Research Update – Canaan Fir and Douglas-fir Improvement

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Part 1 – Canaan Fir

Surveys indicate that needle loss or "messiness" is a major reason why consumers choose artificial over real Christmas trees. Renewed marketing efforts might help the industry sell more trees, but certain problems still exist with the product itself. We need to continue and strengthen our efforts to improve several Christmas tree traits, including needle retention. The Christmas tree industry must provide consumers with a product that will perform well while on display in their homes. Maintaining hydration is critical for acceptable needle retention in the postharvest environment, however genetics also play a crucial role. Needle retention performance varies widely between species, between seed sources within a species and even within a single seed source of the same species. The objective of this research project is to locate and develop sources of Canaan fir with superior postharvest characteristics.

Canaan fir with excellent Christmas tree characteristics can be found on farms throughout Pennsylvania and the eastern U.S. Many of these individual trees have been periodically set aside and planted into seed orchards. Needle retention testing of fifty-five trees in one such Adams County Canaan fir seed orchard began in 2003 and continued through 2005.

During October 2003, 2004 and 2005, branches with the current and previous season's needles were removed from the trees and transported to the P.S.U. post harvest display room at the Russell E. Larsen Research Center, Rock Springs, PA. Testing was also performed at Washington State University Puyallup Research and Extension Center, Puyallup, WA. Branches were displayed dry for the duration of the display period and maintained under continuous standard fluorescent lighting, at 48% ± 5% relative humidity, and 68°F ± 4. Needle loss data was obtained at day 0, 7, and 10 by gently rubbing two fingers over the needles. The extent of needle loss was evaluated on a 0 to 7 scale where 0 = none and 7 = 91-100 % loss. Needle loss data was compared and correlated each year of the 3-yr. test period to verify individual tree performance.

Of the fifty-five trees tested, eight received an excellent needle retention rating of less than 1% needle loss for first and second year needles over the test period, during the 3 test years. These eight trees were selected for grafting and terminal leaders were harvested during spring of 2005 and 2006. Cleft grafts were made using containerized 5-year old Canaan fir as rootstocks in April of each year (Figure 1). Approximately 75 clones were derived from the original eight mother trees. After the grafts successfully healed, the trees were transplanted into larger containers and moved into the P.S.U. Pot-in-Pot nursery (Figure 2). This production system optimizes the root growth environment resulting in a large plant in a relatively short period of time. After the 2006 season in the

Pot-in-Pot nursery the first group of grafted trees were large enough to move to the seed orchard.

In 2005 a six acre site was secured at the P.S.U. Horticulture Farm at Rock Springs, PA for the establishment of the Canaan fir and Douglas-fir seed orchard. The site was cleared and prepared for planting during 2005-2006. The first grafted Canaan fir trees were planted in October, 2006 (Figure3). Future plans for the seed orchard include the construction of a deer fence and expansion of the Canaan fir needle retention testing. The Canaan fir seed orchard established near State College, PA by Dr. Henry Gerhold entered the needle retention trials in 2005, with 50 of the 165 trees being tested. Plans are also underway to test the progeny of the eight Canaan fir selected from the Adams County seed orchard.

The author wishes to thank the Pennsylvania Christmas Tree Growers Association for their generous support of this, and other research projects.

Figure 1. Terminal leaders from Canaan fir with superior needle retention are cleft grafted to container-grown 5-year old Canaan fir rootstock. This procedure is usually performed late March to early April.

Figure 2. After the cleft graft has healed, the tree is transferred to a larger container and moved to the P.S.U. Pot-in-Pot nursery for a season of accelerated growth.

Figure 3. Seed orchard of improved Canaan fir established at the P.S.U. Horticulture Farm, October 2006. The orchard will eventually contain clones of at least 20 parents with excellent Christmas tree characteristics and proven needle retention performance.

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Part 2 – Douglas-fir

Each year Rhabdocline needlecast disease (*Rhabdocline pseudotsugae*) affects countless acres of Douglas-fir across Pennsylvania. The disease can be devastating to Christmas tree farms and can set back salability by years. The pathogen is distributed throughout the northeast United States and, unfortunately, the Lincoln National Forest provenance favored by Pennsylvania growers is very susceptible. The only thing lacking to trigger an infection on many farms is favorable environmental conditions in the form of abundant moisture and cool temperatures during budbreak. The longer these cool, moist conditions persist during shoot elongation, the greater will be the incidence and severity of Rhabdocline needlecast disease. Chlorothalonil (Bravo) has been shown to be an effective chemical control, however alternative strategies for Rhabdocline management are needed to achieve any long term solution to this expensive problem. Part of this strategy should include isolating and propagating resistant Douglas-fir.

Douglas-fir showing resistance and/or immunity to Rhabdocline needlecast are common throughout Pennsylvania Christmas tree plantations. In previous PCTGA-funded studies, numerous individual trees exhibiting immunity to the disease where located (Figure 1). Under normal commercial production scenarios these trees are usually sprayed and harvested along with the disease-susceptible trees. Indeed, growers may not be aware that these resistant trees are even present on their farms. The objective of this project is to identify, select and multiply this disease resistant genetic resource. To date, there is no existing program in the eastern U.S. actively engaged in propagating Rhabdocline-resistant Douglas-fir.

Between 2002 and 2005, Rhabdocline-resistant Douglas-fir from the Lincoln N. F. seed source were located and evaluated. Most of these trees were growing in Clinton, Schuylkill or Centre Counties on commercial Christmas tree farms, or in abandoned fields. Resistant trees were selected from fields with obvious Rhabdocline infection, and in most cases were in direct physical contact with infected trees. Trees were also evaluated for acceptable Christmas tree traits such as growth rate, form and needle color. Terminal leaders of selected trees were removed for grafting trials in April 2005 and 2006 (Figure 2). Scions were cleft grafted onto 5-year old containerized Douglas-fir rootstocks. Grafts were allowed to heal and break bud under controlled greenhouse conditions (Figure 3) prior to being transferred to the P.S.U. Pot-in-Pot nursery. After one full growing season in the nursery, trees were planted into the Douglas-fir seed orchard located at the P.S.U. Horticulture Farm, Rock Springs, PA. Approximately 85 clones have been successfully established from 13 Rhabdocline-resistant mother trees.

Future project plans include the development of a greenhouse system and protocol for artificial Rhabdocline inoculation of Douglas-fir. This would enable us to inoculate trees under controlled conditions and would aid in the verification of Rhabdocline resistance within the population of cloned trees. Efforts are also ongoing in the establishment of a tissue culture system for the micropropagation of Rhabdocline-resistant Douglas-fir.

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Figure 1. Douglas-fir growing in Schuylkill County, PA, showing Rhabdocline needlecast susceptibility (left), and tolerance (right). These trees are from the Lincoln National Forest seed source.

Figure 2. Terminal leaders removed from Rhabdocline-resistant Douglas-fir growing in Clinton County, PA, April 2005.

Figure 3. Cleft grafted Douglas-fir breaking bud in the greenhouse, June 2005. Successful grafts were grown for one season at the P.S.U. Pot-in-Pot nursery, prior to field planting at the P.S.U. Horticulture Farm.