Timing of Collection and Seed Source Affects Rooting of White Fir Stem Cuttings[1]

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Abstract – The importance of white fir as a Christmas tree and its variation in color and form make it a good candidate for clonal development. This experiment examined the effect of timing of collection on rooting stem cuttings. In addition, the effect of seed source of stock plants on rooting of stem cuttings was examined. Nine weekly collections were made from the beginning of December to the end of January, 1991 and nine seed sources were sampled. The best rooting was seen in cuttings collected January 7. Three northern New Mexico seed sources rooted better than the other sources (60% across all collection dates). Root characteristics were affected by timing of collection and seed source of stock plant.

INTRODUCTION

White fir (*Abies concolor*) is native to New Mexico and the southern Rocky Mountains and is an important Christmas tree species. There is variation in needle length, needle color and crown density which influence the appearance of the tree. Needle length can range from two cm to six cm and color ranges from silver to dark green. These characteristics are important in determining suitability for Christmas tree production. Once desirable characteristics are identified, clonal development is needed to capture these variations.

Asexual propagation by stem cuttings is one means of capturing the variation in white fir. However, very little work has been done on vegetative propagation of white fir. While certain aspects of propagation of conifers are similar, developing a propagation program specifically for white fir is necessary. Important factors for vegetative propagation include timing of collection which is influenced by environmental conditions.

Seasonal variation in rooting capacity is a well known. Previous experience with white fir as well as published reports suggest that timing of collection could be critical to rooting success of cuttings (Moe and Andersen 1988, Hartmann and Kester 1983). Most conifers root best in the winter months after some chilling of the set bud has occurred and before budbreak in the spring. Research on Douglas-fir has shown rooting is related to bud dormancy (Bhella and Roberts 1975, Roberts et al. 1974). In Douglas-fir rooting was low during pre- and true dormancy, and highest during post-dormancy (August through December). Propagation for other conifers grown in northern New Mexico is best in December or January and it seemed possible that white fir would root best during that time also (Wagner et al. 1989, Schaefer 1989).

In addition, it is well-established that rooting potential varies greatly between families and even within families. Screening of potential clones with desirable characteristics for rooting capacity is necessary in developing a program of improvement for white fir. A provenance study established at the Mora Research Center allowed for screening of a wide range of genotypes and seed sources for rooting potential.

OBJECTIVES

The objectives of this experiment were to develop techniques for stem cutting propagation of white fir to allow clonal development by looking at timing of collection and seed source variation in rooting.

MATERIALS AND METHODS

The white fir stock plants were field planted in 1978 as a provenance test, and hedged to 1 m in 1989. Weekly collections were

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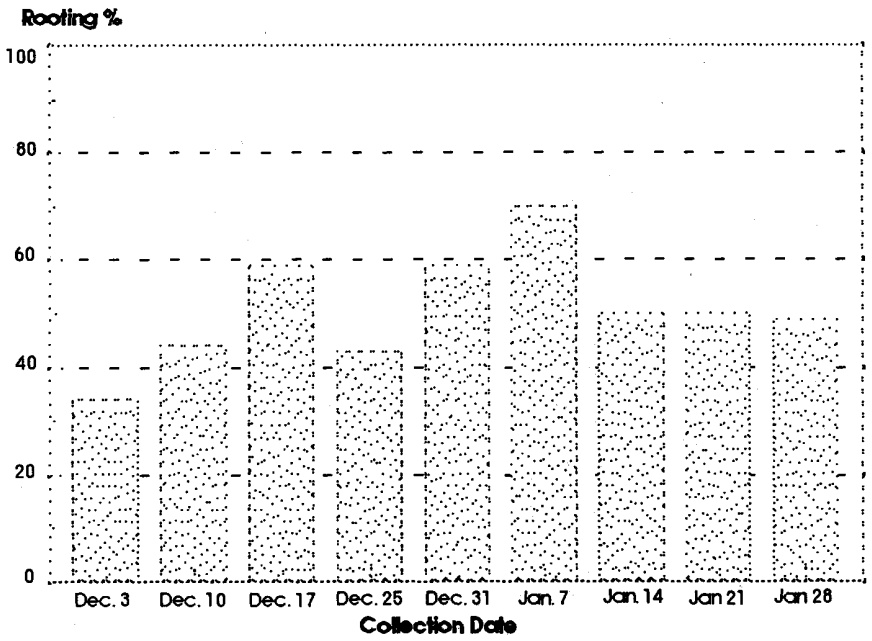

Figure 1. Rooting percent of white fir stem cuttings by collection date.

made from December 1, 1990 to January 30,1991 (a total of nine collections). Stock plants from nine New Mexico seed sources were selected with five trees sampled from each seed source. The seed sources ranged from southern New Mexico to northern New Mexico origins. For each collection date, five cuttings were taken from each stock plant. All cuttings were taken from the mid-section of the hedged trees, with all cuttings being approximately the same length.

The cuttings were processed immediately after collection. Processing included recutting to 12.5 cm, removal of the needles from the lower 2.5 cm of the cutting and a quick dip into a liquid root promoting plant growth regulator. The quick dip was a solution of 1250 ppm indolebutyric acid (IBA) and 1250 ppm napthalenacetic acid (NAA). Cuttings were placed into Ray Leach C-10 "Cone-tainers"™ (Stuewe and Sons Inc., Corvallis, OR) filled with a 1:1 vermiculite: perlite mix (v:v).

Cuttings were placed onto a propagation bench with bottom heat (18°C) and an overhead moving boom mist. Mist was applied hourly during daylight hours. The entire bench is enclosed in a fabric tent kept wet with overhead mist. Greenhouse temperatures were 20 to 25°C. After 16 weeks the cuttings were evaluated for rooting. In addition to rooting, root number, root length, root branching and shoot elongation/budbreak was evaluated. Root number was the number of roots originating at the base of the cutting. Root length was a measure of the longest root length. Root branching was a code from 0 to 3 of degree of branch root development with 0 being no branch roots present, to 3 highly developed branch roots.

The experimental design was a split plot design. the. whole plot treatment design was a completely randomized block (source) with collection date as the split factor. Statistical analyses were done using analysis of variance techniques (GLM, SAS Institute, 1989). Discrete data were analyzed using categorical model

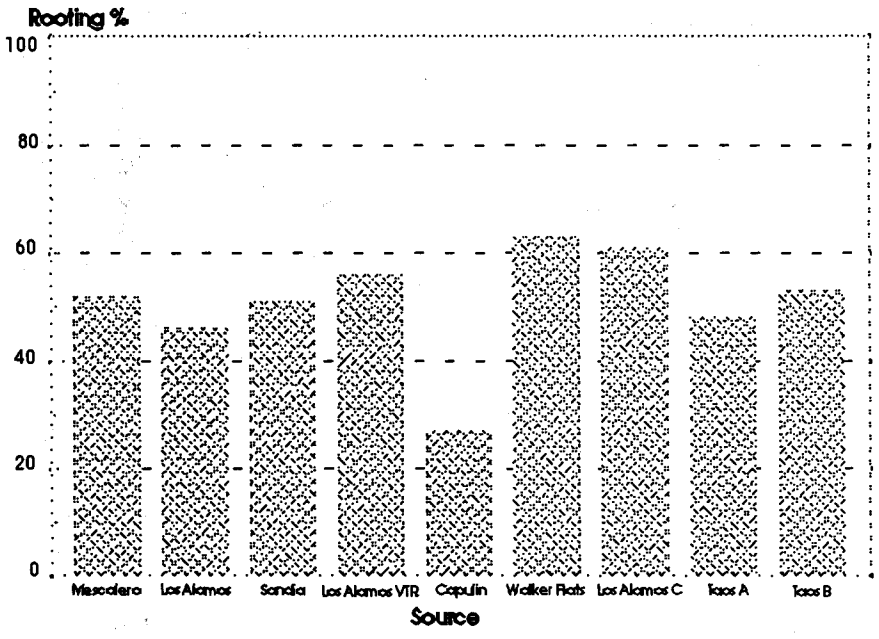

Figure 2. Rooting percent of white fir stem cuttings by seed sources of stock plants.

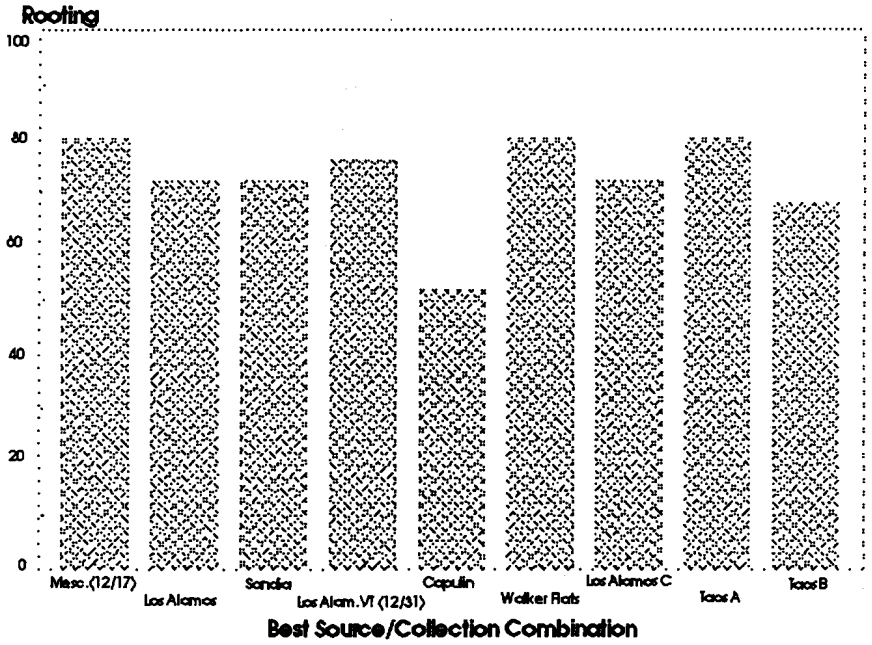

Figure 3. Root number, length and branching of rooted white fir stem cuttings by collection date.

analysis (chi-square test, CATMOD, SAS Institute, 1989).

RESULTS

Overall rooting was fairly high with the best collection date and seed source rooting at 80%. Rooting varied by collection date and seed source. The best collection date over all sources was January 7 with 70% rooting, the worst rooting was seen from cuttings collected December 3 with 34% rooting (Figure 1).

The analysis suggests that rooting, when determined by collection date is a quadratic function, in that rooting is low at the beginning, peaks more or less in the middle and then drops off. By seed source, collection date was significant for all but two sources (Los Alamos C and Taos B). Los Alamos C showed a peak at December 31, but also showed high rooting for the last two collection dates. Taos B rooting peaked at the January 7 collection, showed a drop for the January 14 collection and then increased rooting. Most sources showed peak rooting on the January 7 collection date (Figure 3). The southernmost seed source (Mescalero) showed peak rooting for the December 17 collection, and the Los Alamos VTR source showed peak rooting from the December 31 collection.

As expected, seed source of stock plants was important in rooting potential. Rooting for the nine sources ranged from 27% to 62% across all collections (Figure 2). The best sources for rooting were the Walker Flats, Los Alamos C and Los Alamos VTR sources, all northern New Mexico sources. There were four sources with rooting levels greater than 50% across all collections and four sources with rooting levels from 46% to 50%. Only one source showed very low rooting responses. Tree to tree variation was also important in determining rooting success. Overall rooting of cuttings by tree ranged from 2% to 87%. Most of the trees fell between 50% and 87% of the

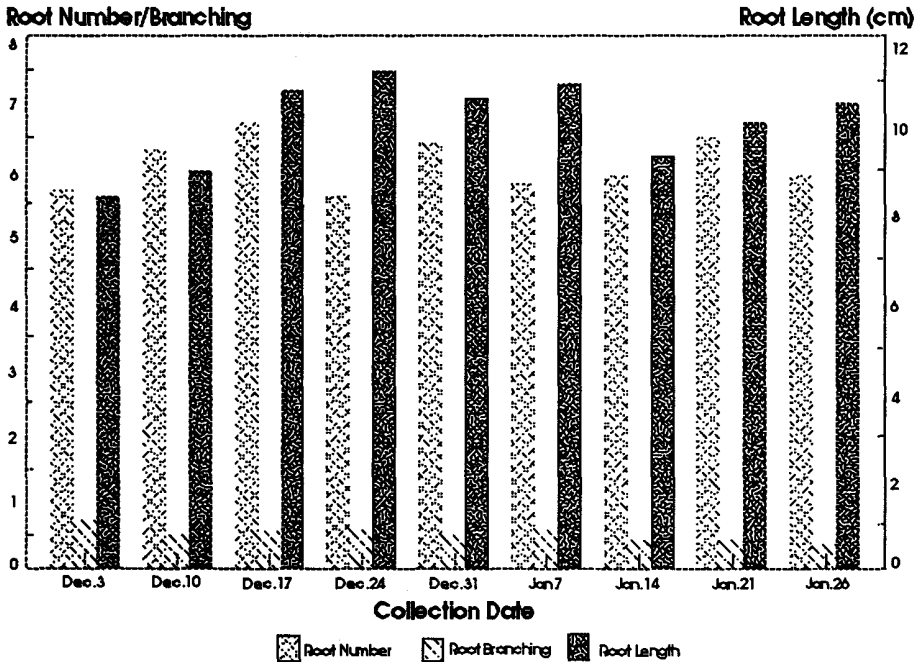

Figure 4. Root number, length and branching of rooted white fir stem cuttings by seed sources of stock plants.

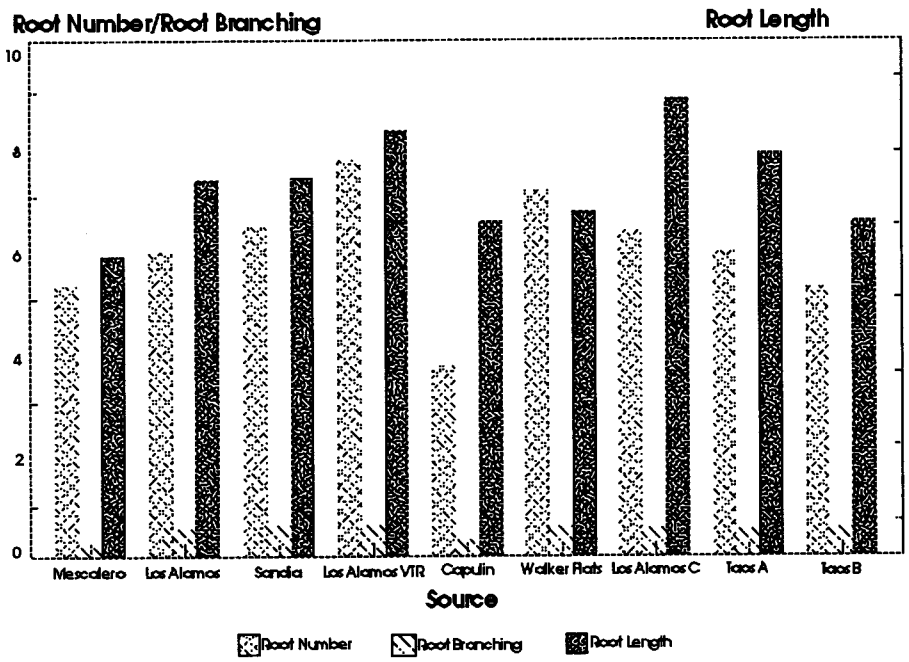

Figure 5. Rooting of white fir stem cuttings by seed source for best collection date of that source. Collection date is January 7 unless otherwise noted.

cuttings rooting. Of the 45 trees sampled, 53% showed 100% rooting for at least one collection date.

Root characteristics were analyzed without those cuttings not rooted. There was no interaction between collection date, source and root characteristics. The highest values for root characteristics did not necessarily correspond with the highest rooting collection date (Figure 4). Root number was not significantly affected by collection date ($p > 0.1$). Root length was significantly affected by collection date ($p = 0.0002$). The greatest root length was seen from cuttings taken December 24 and January. Root branching was also significantly affected by collection date ($p = 0.0029$). Cuttings collected December 3 and January 7 showed the highest root branching.

All the root characteristics measured were significantly affected by seed source of stock plants ($p = 0.0001$). The highest values for all three root characteristics measured were seen in the three best rooting sources (Figure 5). Mean root number ranged from 5.24 to 7.69 roots per cutting. Mean root length ranged from 8.16 cm to 12.39 cm, and mean root branching ranged from .19 to .62.

DISCUSSION

The results of this experiment indicate that white fir is adaptable to a stem cutting propagation program. First year results (one year past hedging) were acceptable. However, it is clear that timing of collection is critical to success as seen in the range of rooting success from 34% to 70% over nine weeks. Determining the optimum time for collection is critical to successful rooting. Not only does timing of collection affect rooting but it also influences root development as evaluated by root length and root branching but in this study not root number. Combining the two factors to obtain acceptable rooting and root development is important.

The highest rooting levels were seen from the January 7 collection and collections from December 17 and December 31 also rooted well. The drop in rooting seen for the December 24 collection corresponds with a severe cold spell (1 week below -20°C). The severe cold may have adversely affected rooting of cuttings collected during that period. Although a follow-up study is necessary, rooting of white fir stem cuttings appears highest from mid-December to early January.

Seed source and tree within seed source are also important factors in rooting success. Most of the sources rooted fairly well and could easily be included in a propagation program. Although some of the sources did not root as well overall, it does appear as if the poor rooters have a narrower window for optimum rooting success than do the better rooting sources. All seed sources had at least one tree which rooted fairly well which will allow for including at least some trees from all seed sources in a propagation program.

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