fig. 1). Needle retention of Fraser fir branches is correlated with raffinose content, which tends to increase with accumulation of chill-

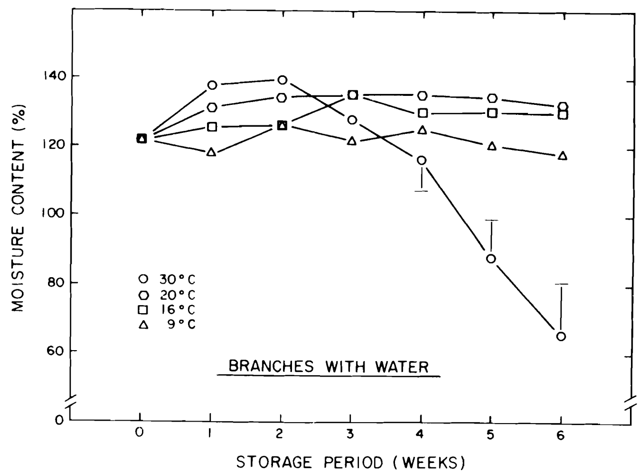


**Fig. 2.** **Weekly changes in needle moisture concentration (dry weight basis) of cut Fraser fir branches harvested Oct. 3 and Nov. 28 and held with water at 9, 16, 23, and 30°C (48, 61, 73 and 86°F). Each data point is the mean of 12 branches (6 trees × 2 harvest dates). Vertical bars represent SE. SE not shown were ≤ 3.0%.**

ing in the fall (9). Regardless of harvest date, branches stored without water at 30° (86°F) dried rapidly and turned brown, which rendered them unacceptable in appearance and a fire hazard. The disadvantage of harvesting too early was overcome by providing branches with water if the postharvest temperature was ≤23°C (73°F). However, these branches experienced massive needle loss at 30° (86°F). Thus, postharvest temperatures approaching a constant 30°C (86°F) should be avoided, regardless of harvest date or moisture status.

Branches promptly placed in water remained green and fresh with very little needle loss except at 30°C (86°F). There is apparently a critical postharvest temperature between 23° (73°F) and 30°C (86°F) which triggers needle drop. The universal recommendation for maintaining tree freshness and needle retention is to promptly place the butt of the tree in water following harvest. Under conditions of high ambient air temperature, putting a Fraser fir in water may actually promote needle loss after a period of 2 to 3 weeks. One might suspect increased fungal and microbial activity at higher temperatures as a cause, but this has not been tested. Preservatives in the irrigation water have generally provided no clear advantage over water alone (1, 2, 6, 10, 14).

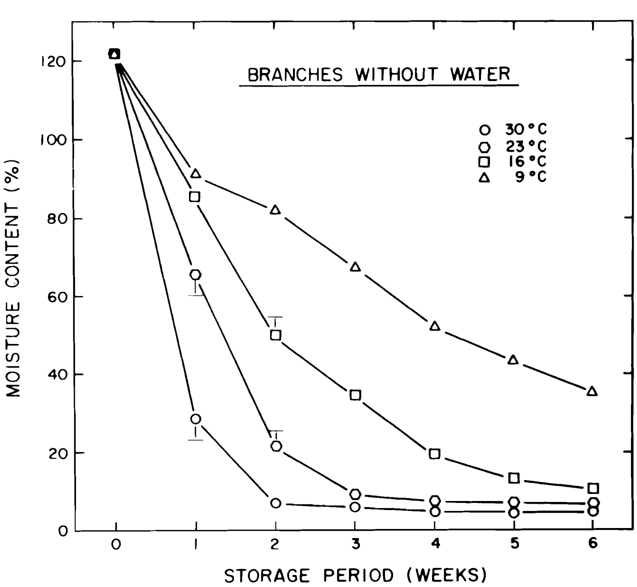


**Fig. 3.** **Weekly changes in needle moisture concentration (dry weight basis) of cut Fraser fir branches harvested Oct. 3 and Nov. 28 and held without water at 9, 16, 23, and 30°C (48, 61, 73 and 86°F). Each data point is the mean of 12 branches (6 trees × 2 harvest dates). Vertical bars represent SE. SE not shown were ≤ 2.5%.**

After a Christmas tree is cut, it begins to dry, the rate depending primarily on temperature and relative humidity. In contrast to White spruce (*Picea glauca* Voss.) which loses foliage during the drying phase (7), Fraser fir (5) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) (3, 11) do not. The critical moisture content (14), i.e., the moisture content below which a tree will not fully rehydrate when placed in water, is approximately 75% (dry weight basis) for Fraser fir, which corresponds to xylem pressure potential of −4.0 MPa (5). Branches without water at 30°C (86°F) reached 75% moisture content in 3 to 4 days while those at 9°C (48°F) required 2 1/2 weeks (Fig. 3). This underscores the advantage of low temperatures in preserving tree freshness. Despite prior emphasis on the importance of the postharvest environment in affecting keeping quality and needle retention (4, 7, 8, 12), the present study, to our knowledge, is the first to document the effect of temperature on the drying rate of a Christmas tree species under reasonably controlled conditions.

## Significance to Nursery Industry

Because cut Christmas trees are perishable products, producers and consumers need information to improve shelf life. These results indicate that needle retention and appearance of Fraser fir is improved by 1) later harvest dates in the fall, 2) lower storage temperatures, and 3) providing water to cut trees. Producers and consumers should be vigilant to avoid postharvest temperatures approaching a constant 30°C (80°F) where tree quality fails quickly, with or without water. This may require shading of baled trees, refrigeration of closed transport vehicles, overhead irrigation of trees on retail losts (12), and display of trees away from heat sources such as wood stoves, heaters, and radiators, while avoiding the practice of piling trees on hot pavement.

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# Tolerance of Direct-Seeded Honey Locust to Preemergent Herbicides in Various Soil Types[1]

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## Abstract

Various soil types were seeded with honey locust (*Gleditsia triacanthos L.)* and treated with preemergent herbicides to determine their effect on germination, seedling survival, and growth. Tested were alachlor at 2.2 (2.0), chloroxuron at 2.2 (2.0), DCPA at 11.2 (10.0), EPTC at 4.5 (4.0), napropamide at 1.1 (1.0), oxadiazon at 4.5 (4.0) and profluralin at 0.6 (0.5) kg ai/ha (lb ai/A). Acceptable survival and growth was found for all but oxadiazon which significantly reduced survival in the sandy loam soils.

**Index Words:** *Gleditsia triacanthos*, seeding, toxicity, herbicides, alachlor, chloroxuron, DCPA, EPTC, napropamide, oxadiazon, profluralin

## Introduction

Wbed control in tree nurseries is essential, but costs are high with hand-weeding methods (1). Herbicides are often less expensive and convenient if used properly (2), however, herbicide tolerance varies with tree species. New herbicidal products need to be evaluated for damage to tree seed and seedlings.

Previous greenhouse pot studies have evaluated the tolerance of black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditsia triacanthos* L.) seed to various common herbicides in peat/sand mixtures (5) and black locust in peat/sand/soil (7, 8) and in seedbeds (3), suggesting that the use of herbicides in direct seeding might be feasible. However, high germination rates in pot studies were not duplicated in field trials using black locust seed from the same seed lot (6), whereas honey locust survival was nearly the same. Soil moisture problems, rodent pilferage, and/or herbicide activity may all have contributed to poor survival of black locust when planted in the field. Further testing in various soils under controlled greenhouse conditions with black locust showed good survival and growth with many preemergent herbicides (4). Similar activity may be likely with seeded honey locust.

This report compares several trials of seedling survival and growth of honey locust seed planted in different soil types, when treated with seven different preemergent herbicides one day after seed sowing under controlled greenhouse conditions.

## Materials and Methods

Seed was scarified with concentrated sulfuric acid for 60 minutes. Twenty-five seeds were planted per individual 3.8 l (#1) plastic nursery containers at 0.6 cm (0.25 in) depth in each of the following soil types:

- Eudora silty-clay loam with a pH of 7.5, 2.0% organic matter, 146 kg/ha (130 lb/a) available phosphorus (P), and 560 kg/ha (500 lb/a) exchangeable potassium (K).
- Shellabarger sandy loam with a pH of 6.1, 1.6% organic matter, 37 (33) P, and 575 (513) K.
- Cass loam/sandy loam with a pH of 7.7, 1.2% organic matter, 22 (20) P, and 336 (300) K.
- Keith silt loam with pH of 6.8, 1.3% organic matter, 70 (62) P, and 1930 (1722) K.
- Waldeck, fine sandy loam with pH of 7.2, 1.2% organic matter, 56 (50) P, and 411 (367) K.

The following day, three replications (containers) of each of eight herbicide treatments were applied to the soil surface of randomly selected containers. Eight treatments (Table 1) using the best herbicide rates from our previous trials (5, 6) were prepared: alachlor (Lasso) 2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl) acetamide at 2.2 kg/ha (2.0 lb/a), chloroxuron (Tenoran 50W) N'-[4-(4-chlorophenoxy)

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