CANADIAN FORESTRY SERVICE CONTAINER PLANTING TRIALS IN ALBERTA, SASKATCHEWAN, AND MANITOBA

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Abstract -- Field performance of five container systems -- Ontario tube, B.C./C.F.S. Styroblock, R.C.A. sausage container, Japanese paper pot and the Spencer-Lemaire book planter -- used in Alberta, Saskatchewan and Manitoba, Canada Early performance is promising for the "plug" and biodegradable container systems.

BACKGROUND

Research and small-scale trials of container planting started in the prairie provinces in 1962 (Ackerman et al, 1965). Early work was done in Alberta with a wide variety of containers, mostly rigid-walled and left intact at the time of planting. Container volumes were small, generally less than two cubic inches with diameters of one inch or less. The Ontario-type split plastic tube was the most widely used container in early large-scale trial and operational plantings.

The Alberta Department of Lands and Forests and North Western Pulp and Power Ltd. developed rearing systems simultaneously which produced healthy but small seedlings. The small seedlings resulted from the short rearing periods then in use. Although basic economy greenhouses were at first considered, most agencies in the Prairie Provinces wisely opted for moderately priced structures where temperature control was possible within reasonable limits. It was recognized very early that the services of a dedicated and knowledgeable greenhouseman were indispensable.

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About 1970 it became apparent that the Ontario-type container system was not living up to expectations. Sufficient data were available to show conclusively that survival was mediocre and growth was slow. Studies in other provinces substantiated this and Government and Industry in the prairie provinces turned their attention to the plug or root-free system of container planting.

In our work with container planting most emphasis has been on biological aspects; mechanization of a system has not been stressed and will not until the various reforestation agencies select proven systems. At present the container systems in use in the prairie provinces are Spencer-Lemaire book planter, Japanese paper pot, Research Council of Alberta peat sausage and the B.C./C.F.S. Styroblock.

FIELD PERFORMANCE OF VARIOUS CONTAINER SYSTEMS

My colleagues from Manitoba, Saskatchewan and Alberta have discussed their container rearing and planting programs in detail. The purpose of this paper is to outline various container trials and evaluations conducted by the Canadian Forestry Service (CFS) in the Prairie provinces since 1965 and to arrive at some conclusions concerning success. All of the trials and evaluations undertaken were done in co-operation with the various operational reforestation agencies in the region.

Only trials and evaluations of initially promising container systems were considered for discussion in this paper. Many other containers

produced from a wide variety of materials have been tried in the prairie provinces and rejected for biological, economic or operational reasons.

1. Appraisal of the Ontario-type tube system

This system which is based on the planting of seedlings growing in split, plastic tubes, was used on pilot-scale trials by North Western Pulp and Power Ltd. and the Alberta Department of Lands and Forests from 1965-1970. Container planting programs in Alberta during this period approximated 2 million seedlings annually. Small-scale trials of several thousands of container seedlings were also planted in Manitoba and Saskatchewan prior to 1970. In all cases the Ontario-type tubes used were 1/2 and 3/4 inches in diameter and 3-1/4 inches in length.

Rearing schedules varied somewhat between agencies but the schedule developed by North Western Pulp and Power Ltd. (Carman 1967) and followed with slight variations by other agencies usually resulted in vigorous but small seedlings. Basically rearing consisted of four weeks in the greenhouse with regular watering and fertilization and supplementary light at temperatures of 65 - 75°F. Seedlings were then hardened-off for a further four weeks in cold frames prior to planting.

CFS involvement in container planting evaluations started in 1965 (Johnson and Marsh 1967) on North Western Pulp and Power's first pilot trial. Sample plots were established on a variety of sites to monitor survival and growth. Additional plots were established in 1966 and 1967 container plantings. A total of 180 sample plots of 100 seedlings each were established. Similar assessments of container planting in various Forest Districts of Alberta were conducted by Soos (1970) and later in Saskatchewan and Manitoba by Froning (1972).

Figures 1 and 2 show survival of western white spruce (Picea glauca (Moench) Voss var. Abertiana (S. Brown) Sarg.) and lodgepole pine, (Pinus contorta Dougl. var. latifolia Engelm.) Ontario-type tubelings by year of planting on the North Western Pulp and Power Lease 1, 3 and 5 years after planting. In most trials initial survival was good but three to five years after planting survival declined to an unacceptable level. The very small stock produced and small container volume with subsequent root restriction are considered to be the main factors responsible for poor survival.

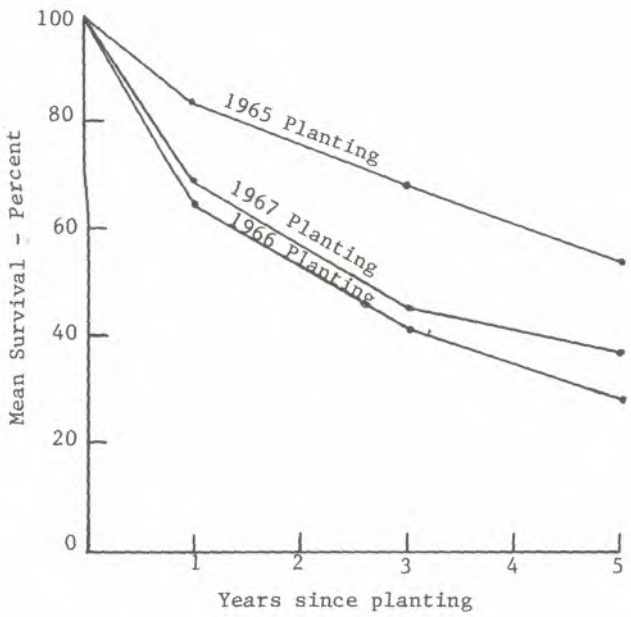

Figure 1.--Survival of white spruce planted in Ontario-type containers. North Western Pulp and Power Ltd., Hinton, Alberta.

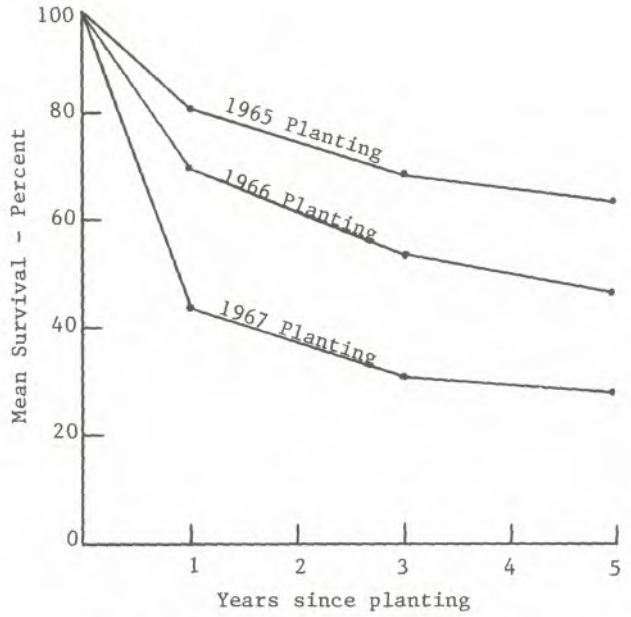

Figure 2.--Survival of lodgepole pine planted in Ontario-type containers. North Western Pulp and Power Ltd., Hinton, Alberta.

Figures 3 and 4 compare the average heights of container stock with white spruce and lodgepole pine wildings on North Western Pulp and Power holdings near Hinton, Alberta. The heights for wildings are based on the random selection of several hundred seedlings growing in the general areas where container planting was done. It will be noted that the average height of container stock at age 6 is well below that of naturals; about one-half for lodgepole pine and about one-third for white spruce.

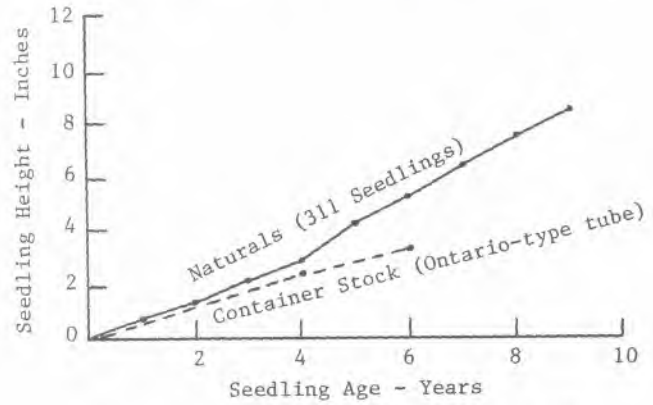

Figure 3.--Height-age relationships of western white spruce natural seedlings and container stock (Ontario-type tubes).

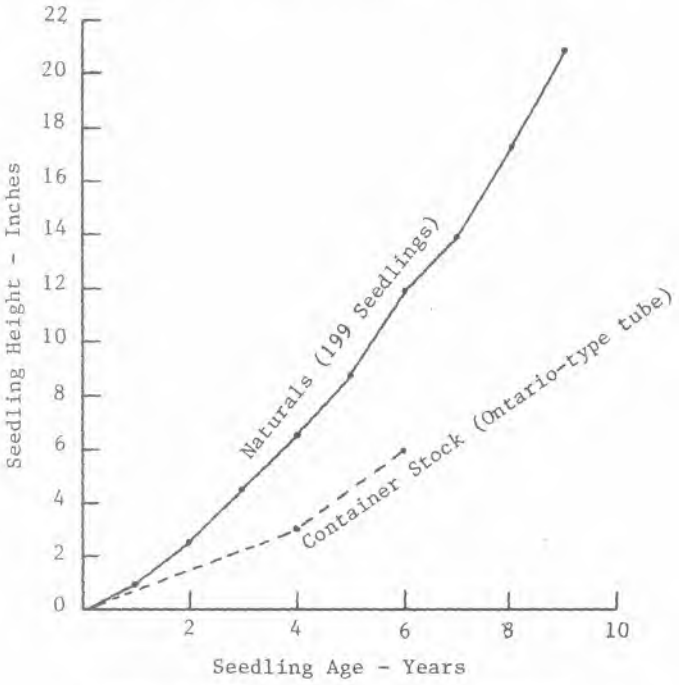

Figure 4.--Height-age relationships of lodgepole pine natural seedlings and container stock (Ontario-type tubes).

2. B.C./C.F.S. Styroblock Trials

The styroblock was one of the first systems used in Alberta in which the seedling was removed from the container before planting. It was introduced on a trial basis by CFS in 1970 to gain some experience in rearing and to rate field performance under Alberta conditions,

Use of the system at that time required the growing of fairly large seedlings with well developed root systems in order to facilitate extraction from the styroblock mould. Seedlings were large compared to container stock previously produced in the Ontario-type tube. In retrospect this feature which at the time was considered a drawback by many, proved to be the principal reason for the success of the system. The longer rearing period resulted in robust seedlings which show promise in the Prairie Provinces.

Styroblock seedlings for the various CFS trials discussed were reared from 12 - 14 weeks in the greenhouse and hardened-off in cold frames for a further four weeks. Thus age at planting was approximately 18 weeks in contrast to 8 to 10 week-old tubed seedlings previously used in operational container plantings.

Rearing methods are similar to those described for the Ontario-type tubelings. Styroblock cavities are 2.5 cubic inches. Greenhouse temperatures were maintained at 70 degrees F during the day and 60 degrees F at night with an 18 hour photoperiod. Fertilization started at three weeks from germination and was applied once a week. Water was applied manually as required.

The introduction of the styroplug in 1970 was followed by more comprehensive trials in 1971, 1972 and 1973. These trials were established in 17 locations between the 49th and 60th parallels and covered a wide range of climatic and soil conditions. Bare root 3 - 0 stock was also planted for comparative purposes. Lodgepole pine, jack pine (Pinus banksiana Lamb.), white spruce, black spruce (Picea mariana (Mill.) BSP.), and Engelmann spruce (Picea engelmanni Parry) were the species planted. (Appendix I shows survival and average total dry weights each year after planting. Average total dry weights are also shown for stock immediately before planting.)

Average total dry weights of styroplugs from 9 small trials at planting and 1 and 3 years after is compared to that of average 3 - 0 bare-root stock [3] at lifting in Figure 5.

[3] Data from quality monitoring studies L. Carlson, CFS, Edmonton.

It will be noted that for both lodgepole pine and white spruce the size of styroplugs 3 years after planting (1973 was greater than 3 - 0 stock just prior to planting. The 3 - 0 stock was representative of that lifted at Oliver Tree Nursery, Alberta, during 1973. The economic advantage of producing styroplugs is immediately suggested but an analysis is not warranted until further data are available.

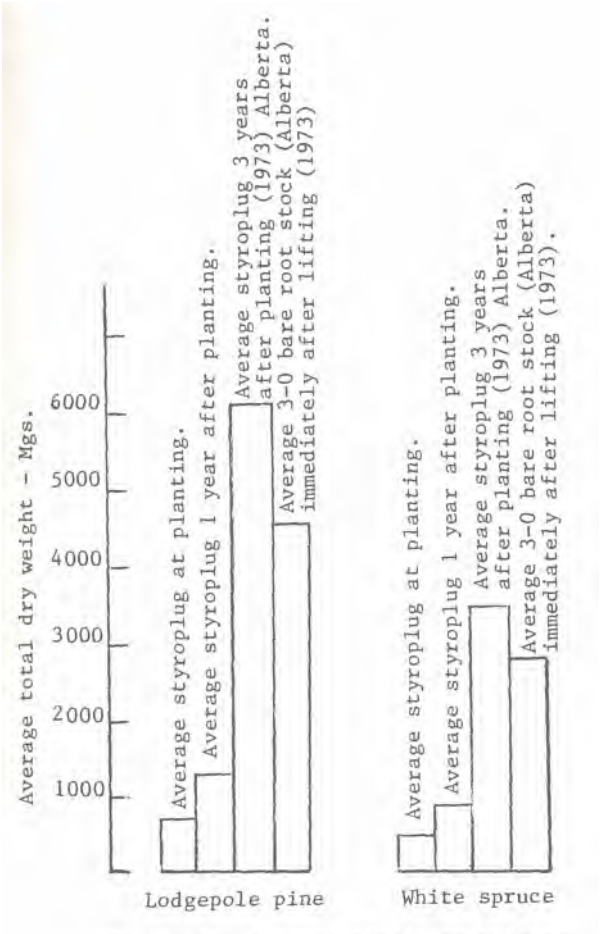

Figure 5.--Average total dry weights of styroplugs and 3-0 bare root stock in Alberta.

3. Research Council of Alberta Peat Sausage Container

The RCA peat sausage is produced by extruding a semi-fluid peat paste into 1-inch tubular polyethylene casing. The casings are cut into 3-inch lengths and packed into trays and seeded.

RCA seedlings were included in trials established in 1971, 1972 and 1973 in Alberta. The seedlings received the same rearing treatment as the styroplugs but because of high peat compaction were difficult to keep moist and required frequent watering. It is believed that this problem has been overcome as sausages received from the Research Council of Alberta for additional trials this year have produced excellent seedlings and required little more care in watering and fertilizing than other systems.

Appendix 2 shows first-year survival of RCA seedlings on trials conducted during 1971 and 1972 in the same locations as the styroplug trials. Total dry weights of seedlings at planting and one year after are also shown. A difference in size of stock planted in 1971 and 1972 is evident. This is due to peat compaction problems in the 1972 trials. High compaction also resulted in significant frost heaving during the first year after planting

4. Paper Pot System

CFS paper pot trials discussed here are confined to Manitoba due to a particular interest in the system by that province. Prior to the CFS trials the Manitoba government had started paper pot trials in 1970 and some of the results are included in this paper.

The rearing method for CFS trials was identical to that used for the styroblock and sausage container stock previously discussed. Jack pine and white spruce were used in the trials and three sizes of paper pot were tested as follows:

Series	Diameter (ins.)	Length (ins.)	Vol. (cu. ins.)
BH 213	.8	5.1	1.8
BH 313	1.2	5.1	4.8
BH 408	1.5	3.0	4.3

The first CFS trials were conducted in 1972 and consisted of three areas each of jack pine and white spruce. Trials comprised approximately 500 seedlings and the sites were prepared by barrel scarification and in one case scalping prior to planting.

Survival of 1972 and 1973 CFS trials and one 1970 Manitoba government trial are shown in Appendix 3. Dry weights are also shown for average seedlings on each trial following planting. It will be noted that size of seedlings was largest in 408 containers followed by 313 and 213 respectively. Seedling size is a reflection of diameter and volume of the container.

Figure 6 compares average total dry weights of paper pot jack pine seedlings 3

years after planting (1973) with the average total weights of jack pine 3 - 0 stock lifted from the Pinelands Nursery, Manitoba in 1973. [4] The large size of the paper pot seedlings from this limited trial is impressive.

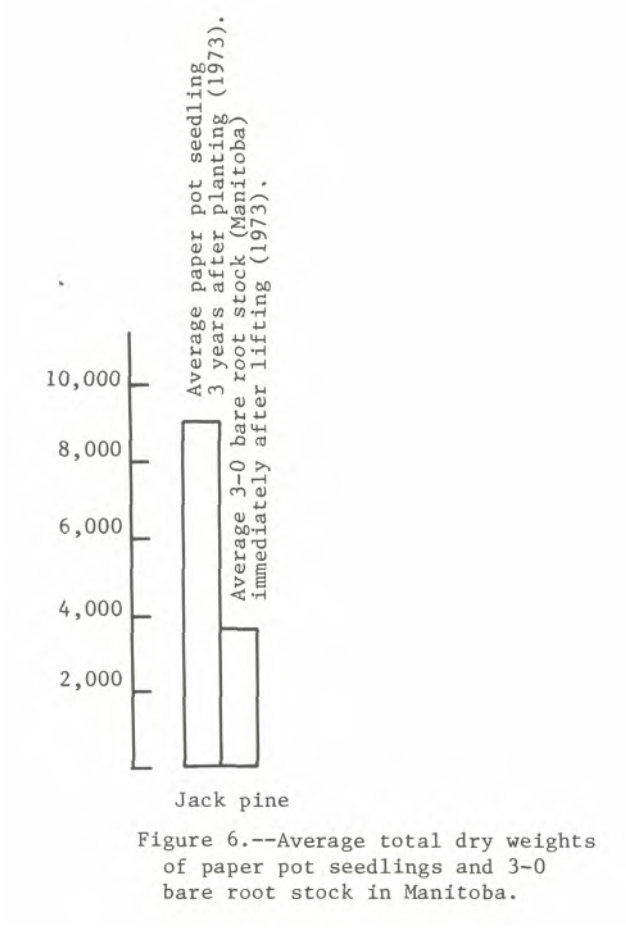

Figure 6.--Average total dry weights of paper pot seedlings and 3-0 bare root stock in Manitoba.

4. Spencer-Lemaire Book Planter

This system is presently in operational use by North Western Pulp and Power Ltd. and by the Alberta Department of Lands and Forests. Seedlings are greenhouse-reared for four weeks and cold-framed 10 weeks for pine and 16 weeks or spruce. During cold-framing seedlings are watered as required and fertilized weekly. In addition to rearing stock for the current year's planting requirements some stock is over-wintered.

CFS is involved in an assessment of the system in North Western Pulp and Power lease holdings. Plots were established in the 1972 plantings and first-year survival data are available. Unfortunately further performance data from large field trials were not available for this report.

First-year survival of the Spencer-Lemaire seedlings is encouraging (Appendix 4).

4 Data from quality monitoring studies L. Carlson, CFS Edmonton.

CONCLUSIONS

Unfortunately this symposium is about two years early for the presentation of adequate 3 to 5 year performance data from the prairie provinces. Based on available CFS trial data the best performance has been from container systems in which the container is removed from the seedling prior to planting or degrades shortly after planting. Most of these systems have shown satisfactory early performance and are regarded with cautious optimism.

Given equal rearing schedules, container diameter and volume, and rooting medium there is little apparent difference in the early performance of the systems used. There are drawbacks associated with some systems which limit their operational use. Early compaction problems and difficulty in removing the casing were noted with the RCA sausage container. The former difficulty seems to have been overcome but there are still problems with the latter which should not be insurmountable. Spiralling of roots in the Styroblock was a problem but this has been overcome by structural modification of the container. Rooting between chambers of the Spencer-Lemaire book planter has been eliminated or greatly reduced. These are examples of problems which have been associated with container rearing and a great many of them have been resolved through research and development programs.

Each container system has its proponents and the selection of a system must be based on operational and economic considerations with special regard to performance information.

These trials suggest that container planting in the "plug" form or using biodegradable containers may be a viable and economically attractive reforestation method which is well suited to mechanization in rearing and planting -- a feature which is important considering today's decreasing labour force.

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APPENDIX 1

PERFORMANCE OF STYROBLOCK SEEDLINGS

Year trial est.	Species	Location	Number planted	Performance: Av. tot. dry wt. at planting Mgs.	1 year after planting: Av. tot. dry wt. Mgs.	1 year after planting: Survival %	2 years after planting: Av. tot. dry wt. Mgs.	2 years after planting: Survival %	3 years after planting: Av. tot. dry wt. Mgs.	3 years after planting: Survival %	Remarks
1970	Lodgepole pine	Lesser Slave Lake, Alberta	400	656		96			5,236	90	
"	"	Whitecourt, "	400	605		97			14,490	69	
"	"	Peace River "	400	547		18			1,672	16	100% rabbit browsed 1972-73
"	"	Edson "	600	589		89			3,106	80	
1971	"	Bow Forest "	2,000	393	683	59					Severe drought
"	"	Whitecourt "	2,000	399	1,779	90					
"	"	Grande Prairie, Alberta	2,000	439	528	18					Severe rabbit damage
1972	"	Crowsnest "	2,000	386	1,237	78					
"	"	Bow Forest "	2,000	393	683	93					
"	"	Whitecourt "	2,000	604	1,360	95					
"	"	Grande Prairie	2,000	416	2,379	99					
"	"	Watson Lake, Yukon	600	593	1,233	92					
1970	Jack pine	Lac La Biche, Alberta	400	675		80			5,870	70	20% rabbit browsed 1972-73
1972	"	Liard, Yukon	2,800	593	1,233	96					
"	"	Ft. Smith, N.W.T.	2,000	500	970	93					
"	"	" "	2,000	431	1,064	89					
"	"	Sandilands, Manitoba					1,347	71			
"	"	1/2 Way Tower Sandilands, Manitoba	485			69	3,249	66			
"	"	Candle Lake, Sask.	160				8,764	97			
1973	"	Sandilands, Manitoba	415		2,273	99					

(Continued, next page)

APPENDIX 1 (continued)

PERFORMANCE OF STYROBLOCK SEEDLINGS

Year trial est.	Species	Location	Number planted	Av. tot. dry wt. at planting Mgs.	Performance: 1 year after planting — Av. tot. dry wt. Mgs.	1 year after planting — Survival %	2 years after planting — Av. tot. dry wt. Mgs.	2 years after planting — Survival %	3 years after planting — Av. tot. dry wt. Mgs.	3 years after planting — Survival %	Remarks
1973	Jack pine	Sandilands, Manitoba	380		1,351	99					
"	"	" "	405		1,810	99					
"	"	" "	370		2,335	97					
1970	White spruce	Lac La Biche, Alberta	600	540		98			2,772	95	
"	"	Lesser Slave Lake "	600	531		99			4,908	98	
"	"	Whitecourt "	600	494		98			4,430	74	
"	"	Peace River "	600	462		68			1,572	60	Heavy rabbit damage
1971	"	Whitecourt "	2,000	241	637	61					
"	"	Lac La Biche "	2,000	170	463	44					
"	"	Footner Lake "	2,000	278	873	96					
1972	"	Whitecourt "	2,000	241	637	92					
"	"	Lac La Biche "	2,000	170	463	97					
"	"	Grande Prairie "	2,000	282	575	97					
"	"	Footner Lake "	2,000	413	1,287	98					
"	"	Candle Lake, Sask.	160				3,348	92			
"	"	Ft. Smith, N.W.T.	2,000	395	806	93					
"	Engelmann Spruce	Crowsnest, Alberta	2,000	286	900	78					
"	Black spruce	Watson Lake, Yukon	600	583	858	75					
"	"	Liard "	2,600	583	858	93					

I. Av. tot. dry weight
based on random selection of 10 - 20 seedlings.

APPENDIX 2

PERFORMANCE OF RCA SAUSAGE SEEDLINGS

Year trial est.	Species	Location	Number planted	Av. tot. dry wt. at planting Mgs.	Performance: 1 year after planting — Av. tot. dry wt. Mgs.	1 year after planting — Survival %	2 years after planting — Survival %	3 years after planting — Av. tot. dry wt. Mgs.	3 years after planting — Survival %	Remarks
1971	Lodgepole pine	Bow Alberta	2,000	437	892	47				
"	"	Whitecourt "	2,000	502	2,009	97				
"	"	Grande Prairie "	2,000	632	767	22				Severe rabbit browsing
1972	"	Crowsnest "	2,000	304	682	70				
"	"	Bow "	2,000	267	562	94				
"	"	Grande Prairie "	2,000	257	1,224	99				
1972	Engelmann spruce	Crowsnest "	2,000	206	704	53				
1971	White spruce	Lac La Biche "	2,000	187	740	57				
"	"	Grande Prairie "	2,000	378	860	40				
"	"	Footner Lake "	2,000	382	1,085	96				
1972	"	Whitecourt "	2,000	359	768	86				
"	"	" "	2,000	182	790	92				
"	"	Grande Prairie "	2,000	155	651	96				
"	"	Footner Lake "	2,000	174	579	92				

APPENDIX 3

PERFORMANCE OF PAPER POT SEEDLINGS

Year trial est.	Species	Location	Number planted	Av. tot. dry wt. at planting Mgs.	Performance: 1 year after planting		2 years after planting		3 years after planting		Size of Paper Pot
					Av. tot. dry wt. Mgs.	Survival %	Av. tot. dry wt. Mgs.	Survival %	Av. tot. dry wt. Mgs.	Survival %	
1971	Jack pine	Sandilands, Man.	2,000			97			9,022	83	213
1972	" "	Belair "	530				2,200	59			408
"	" "	Marchand "	505			71	1,752	68			408
"	" "	Sandilands "	460			55	3,035	51			408
1973	" "	" "	105		1,974	99					408
"	" "	" "	370		731	97					313
"	" "	" "	455		531	97					213
"	" "	Piney "	325		295	91					213
"	" "	" "	330		597	93					313
"	" "	" "	105		1,810	100					408
"	" "	Sandilands "	305		637	93					313
"	" "	" "	330		357	97					213
"	" "	" "	95		1,491	100					408
"	" "	" "	410		831	97					313
"	" "	" "	415		502	96					213

APPENDIX 4

1st YEAR SURVIVAL OF SPENCER-LEMAIRE SEEDLINGS
(NORTH WESTERN PULP AND POWER LTD., HINTON, ALBERTA)

Plot	Species	No. trees on plot	Location	Year Planted	Survival Fall 1973
1	Lodgepole pine	100	Camp 6	1972	58
2	White spruce	100	"	"	72
3	" "	100	"	"	86
4	Lodgepole pine	100	"	"	93
5	" "	100	"	"	90
6	" "	100	Camp 29	"	99
7	" "	100	"	"	97
8	" "	100	Camp 7	"	95
9	" "	100	"	"	97