TREE IMPROVEMENT AT THE WOODLAND DIVISION OF GEORGIA-PACIFIC CORPORATION IN MAINE AND NEW BRUNSWICK

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ABSTRACT.--Tree improvement at the Woodland Division of Georgia-Pacific Corporation has come a long way in the last five years. This paper gives an overview of the progress in white spruce, black spruce and tamarack seed orchard development and other tree improvement research.

GEORGIA-PACIFIC CORPORATION'S WOODLAND DIVISION is located in Washington and Aroostook Counties in Maine and across the international border in York and Charlotte Counties, New Brunswick Canada. The total forest land holding amounts to over 800,000 acres, with approximately 450,000 acres located in Maine and 350,000 acres in New Brunswick. Timber on these lands is used in our 600 ton/day pulp and paper mill and 50 million board feet per year in our Chip-N-Saw stud mill which is located in Woodland, Maine, and our 90 million square foot 3/8" base per year softwood plywood mill in McAdam, N. B. The new waferboard mill, producing 166 million square feet 3/8 base per year, is located in Woodland, Maine and will be coming on line this fall.

Two greenhouse complexes located in Old Ridge, St. Stephen, N. B. and Grand Falls, Woodland, Maine each produce over 1 million containerized seedlings per year, which are planted on company land. Presently most of the seed for this greenhouses is being procurred through commercial seed dealers. Only small amounts have been picked from local stands. However, in the near future we will be obtaining improved local seed from clonal seed orchards of tamarack (Larix laricina (De Roi) K. Koch.), hybrid larch (Larix-x) and white spruce (Picea glauca (Moench) Voss) and seedling seed orchards of black spruce (Picea mariana, Meller) and white spruce.

SEED ORCHARD DEVELOPMENT

Selection.--In 1975 a selection program for fast growing high quality white spruce was started. Due to the cut history of our timber and the highly variable soil and sites, a combination selection system has been used. This system utilizes the comparison trees when they are available and subject all candidate plus trees and comparison trees to a point system.

The following information is taken in the field and recorded on the selection form for each candidate plus tree located: the species, location, data, selecting crew, stand type, aspect, drainage, line number and distance. Two increment cores are extracted at breast height and placed in labeled straws. These are examined in the office to determine age and periodic 10-year growth rates for the last 40 years. The other measurements taken in the field are:

Total height in feet.
Height to base of live crown.
Estimated relative height to 3 closest competing trees in feet.
Crown class.
Branch angle estimated to nearest 10^{0}.
Crown radius in feet at maximum radius and 90°, 180°, 270° from the maximum radius.
DBH to 0.1 inch.
Distance between node nearest DBH and next highest node to 0.1 feet.
Distance between node nearest DBH and next lowest node to 0.1 feet.
Remarks.
Location map with distance and bearings.

Each tree measured earns a total number of points as shown in Table 1.

Table 1.--Point System for Canadidate Plus Tree Evaluation

Age: 30-40 yrs or less	10 points
41-50 " " "	9
51-60 " " "	8 "
61-70 " " "	6 "
71-80 " " "	4
81-100 " " "	2 "
100 yrs +	0 "
10-year Periodic Diameter Growth for Last 40 years	
>5.0"	6
4.0"-5.0"	5
3.0"-3.9"	4
2.5"-2.9"	3
2.0"-2.4"	2
1.5"-1.9"	1
<1.5"	0
Live crown ratio	
0.8-1.0	1
0.6-0.8	2
0.4-0.6	3
0.3-0.4	1
<0.3	0
Crown class	
Dominant	4
Co-dominant	2
Intermediate or overtopped	0
Mean annual diameter growth	
- 0.4"	
0.3"-0.4"	4
0.25"-0.3"	3
0.20"-0.25"	2
<0.25"	
Distance between 3 nodes around breast height	
2.5'-3.5'	2
1.5'-2.4'	1
<1.5'	

In the fall of 1979 and spring of 1980 we used the company's Bell Jet Ranger helicopter to locate good stands of tamarack. This pre-screening made our ground work much more effective. A couple of hours in the air would line up enough ground work for a week or more for the man doing selection. Since he saw the stand from the air he was familiar with the access, the best areas in the stand and the obstacles such as swamps, streams or bogs to work around.

We are active members of the New Brunswick Tree Improvement Council (NBTIC) and work with their selection systems on our Canadian lands. Since we began selecting in Canada we have located 15 white spruce, six tamarack and one balck spruce for the NBTIC selection program.

Scion collection.--The biggest problem in developing a clonal seed orchard once the selection has been made is the safe, rapid collection of good quality scion which is in the top of the best, tallest trees around. Since the collecting is done in late winter and early spring, the weather is often a major factor in collecting scion.

Initially in 1975, a .22 magnum was used to attempt to clip 0 off the top side branches of white spruce. This proved to be ineffective due to the branches hanging up in the crown. This left us to climbing with a ladder, ropes, climbing spurs, and branch climbing. Even with the best technique, climbing is slow and hazardous in white spruce and down right dangerous in tamar ack. Spruce branches are quite strong and a small live or dead limb can support a good portion of a climbers weight, however, tamarack branches, over one inch in diameter, have suddenly let this climber down without any warning, even after supporting a load for several minutes.

In 1980 we purchased a H & R single shot 44 magnum with a high eye relief 4-power Leapold scope. A local reloader fixed us up with a standard hollow point powered by only eight grains of powder. With this equipment one man can easily collect the best scion by shooting the top four to eight feet out of the tree. Aerial photographs are used to determine the safe direction to shoot. The scion is left on the major branches, which are placed in a grain bag and packed with snow. This insures that the scion will remain fresh for a week to ten days or longer. Since this collection method is fairly rapid, we collect only enough trees to keep the grafting program going for a week or so.

This insures that fresh scion is used through out the grafting program.

Grafting.--Initially we did some outside grafting on wild stock and in a transplant bed containing both bear root and containerized white spruce. In our climate this type of grafting is difficult due to the cold, insects, particularly the budworm, and accessibility. Since 1977 we started using potted seedlings in a production greenhouse. In 1979 a smaller greenhouse was constructed which allows us to regulate the temperature exclusively for grafting.

White spruce has always been a difficult species for us to graft. The experience gained from "the school of hard knocks" and especially the break through made at the Acadia Experimental Station, of the Maritime Forest Research Centre, we now achieve 20 to 40+ percent success in our white spruce grafting. Some of the keys to success are 1) using the side approach method on the previous year wood, 2) being very careful in making a smooth cut and not exposing the pith of the root stock or scion, and 3) using Dilmont's grafting wax which has a much lower melting point (128°F) than the other grafting waxes used. All our grafts are made on 11/2 to 4 year old potted white spruce root stock, which has been kept in a shade house a few days to a week before being brought into the grafting house and being placed under the benches to thaw. A dorment oil is sprayed on the root stock in the fall and again as they come into the greenhouse to help control insect problems.

After grafting, the trees are placed under the greenhouse benches where the temperature is between 55°-65°, until the buds swelling occurs on the scion or the root stock buds have broken. Then they are placed on top of the benches.

Grafting tamarack is much easier than white spruce. The grafts are made on 11/2 to 3 year old potted Japanese larch (Larix leptolepis Gord.) grown under shade, using the same grafting techniques as we use in white spruce, 90+ percent success is easily obtainable.

Pruning back the root stock on white spruce and espeically tamarack several times after the initial bud break is necessary to insure a vigorous graft. Also light, careful applications of fertilizer, especially nitrogen, must be made until a strong graft

union is achieved. One application of too much fertilizer too soon will cause the grafts to bolt.

From 1976 to present we have successfully grafted 60 ortets of white spruce represented over 556 ramets. Forty-two ortets are from selections made on Georgia-Pacific land. The remaining 18 ortets were from scion exchanges through New Brunswick Tree Improvements Council (NBTIC) and Cooperative Forest Research Unit at the University of Maine.

In the last two years work with tamarack, 46 ortets have been grafted, represented over 651 ramets. Twenty-nine ortets were from Georgia-Pacific land, and the remaining 17 ortets were obtained through scion exchanges with NBTIC.

This last spring scion from 10 select hybrid larch from the Province of Quebec, were also passed on to us by NBTIC for grafting. We have grafted them on Japanese root stock successfully and have the ten ortets represented over 83 ramets.

Seed orchard preparation.--Over the last four years we have cleared 22 acres near the Grand Falls Greenhouse complex. Two irrigation ponds were built on the small seasonal stream running through this area in 1979. The topography is lightly rolling and the soils are primarily glacial tills that are more stoney in the low areas. On the recommendation of several soil scientists 1.8 tons of calcite grit and 330 pounds of 10-10-10 fertilizer were spread over the area. This was done using the company helicopter and slung spreader bucket. The site is being rototilled in to a depth of 4 or 8", to incorporate the calcite and fertilizer into the soil. Due to the rocky soil the rototiller has had a lot of down time. After tilling a special grass mixture of Kentucky 31 tall fescue (54.88%), perennial rye grass (40.18%) and white clover (2.94%) is spread and worked into the soil with a drag.

Seed orchard planting.--A small white spruce seedling seed orchard salvaged from an old planting on Georgia-Pacific land was transplanted along one side of the seed orchard area. Four families are represented with over 20 trees from each being planted at 16 x 16' spacing. These trees are from selection made in the 1960's by the Spruce-Fir Committee.

The start of the white spruce clonal seed orchard was planted in 1979 at 16 x 16' spacing. As of this July this year it contains 37 ortets represented over 237 ramets. In the spring of 1981 it will be increased to at least 60 ortets represented over 556 ramets with the planting of the grafts on hand. Despite last winter's lack of snow and unusual weather conditions, we only lost less than 10 percent of planted ramets. However, a number of ramet's root stock were badly winter burned.

In the early summer of 1979 the start of the tamarack clonal seed orchard was planted using a 16 x 16' spacing. Last winter unusal weather conditions, lack of snow and other factors resulted in about 30 percent loss of the ramets. As of June 1980 this orchard contained 16 ortets represented over 82 ramets. This seed orchard will be significantly increased in 1981 to 46 ortets represented by 650 ramets using the grafted stock on hand.

Next spring the small hybrid larch clonal seed orchard (10 ortets - 83 ramets) will be planted at 16 x 16 spacing. This will be added to if more material becomes available.

In January 1980 seed for 114 family black spruce seedlings seed orchard from NBTIC was sown in our greenhouses. This is being outplanted on a seed orchard site on our Canadian lands this summer. The same seed orchard material that was grown in our Grand Falls greenhouse will be planted at our seed orchard site in Maine in the spring of 1981. Each family will be represented at least 100 times in New Brunswick and at least 40 times in Maine in randomly planted design.

Black spruce appears to be somewhat resistant to budworm feeding and performs well in our plantation, however, obtaining good seed is very expensive ($200/pound in 1980 and in some years impossible to buy). Therefore we will be looking forward to seed production from these orchards.

Other tree improvement work.--Douglas Fir provenance
In 1977 with the help of Ed Palplad of Pennsylvania and Gerald Rehferldt, U.S.F.S., Forest and Ranger Experiment Station, Idaho, we collected 23 source Douglas Fir (Pseudotsuga menziesii var. glauca Franco.). These seed source range from New Mexico through British Columbia. They were grown in our greenhouse and were outplanted on two test sites in 1979. Each block was planted with 10 tree rows and replicated six and eight times. The first years planting survival looks good, however, a number of trees are not very thrifty.

Japanese larch progeny test .--Jack Winieski, the Dept. of Environmental Resource, Pennsylvania supplied us with 10 individual seed sources and a bulk seed lot from their seed orchard. Even though we had some problems with germination, we did manage to get eight seed sources and the seed orchard bulk seed lot into a field planting in 1979. It was planted in 10 tree rows and replanted six times. First year survival looks very g-od.

Western white pine x eastern white pine hybrid trial.-

A small planting of eleven western white pine x eastern pine (Pinus monticola Dougl. x Pinus strobus L.) pine were acquired through Tom Adams of the University of New Hampshire in 1975. The pollen parents were some of Bingham's blister rust resistant western white pine selections. The maternal parents were selected eastern white pine clones in the University of New Hampshire's breeding arboretum. These crosses were made by myself in 1971 and 1972. Several of the trees are growing very well and a few are bearing cones.

Eastern white pine progeny test.--In 1976 Tom Adams of the University of New Hampshire planted a 36 tree white pine progeny test. A four tree row plot with eight replications was used. In the summer of 1978 it was mechanically released from competing weeds. In April this year this test looked to be in good shape.

Eastern white pine provenance test.--In January 1979, Clyde Hunt, U.S.F.S., Broomville, Pa. delivered seed from 54 sources of white pine. It covers much of the range and contains a number of selected sources. This was stratified and sown in our Grand Falls Greenhouse in 1979. Part of this was outplanted. A trial using 5 x 5 tree blocks replicated four times in June 1980. The remaining material is being held for distribution by Clyde Hunt.

Hybrid poplar clone bank.--A clone bank of 103 clones of hybrid poplar, (Populus - X -) was set out adjacent to our seed orchard site in Maine. Most of this material was obtained through Tim Demeritt of the USFS, Durham, New Hampshire. Many of the clones were developed by Ernest Schreiner, a number of years ago. A systematic row planting was used with up to 16 trees of a clone per row. It is planted at 4 x 8' spacing and is not replicated.

Cooperative forest research unit plantings.--In cooperation with the CFRU, three special plantings have been made on our Maine lands.

These include a nursery selection planting planted in 1977, a 29 source Jack pine (Pinus banksiana lank.) provenance test established in 1976 and a Russian Scotch pine (Pinus sylvestris L.) provenance test having 49 sources established in 1979.

New Brunswick tree improvement plantings.--Several plantings under the direction of NBTIC have been located on our New Brunswick lands. These include a black spruce stand test testing 43 selected stands established in 1978; a Jack pine stand test, testing 44 selected stands established in 1978; an Ottowa Valley white spruce progeny test; a 44 open pollenated test established in 1979 and a Jack pine progeny test; a 145 open pollenated test to be established this year.

SUMMARY

We feel that a fair amount of tree improvement work has been started at the Woodland Division of Georgia-Pacific Corporation in the last five years, however, we realize that it is just the beginning. In the future NEFTIC meetings, I plan to keep you updated on our tree improvement work so that we may exchange information material and ideas.