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Forestry Report

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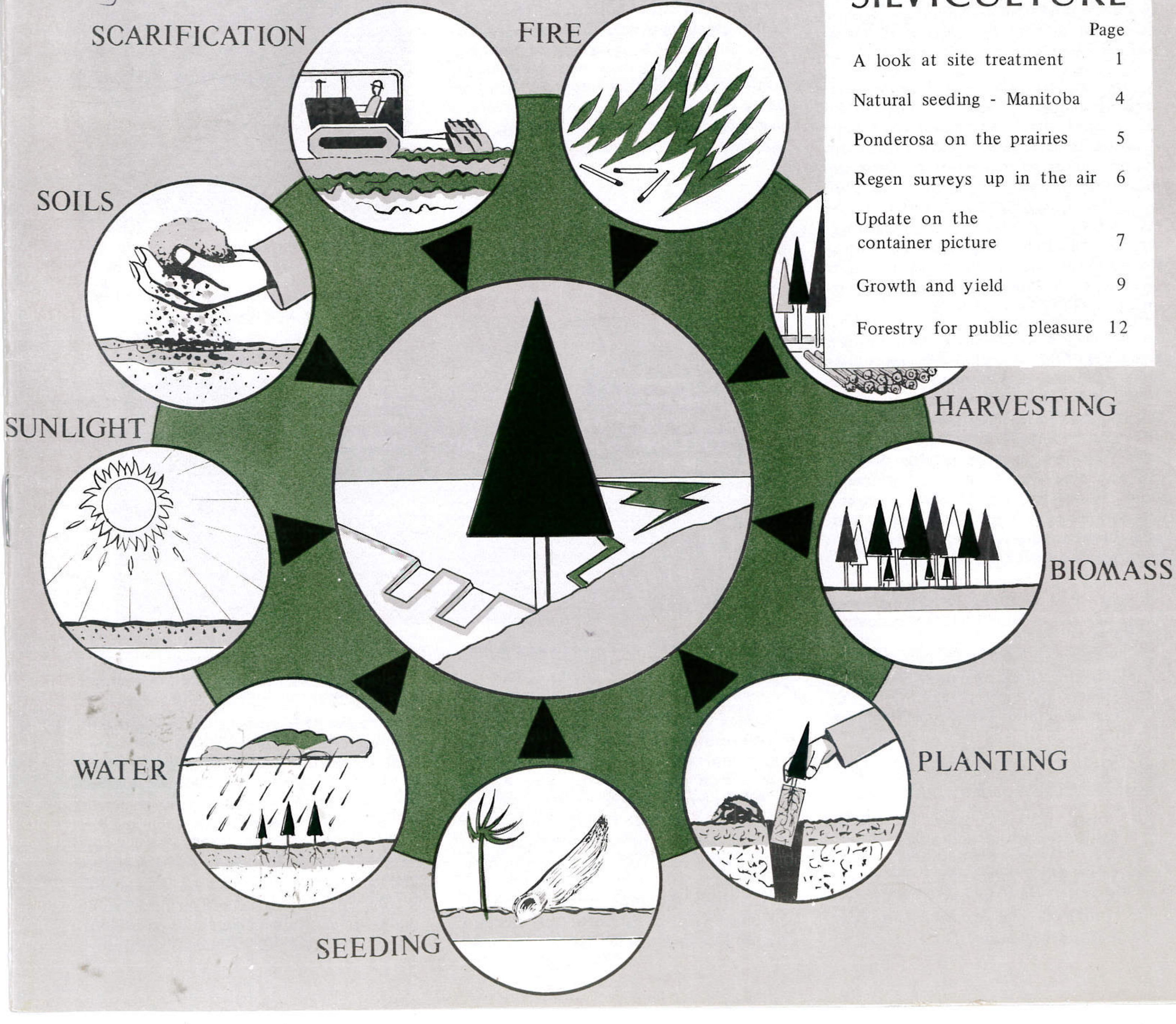


A LOOK AT SITE TREATMENT

SCARIFICATION SUCCESS...

SASKATCHEWAN

In 1967, the first and, so far, only pulpmill in the province was established near Prince Albert. Public concern focused on this large mill, particularly on the ecology of the 47,000 square kilometers to the north of Prince Albert where timber would be harvested to supply it. Public criticism of clearcutting and reforestation practices prompted early development of a silvicultural technique suitable for regenerating the large clearcuts that were soon to appear.

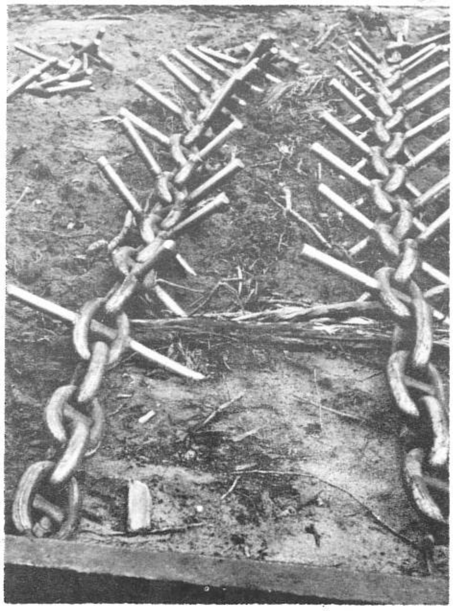
In 1967 the Canadian Forestry Service initiated a series of demonstrational trials using barrel and anchor chain scarification of jack pine clearcuts to obtain natural jack pine regeneration. These demonstrations in 1967, 1968, and 1969 showed that jack pine cutovers could be successfully regenerated from seed available in the slash. Operational scarifications by the pulp company commenced in 1969. Over 7500 ha have been so treated to date (December 1974).

In 1974 the Canadian Forestry Service carried out an appraisal of approximately 2000 ha of the areas scarified in 1969, 1970, and 1971 in order to evaluate the results of the operational treatments on various sites in the region. The areas examined are representative of typical jack pine sites found in the Mixedwood Forest Section of Saskatchewan. The topography, in general, is gentle and well suited to the anchor chaining treatment using rubber-tired skidders.

Sequential sampling techniques using 81-ha blocks and $4m^2$ quadrats indicated:

1. Five of six areas showed softwood stocking (predominantly jack pine) greater than 40 percent. Many areas were also well stocked with aspen.
2. Stocking increased with scarification intensity.
3. Areas treated 5 years previously were over 90 percent stocked.
4. Thirty-three percent of the quadrats in the 5 year old scarifications contained ten or more jack pine stems per quadrat. This dropped to fifteen and ten percent, respectively, in the 1970 and 1971 scarifications.

These results suggest that softwood stocking improves for at least three years following scarification. This is in direct contrast to the planting alternative where stocking usually declines through mortality. It is suggested, therefore, that scarification is the most suitable method of reforesting these jack pine types when sufficient seed is available in the slash. However, if tendencies toward overstocking continue with future scarifications it may become necessary –on some areas-- to decrease treatment intensity. Also, because stocking may increase for at least 5 years following treatment, final stocking estimates should be postponed accordingly.



NORTHERN MANITOBA

Anchor chains have become the principal scarifying tool in northern Manitoba.

Since the establishment of the Manitoba Forestry Resources pulp and sawmill complex (formerly known as Churchill Forest Industries) at The Pas in 1970, cut-over acreage in the Northern Region has increased rapidly from about 1200 ha per year before 1969 to an average in excess of 8,100 ha per year to date.

In 1968 the province of Manitoba embarked on a program of scarification on cutovers to promote natural regeneration. Since that year an increasing amount of acreage has been scarified, from about 40 ha in 1968 to about 2,800 ha in 1974. Initial scarification was by means of shark-finned barrels, but since 1970 ground preparation has been done exclusively with anchor chains, with all areas receiving the same treatment intensity. The earliest scarified cutovers were mostly the drier more accessible jack pine types. In subsequent years, when anchor chains became the principal scarifying tool, an increasing acreage of spruce cutovers was also treated.

A preliminary regeneration survey was carried out in 1973 by the Canadian Forestry Service personnel in Winnipeg on areas which had been cut over and scarified during the period 1968-70. Considering a stocking of 40% acceptable, it was found that the amount of regeneration of jack pine cutovers was generally more than adequate. On the spruce (both black and white) types regeneration stocking was generally below the acceptable level except where jack pine had also been present in the stand. These findings agree in general with those of Provincial personnel on recent cutovers.

It was concluded from the survey that on some of the jack pine types, scarification might not have been needed, or at least not to the intensity carried out, whereas on some of the spruce cutovers, the ground preparation was not adequate, assuming that the slash had provided enough seed for adequate restocking.

The possibility of relying on seed from the uncut stand to regenerate spruce cutovers was investigated in 1974. On areas scarified 4 to 5 years previously spruce regeneration was noticeable to about 45 meters from the stand edge. Cutovers up to 10 years old in eastern Manitoba had seeded in to a distance of 90 meters. Therefore, when the cuts are not too extensive, eventual restocking may occur from the edges, particularly on the wetter spruce sites, even if initial regeneration after treatment is inadequate. On some of the spruce types where regeneration fails, consideration may have to be given to different scarification techniques.

By categorizing cutovers according to pertinent factors such as regeneration success, scarification chance (amount of slash, topography, soil type, etc.) and scarification techniques, guidelines will be developed to assist the forest manager in selecting optimum regeneration methods.

SCARIFICATION — NOT WHAT YOU DO BUT HOW YOU DO IT

It is suspected that the physical nature of heavy clay loam tills impedes root development of white spruce seedlings and adversely affects height growth. An experimental planting was estalbished in the Riding Mountain National Park, Manitoba in 1963. Four different planting media were prepared: 1) all soil down to the B horizon removed with a bulldozer (scalped), 2) treatment as in (1) and the B horizon cultivated by spading, 3) entire soil profile mixed by spading, and 4) no disturbance.

On each treatment 90 white spruce transplants (2-2) were planted in May of 1963. The experiment was replicated in 1964 and 1965. Since ground vegetation presents the serious competition to tree growth on undisturbed clay loam tills it was removed manually during the years subsequent to planting.

Heights of surviving white spruce and the length of the terminal shoot were measured in 1973.

Average height and leader length (cm) by treatment in 1973

	(1) scalped	(2) scalped & spaded	(3) spaded	(4) control
		1963 plantation		
Avg. height	91	112	142	157
Avg. leader length	10	11	15	17
		1964 plantation		
Avg. height	76	86	132	109
Avg. leader length	8	7	12	11
		1965 plantation		
Avg. height	104	140	178	147
Avg. leader length	12	14	26	21

Within the scalped and non-scalped treatments the spaded treatments generally produced taller trees than the non-spaded treatments (compare 1 with 2, and 3 with 4). Therefore, it would seem that cultivation, by improving the soil structure, did improve height growth (possibly through improved root development). However, the negative effect of scalping apparently overrides the benefical effect of cultivation when the scalping and spading treatment are combined. Height growth following removal (scalping) of the organic layers and the A horizon (which contain a major protion of the nutrients essential for tree growth) was significantly less than that following spading alone or no treatment.

PRESCRIBED BURNING — LIMITED SUCCESS ON PINE SITES IN SOUTHEASTERN MANITOBA

Site preparation is a major part of the regeneration program in jack pine management and any means of reducing costs in this area is welcome. The successful use of fire in jack pine and red pine management in the Lake States encouraged foresters in Manitoba to incorporate burning into their regeneration program. Although the most common jack pine sites in southeastern Manitoba are more impoverished, in the terms of soil and moisture conditions, than the successfully treated sites of the Lake States, there was initially no reason to expect poor results in Manitoba. Unfortunately, although costs were low, success was limited. Attempts at seeding failed and planting success, while variable, was generally unsatisfactory. A number of studies have subsequently provided enlightening information to the burning program.

There is considerable area of pine-aspen-birch stands in southeastern Manitoba. These stands support considerable understory and concentrations of jack pine slash are sporadic after harvesting. Heavy green vegetation cover reduces fire spread and temperature Burning encourages a large increase in numbers of shrubs, herbs and hardwood sprouts; aspen, raspberry, rose and snowberry, along with various herbs and grasses constitute severe competition to regeneration one year after burning.

On dry and moderately fresh sites supporting pure stands of jack pine more severe fires, and thus increased mineral soil exposure, can be achieved. However, on the sandy, well drained sites of southeastern Manitoba such fires produce no lasting beneficial effect (albeit there is no serious site deterioration).

Continued Page 4

PRESCIBED BURNING *Cont'd.*

The destruction of nutrients by fire, or post-burn removal from the burned organic mantle by leaching, was originally a consideration of great concern. However, losses of major elements, with the exception of nitrogen, were more than adequately offset by additions from slash and vegetation destroyed during burning. Nutrient levels in mineral soil were virtually unchanged by burning. In the spring following late summer burns nutrients were at pre-burn levels. It is thus apparent that burning will not provide increased soil nutrient levels over a period long enough to be of any significant benefit to jack pine re-regeneration.

Burning does not improve environmental conditions for germination and establishment. The microclimatic environment created by high hazard burning is very severe. Surface temperatures are high and prolonged periods of critical temperatures are common on all major seedbeds created by the burn. Moisture conditions of the burned areas are less favorable than on scarified areas; moisture content of burned soils is decreased at a significantly greater rate than that of scarified soils and is much more variable over a given area. Over prolonged rainless periods or periods of light precipitation, both common in southeastern Manitoba, a scarified area would provide greater protection from drought and heat mortality than a burned area.

Many potentially competitive vegetation species are greatly reduced by severe burning, while others, such as rose and snowberry, are increased. At least one year or more of reduced competition can be expected on moderately fresh sites following burning. By the second year, however, some shrubs, such as blueberry, and grasses and sedges recover considerably and may provide severe competition in local areas, even through much of the burn is still relatively free of vegetation. Where species such as bracken fern, snowberry or rose dominate the site even severe burning will increase competition. On dry sites, where bearberry dominates and other shrubs are less important in the vegetative cover, severe burning will undoubtedly provide several years of much reduced competifion.

The results of these studies do not support a recommendation for the use of high intensity prescribed burning as a silvicultural tool on the most common jack pine sites (moderately-fresh and dry)
vicultural tool on the most common jack
pine sites (moderately-fresh and dry) in southeastern Manitoba. Scarifacition would generally have to be carried out following burning, particularly on the moderately fresh site or where seeding is planned, so that very little cost benefit would be realized. The present practice of drum chopping followed by scarification provides nearly as much hazard reduction and at least as long a competition free period as burning. The question then becomes, can burning be carried out more cheaply than drum chopping? The more favorable microenvironment created by scarification makes it the logical choice of site preparation in southeastern Manitoba. Cost benefits of burning alone may well be offset by regeneration failure.

A single burn will control vegetation on dry, unproductive sites (A) but increases vegetation growth on more productive sites (B).

NATURAL SEEDING POSSIBILITIES FOR SOUTHEASTERN MANITOBA PINES

Two conifer species are important to the forest industry of southeastern Manitoba; red pine and jack pine. As nursery production and planting costs increase, foresters are looking more toward direct or natural seeding possibilities. Red pine would seemingly offer the best chance for regeneration from natural seedfall. Studies in the Lake States have shown that good seed crops are produced every 3 to 7 years. However, this pattern seemingly does not exist in Manitoba,

Thinning red pine stands can be an economical means of stimulating seed production.

perhaps because the area is at the edge of the species range, where climatic and biological factors become limiting. Management for natural regeneration in this area, based on prediction of good seed years would be risky. However, studies in southeastern Manitoba and the northern states have indicated that thinning in red pine may stimulate seed production, encouraging the possibility of creating red pine seed production stands or seed orchards to supply seed for direct seeding. In fact, this possibility is now being tested in Manitoba.

Jack pine cones are serotinous in habit, and therefore do not disseminate their seed readily. The serotiny is less pronounced in the southern part of the range and in open-grown trees, thus the possibility of natural seeding from stand edges was investigated. However, seedfall from 20-, 40-and 60-year-old stands of both low and high density proved to be negligible, seldom greater than an ounce and a half (≃1300 seeds) of sound seed per acre. Scalped spots under the study stands were rarely more than 10% stocked and generally produced no seedlings.

Although the serotinous cone habit defeats the possibility of natural seeding from standing trees, it is a valuable characteristic which can be usefully employed in regenerating clear-cut areas. Provided that the cones are on, or within four inches of the ground, heat from the soil surface will melt the resin bond holding the cone scales together and seed is released. As much as 6 to 10 lbs of seed per acre may be released in this manner, with viability probably better than 70%. While only 2 to 5 lbs of this seed is released in May and June, months of high germination potential, studies have shown that germination of seed released late in the year is high in years subsequent to dispersal. Thus, by using scarification techniques which spread and compress slash, jack pine regeneration may be successfully accomplished on many sites without the high cost of planting.

Cone-bearing slash - a valuable seed source on scarified jack pine cutovers.

PONDEROSA PINE — A PRAIRIE HOME FOR A MOUNTAIN SPECIES?

Ponderosa pine has one of the largest natural ranges of North American conifers and exhibits great genetic variation. Consequently it is extensively use for aesthetic and shelterbelt plantations far beyond its natural range.

A study of ponderosa pine from the eastern portion of its natural range, to test the adaptability of some 80 provenances for the Great Plains, was begun in 1962 by the U. S. Forest Service. The Canadian Forestry Service, Northern Forest Research Center cooperated by establishing a plantation near Drumheller during 1968 and 1969 to provide data for the major U.S. research study and also to determine which sources would be most promising for Alberta conditions.

In 1968, 90 bare rooted seedlings (2 + 1) from each of 69 provenances - almost all originating east of the continental divide - were received from Nebraska and lined out because of severe drought conditions in the prepared permanent field location. The planting stock was irrigated twice and first year survival was about 80%. A few sources from southern locations such as New Mexico showed severe winter damage in 1969.

Transplanting of stock, including some newly arrived replacement stock from the North Dakota State Nursery, to the permanent field location began in 1969 and was continued in 1970. Survival of replacement plantings stock from the line out field was found to be very poor during 1970 and 1971, because of decreasingly poor quality of seedlings available, and transplanting was halted.

Weed competition was very severe and herbicides were used with mixed success. Cumulative effect of chemical applications caused severe damage and and unexpected losses during 1972/73. However, surviving seedlings are now growing very well.

Survival, vigor and growth data were collected in 1972 and 1974. Preliminary analysis of data ranks the various sources on a point scale ranging from 10 to 500 points based on survival and current vigor and condition. The quality point average for the two fields involved was combined and was 134 points with an average survival of 49%. The ten best sources showed survivals of from 72% to 95% with vigor and condition ratings averaging from 1.6 to 2.2 (1.0=excellent, 2.0=good, 3.0=fair).

A full report on establishment, survival and growth is in preparation and although it is still too early to make predictions for the future of this species, the results should be of interest to anyone considering ponderosa pine as an ornamental, shelterbelt or timber species in the Prairies Region.

Ponderosa pine can be an attrative ornamental on the prairies.

A PLACE FOR AERIAL PHOTOGRAPHY IN REGEN SURVEYS?

The use of large-scale (1:500) color aerial photographs to assess forest regeneration that is taller than 30 cm is possible. This may be a useful tool for the forester who is annually faced with the task of examining thousands of hectares of cutover and burned-over forest lands in areas where access is a problem.

A test aerial survey undertaken in the spring of 1973 on the east slopes of the Rocky Mountains in cooperation with N.W. Pulp and Power Co. Ltd. showed enough promise for a more elaborate trial to be planned. During October, 1973, in cooperation with the Manitoba Dept. of Mines, Resources and Environmental Management, additional large-scale photography was obtained of an area located approximately 65 km north of Lac du Bonnet in Manitoba.

The test area is a mixture of low-lying bogs and stands of black spruce and tamarack, interspersed with higher sandy and rocky areas of white spruce, jack pine, aspen and birch. Flight lines were located over clear-cut sites in the area. Photography was done using Kodak Aerocolor Negative (2445) 70 mm film, with a Vinten camera equipped with a 15 cm lens. Two scales were flown: 1:1000 and 1:500. The latter scale, which covers 0.04 ha on a stereo triplet, was judged most suitable.

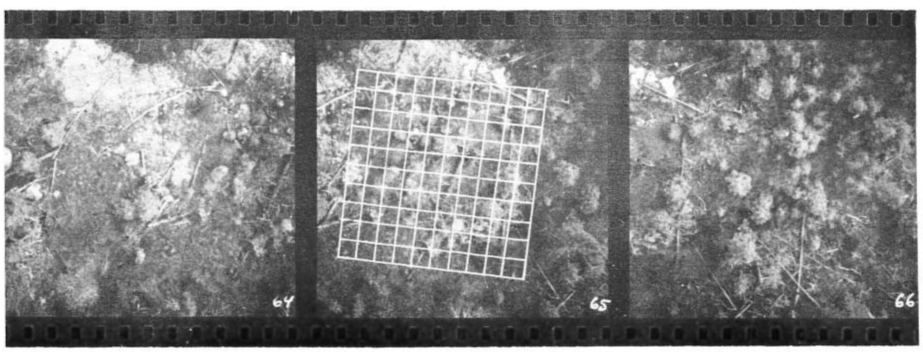
Timing of the photography is critical. It is only during a short period in the spring and in the fall that deciduous vegetation is leafless and the absence of snow cover makes it possible to detect small trees that normally would be hidden. High overcast, pervailing at the time of photography, was judged to improve picture quality by eliminating strong confusing tree shadows. To provide ground truth, ten 0.04 ha plots were located on sites selected from the aerial photographs. Within these plots all trees 15 cm and taller were measured and tabulated by species.

The first consideration was to find out how well regeneration of varying height could be detected on the aerial photographs. Only 13 per cent of the trees between 33 and 61 cm and 70% of the trees between 63 and 91 cm were detected. A similar test conducted at Hinton, Alberta, showed 63 to 100% detection depending on background, for trees 33 to 61 cm tall. Using paired ground and photo plots average stocking on the ground was 42.6% while on the photo it was 32.6%. This difference in the photo sampling may be corrected for any survey by a regression equation which relates photo stocking to ground stocking.

Present results indicate that large-scale photo samplings may be used to assess regeneration that is 30 cm in height and taller on large areas. Areas that are stocked on the basis of airphoto counts should not require additional ground survey because not all seedlings are visible on aerial photographs.

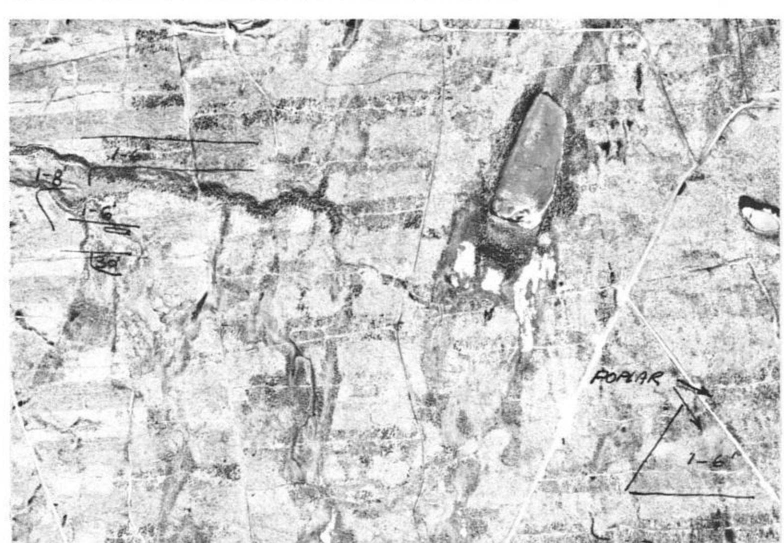
Areas that are not considered stocked from airphoto counts would require double sampling with regression. On the basis of this test it is estimated that for this particular area one ground plot for every ten photo plots would be required to give the most precise and accurate estimate of regeneration at least cost. The precision of ten 0.04 ha photo plots was equalled by 100 randomly spaced 4m^2 quadrats on the ground. The estimated cost for a 0.04 ha photo is $3.00.

In addition the use of small-scale photography may also be used to pre-stratify the area in question for further improvement in sampling design.

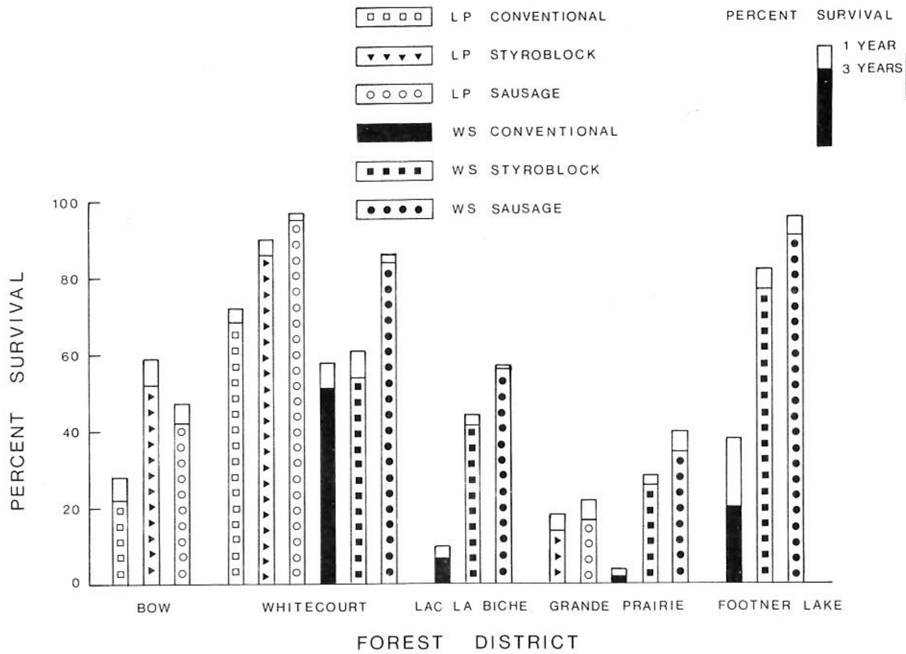


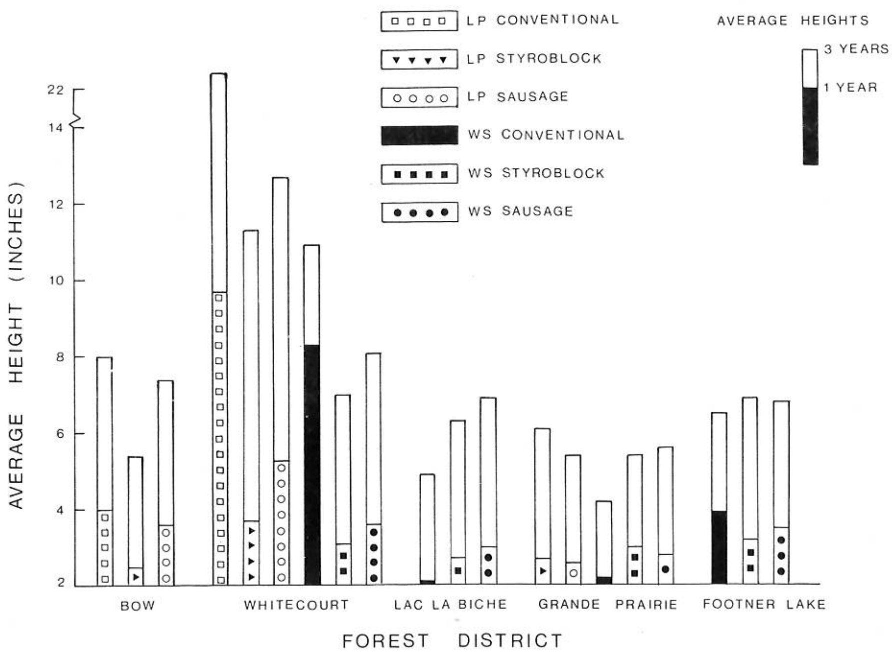
Enlarged 70mm. Kodak Aerocolor photo showing 0.04 ha plot divided into 4m^2 quadrats.

An example of small scale aerial photography of a large clearcut where stratification of regeneration success is possible.



A PLUG FOR THE CONTAINER PROGRAM



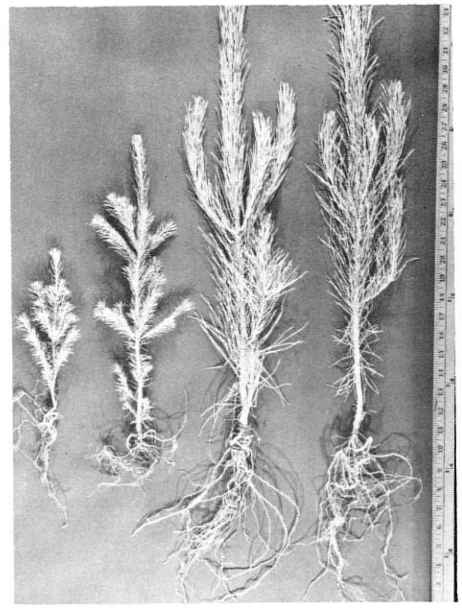


Container planting utilizing a "plug" type seedling was introduced to Alberta in 1970. Three-year results from a small scale Styroplug planting trial were reported by Walker and Johnson (Envir. Can., For. Serv., Inform. Rep., NOR-X84, 1974). In 1971 large scale trails were initiated in five forest districts of Alberta to assess survival and growth of spruce and pine grown in the BC/CFS Styroblock and the Research Council of Alberta Sausage Container. These trials were replicated in 1972 and 1973 and expanded to include a sixth forest district.

Seedlings were reared for a ten week period in the greenhouse and then placed in outdoor cold frames for a further six weeks prior to planting. Weekly applications of fertilizer were made after three weeks in the greenhouse followed by two more applications in the cold frames. Planting took place during July and August of 1971. A small number of conventional bare root stock (3-0) was planted at each location to serve as a comparison with the container seedlings.

Survival of the 1971 container seedlings after three years has been generally excellent in the Whitecourt and Footner Lake Forests (77-95%), fair in the Bow and Lac La Biche Forests (41-56%), and Poor in the Grande Prairie Forest (14-35%). The trials show that after the first year mortality was not substantial. The variability in survival and growth between Forests is attributed to rabbit browsing in in the Grande Prairie and Lac La Biche trials, drought after planting in the Bow, and flooding at Whitecourt (Styroblock white spruce only), Lac La Biche and Footner Lake. The 1972 and 1973 replications should offset these variations and the additional results will strengthen conclusions. To date it may be stated that where rabbit damage was not a factor survival has been acceptable. Survival of conventional stock was in all cases lower than for the container seedling.

Frost heaving of the container seedlings was a problem in 1971 and ranged from 1-27% in the Styroplugs and from 15-64% in the Sausage plugs. Planting in very wet areas and planting plugs with the tops above the soil surface are believed to be the chief causes. In 1972 and 1973 the Sausage plugs were manufactured with a lower bulk density and a subsequent reduction in heaving problems was noted. Planting all plugs approximately 1-2 cm below the soil surface with a small amount of soil pressed over the plug top would largely eliminate any future problems.



White spruce (left) and lodgepole pine (right) container seedlings three years after outplanting.

SURPLUS CONTAINER STOCK? — OVER WINTER

It has been found that for various reasons considerable numbers of container seedlings may be left over at the end of a planting season. To prevent waste or destruction of valuable planting stock, it is necessary to over winter these seedlings and then plant them the following year.

In 1970, a trial was undertaken to compare the performance of over wintered lodgepole pine with first year stock. The trial was conducted at the Kananaskis Forest Experiment Station in the Sublapine Forest Region, 80 km west of Calgary. The site selected was a recently burned over cut block on an old terrace of the Kananaskis River. Due to burning, vegetative competion at time of planting was minimal. Two types of containers were used: the "Ontario" split-plastic tube (1.9 cm diameter x 8.25 cm long) and the "Conweb tube" (a cylinder of 0.3 x 0.3 cm polyethylene mesh, 2.5 cm diameter x 7.5 cm long).

The over wintered stock was sown in early July, 1969, grown in the greenhouse for 6 weeks, and set out in a cold frame to harden off and over winter. Losses due to over wintering were estimated to be less than 5%. The first year stock was sown in early May, 1970. At 6 weeks it was taken out of the greenhouse and hardened off for 2 weeks prior to planting on the 1st of July 1970.

Data on shoot height and shoot dry weights were taken prior to planting in 1970 and in September, 1974 at which time a survival tally was taken. Generally survival was good, and after 4 years was as follows;

1. "Conweb" over wintered 93%
2. "Conweb" 1st year 88%;
3. "Ontario" over wintered 84%;
4. "Ontario" 1st year 71%.

		Conweb Over wintered	Conweb 1st year	Ontario Styrene Over wintered	Ontario Styrene 1st year
Pre Planting 1970	Shoot Height (cm)	5.8	3.2	7.0	3.1
	Shoot Dry Weight (gm)	0.29	0.06	0.28	0.04
1974	Shoot Height (cm)	37.7	24.7	21.3	20.4
	Shoot Dry Weight (gm)	28.18	13.16	9.06	9.16

At time of planting container type had not visibly affected seedling performance. Over wintered stock was significantly larger than first-year stock, as would be expected. After four growing seasons the stock size difference was maintained in "Conweb" containers. In "Ontario" containers the first-year stock outperformed over wintered stock and after four years no size difference was apparent. The type of container used (Conweb vs Ontario) had no effect on the performance of first-year stock. However the over wintered Conweb stock had clearly out performed the over wintered Ontario stock after four years.

In order to meet nursery production quotas and make optimum use of greenhouses, some operators may in the future continue greenhouse operations into late summer, over winter the stock, and plant the following year. In planting areas where vegatative competition is a factor, planting an initially larger seedling, such as over wintered stock, may be beneficial. If the container allows good, early root egression, (a visual inspection in the field showed this to be quite probable with the "Conweb" container) over wintered stock may be the best choice for such areas

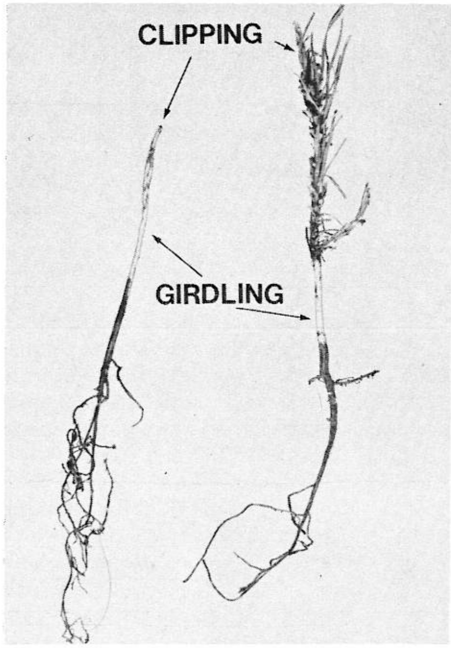
GRASSHOPPERS WORKING OUT OF THEIR FIELD

Reforestration by means of container stock, utilizing the Japanese paperpot, has run into a serious snag in southeastern Manitoba. Container-grown seedlings of jack pine and red pine, generally 12 to 16 weeks old when outplanted, were heavily damaged during the summer of 1974 by grasshoppers, although the cause was not demonstrated until later. The damage occurred from late June to September and showed as chewed and girdled stems, stems clipped off and/or needles chewed.

After initial damage to the seedlings was detected a number of test plots of 100 plants of each species was set out at the end of July. Both species showed a mortality of up to 80% within two weeks after planting. Damage continued at a reduced rate on additional plots established in early September.

Large numbers of grasshoppers were evident on all planting sites. To further ascertain that damage was indeed caused by grasshoppers, a collection of adults was made on September 13 and placed in cages containing 14-week-old jack pine seedlings in the laboratory. The collection contained six species, four from the genus Melanoplus and one each from Camnula and Dissosteira. The grasshoppers were observed feeding on the seedlings and after several days all phases of damage, as observed in the field, showed up in the cages. During the periodic examination of the cages grasshoppers that were observed actively feeding were collected. These were identified as three of the Melanoplus species (bivittatus, bilituratus and borealis).

Preliminary observations indicate



Severe grasshopper damage to container seedlings.

that only first year seedlings are affected. Container seedlings planted in late September of 1973 adjacent a 1974 damaged area showed no grasshopper damage. Also, damage occurred more rapidly on heavily vegetated sites. However, ultimate mortality may not be affected by amount of ground vegetation.

In developing control measures, consideration should be given to the following: (1) various species of grasshoppers are involved and feeding occurs from July (and probably up to 2 weeks earlier) to the first killing frost in the fall; (2) holding the seedlings over winter, and planting out as 2-year-olds, may greatly reduce damage. However, the objective of a container program is partly defeated with the method, plus the transgression of roots between containers becomes a serious problem; (3) although grasshopper populations peak only about every 10 years, 3 to 4 succeeding years with a high and therefore damaging population can be expected.

A persistent repellent would present an ideal control. Before shipment from the nursery seedlings could be sprayed and thus be given protection for the first year. However, no such repellents are known to date. Canadian Forestry Service personnel at the Winnipeg office are planning a number of laboratory and field trials in 1975 with the objective of developing suitable control measures.

WANT TO IMPROVE CONTAINER SEEDLING GROWTH? SHAPE UP!

Understanding the effect of container volume and shape on the growth of seedlings is essential to the economics of container seedling production. The main objective is to produce the largest seedling in the shortest possible time. Generally, the initial rearing phase must be done in greenhouses and this consideration, together with convenience of transportation and field handling, places limits on the size (especially diameter) of container which can be used. Because of this the containers used operationally have generally been small in volume (10cc in the 1960's to 41cc in the 1970's) and consideration for economics and convenience rather than for biological considerations have dominated.

It has been suspected for some time that small rooting volume might seriously inhibit seedling growth during the rearing phase and that limiting the container size might be "false economy". Previous research (Boudoux, M.E. 1970. Dept. Fisheries & For., Bi-monthly Research Notes 26 (3): 29-30 and Scarratt, J.B. 1973. Env. Can., For. Serv., Bi-monthly Research Notes, 29(1); 4-6) indicated that an increased diameter, and thus volume, increased total growth of black spruce, white spruce and jack pine seedlings. If volume only were critical for seedling growth, the economic solution would be to increase the height of the container instead of the diameter. Preliminary studies at the NFRC showed this to be true for increasing lodgepole pine seedling growth. However, research had shown that increasing container height (and therefore volume) did not aid black spruce growth.

Experiments with lodgepole pine demonstrated that larger seedlings are obtained with containers of larger volumes and differences in seedling growth due to container shape is limited to the height: diameter ratio of 1:1. These differences were related to rapid drying of peat in the containers. However the data obtained using white spruce indicated growth increased not only as volume increased, but also as the shape changed (i. e. diameter increased). The different reaction of pine and white spruce to different rooting volumes and container shape can be explained by the natural rooting habit of these species; i.e. pine is a deep rooting species and spruce is a shallow rooting species. This difference in rooting habit is evident even in containers.

The following statements and recommendations can be made with respect to container shape. With the exception of very small containers, diameter does not have a direct effect on the growth of lodgepole pine, only volume of container has that effect. It appears that volume up to 131cc have some effect on white spruce growth and that shape (diameter and height) has a profound effect. Ideally white spruce seedlings would be grown in containers of a 1:1 ratio (12.9cm x 12.9cm) with a volume of 524cc. Neither of these ideals are practical under greenhouse conditions because of space requirements and each species would need a different type of container. One recommended container that could reasonably serve both species, resulting in a relatively large seedling, would be 3.8 cm in diameter and 11.4cm in height having 131cc in volume.

RELIABLE YIELD ESTIMATES FOR LODGEPOLE PINE STANDS

Have you ever been cruising a pure stand of lodgepole pine and wanted a quick, on the site, estimate of total (TCFV) or merchantable (MCFV) stand volume? If so, the following equations may be of interest to you.

$$TCFV(ft^3/ac) = -135.22 + 3.722BA + 0.248\bar{H} + 0.467(BA \cdot \bar{H})$$

$$R^2 = 0.993 \qquad sy.x = 154\ ft^3/ac$$

$$MCFV(ft^3/ac) = 638.08 - 19.540BA - 12.535\bar{H} + 0.758(BA \cdot \bar{H})$$

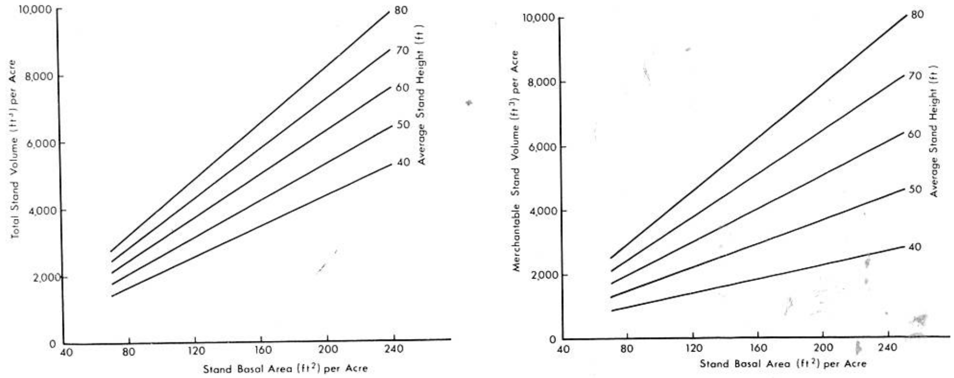
$$R^2 = 0.963 \qquad sy.x = 308\ ft^3/ac$$

where: BA = stand basal area (ft^2) per acre
$\bar{H}$ = average stand height (ft)

The above least-square equations are based upon data from 780 sample plots of essentially pure stands of lodgepole pine ranging in age from 15 to 120 years (stump age) and growing on a wide range of site and density conditions mainly in the Boreal Forest Region of Alberta. TCFV is the cubic foot volume (including the stumps) of all trees per acre larger than 0.5 inches dbhob. MCFV is the volume above a 1.0-foot stump to a 4.0-inch dib top of all trees per acre larger than 4.5 inches dbhob. These equations can readily be reduced to either tabular or graph-

Continued Page 10

ical forms which can be fixed to the cruiser's tally book. Because the relationships are linear, interpolation between classes is simple. Thus the cruiser, equipped with a relascope, or a prism and clinometer can make quick and reliable estimates of total and merchantable yield in the field.



Handy graphical representation of volume-estimate equations.

JACK PINE OR RED PINE FOR SOUTHEASTERN MANITOBA

In the last decade, planting has become a common method of regenerating forest stands throughout Canada. Using this method, the forest manager has a clear choice regarding the species, or mixture of species he will have in his future stands. On some sites his choice may be limited to one species that has a clear advantage over others - e.g., jack pine on sandy, dry sites in the Boreal Forest. On other sites, two or more species may be potentially suitable. Then the manager must make his choice to optimize his objectives. If his objective is maximum fibre yield for given rotation and costs, intelligent planning requires information on growth and yield on given sites for given species.

In the Sandilands Forest Reserve in southeastern Manitoba, sandy, well-drained, nutrition-poor sites with fresh moisture regime constitute an important portion of the total land area capable of producing merchantable forest crop. Because both jack pine and red pine can be grown successfully on these sites, a choice has to be made. Our research provides some needed information.

Eleven years after hand planting 3-year-old stock (2-1 or 3-0) by slit method in southeastern Manitoba we found that:

Proper species selection on planting sites optimizes growth of (a) red pine and (b) jack pine.

(1) Jack pine grew about 30% faster in height than red pine, reaching an average height of 3.3 m compared to 2.6 m.

(2) Jack pine grew over 30% faster in diameter than red pine - to 3.8 vs. 2.8 cm.

(3) The average crown width of jack pine was nearly 50% greater than that of red pine - 2.2 m vs. 1.5 m - at spacings where branch growth was not hindered by crowding from neighbours.

If initial advantage of jack pine conues over the long term, and if greater fibre production is the management objective, jack pine should be favored for planting over red pine on these sites. Information on what spacing to use and some of its implications on stem growth and crown development are summarized in a recent publication, Inform. Rep. - NOR - X 113, which is available on request.

SELECTION THINNING IN JACK PINE STANDS A POSSIBILITY

Overstocked stands of jack pine often become established after a disturbance and require thinning to maintain rapid tree growth and improve merchantable yield. Therefore, in the last 50 years a number of thinning experiments have been established in such stands in Manitoba and Saskatchewan to answer questions regarding the timing (when), the intensity (how much) and the kind (low or crown; pre-commercial or commercial) of thinning that would be required for optimal growth and yield of these stands considering the utilization of the final product. In these thinning experiments, individual trees were between 10 and 60 years of age at thinning, and grew on average and above average sites for the species.

An analysis of data available from all these experiments showed that thinning stimulated diameter growth at all ages and tree sizes. Removing 30% of the basal area in 20 to 30 year old stands on average sites resulted in as much as 25% increment of basal area and total volume 20 to 30 years after treatment. However, manual precommercial thinning is a costly operation (it may require as much as 50 or more man-hours per ha), produces no immediate revenue, and since it results in a relatively minor increase in total volume and cord wood yield at final harvest it is uneconomical. The improvement in total volume and cord wood production would presumably be greater on good sites but would not be sufficient to repay the compounded cost of thinning.

Improvement in board-foot volume production reached 30% at 60 years of age in stands thinned to half of their original basal area at age 20. This improvement is much better than in cord wood volume production, but the compounded cost of thinning would still be still be too high in comparison to the improvement in yield. Moreover, jack pine is used mainly for pulpwood, rather than for lumber.

Precommercial thinning is uneconomical at present...

While precommercial thinning is uneconomic at present, commercial low and crown thinning in middle-aged stands on good sites seems economically feasible. Such a thinning, favoring thrifty dominant and co-dominant trees and removing up to 35% of basal area (reducing 30 m^2/ha to 19 m^2/ha) in vigorous 40-year-old stands, yielded enough merchantable wood (10 cm dbh and over) to cover the cost of operation. Data 15 years after thinning suggest that gross pulpwood yields (i. e., thinning plus final yield) will be greater in treated stands. Growth response to crown thinning occurred later than response to low thinning, but its effect was of longer duration. Therefore, on good sites, a combination of low and crown thinning which removes up to 30-35% of basal area at a stand age of about 40 years may be advantageous because it reduces thinning costs, improves yield, and lowers harvesting and processing costs because of increased tree size.

...but thinning in middle-aged stands on good sites pays.

The results of these experiments are reported in detail in two current publications, Dep. Environment, CFS, Publ. No. 1338 and Inform. Rep. NOR-X-112, which are available on request.

SOME NEW DATA FOR AN OLD QUESTION

Lodgepole pine and poplar species (trembling aspen, balsam poplar and black cottonwood) constitute a large and important part of Alberta's forest resource. These species each form essentially pure pioneer communities and display rapid early growth and dominance. The relative productivity of these species has been a moot point among foresters for many years. To shed light on this, on two sites, the fibre producing potential of a fully-stocked stand of young lodgepole pine was compared with a fully-stocked poplar stand of a similar age.

Data were collected from four, unreplicated, 100m^2 plots located in two areas in the Boreal Forest Region near Fox Creek, Alberta. In the first area, paired lodgepole pine and trembling aspen plots were established in 23-year-old stands. In the second area, paired lodgepole pine and balsam poplar stands, 25 years old, were compared. Characteristics of the stands were as follows:

		Plot 1 (L. pine)	Plot 2 (T. aspen)	Plot 3 (L. pine)	Plot 4 (B. poplar)
Living stems per ha		16,099	19,699	9,101	6,600
Basal area (M^2) per ha		31.2	27.9	32.6	39.0
Mean dbh	(cm)	4.8	3.8	6.4	7.6
Dbh range	(cm)	10-9.6	0.8 - 9.6	1.8 - 12.2	0.5 - 15.2
Mean height	(m)	5.8	6.2	8.7	8.8

In all plots the diameter and height of each tree was measured. Twenty lodge pole pine trees covering a range of sizes were felled and component moisture contents and fresh-weights determined, from which equations were derived for the relationships between component dry-weight and tree size. Using these equations for pine and equations developed by Bella (Can. For. Serv. Inform. Rep. MS-X-12, 1968) for the poplar species, the following estimates of dry-weights (kg/ha) of above-ground component in each stand were made:

Major species:	Plot 1 (L. pine)	Plot 2 (T. aspen)	Plot 3 (L. pine)	Plot 4 (B. poplar)
Stem	56,269	30,922	77,751	59,817
Branch	5,933	4,890	8,003	6,062
Foliage	8,193	2,599	10,651	2,275
Subtotal	70,395	38,411	96,405	68,654
Other species present	8,306	31,397	7,444	0
Total all species	78,701	69,808	103,849	68,654

In the two areas examined lodgepole pine clearly outproduced the poplar species in terms of above-ground biomass, particularly in stem wood. This greater wood fibre production is probably due to the higher proportion of foliage in pine (avg.≈11.2%) as compared to poplar (avg.≈ 5.2 %), the better means of displaying photosynthetic material, and the ability of conifers to photosynthesize for a longer period of time during the year.

Of course these comparisons are limited to one point in time and poplar stands, which arise from suckers, undoubtedly outproduce pine stands, which arise from seed, at very young ages.

MONEY TREE?
EDMONTON'S TREES AND SHRUBS VALUED AT $63,000,000

A tree and shrub survey was carried out in Edmonton, Sherwood Park and St. Albert in September 1973 as part of a background study on urban forestry problems. Results indicated a total of 1,200, 000 trees and 2,500,000 shrubs on 93, 000 residential lots. Seventy five tree and 92 shrubs species were identified; the five most common trees and shrubs being:

Trees		Shrubs	
Spruces	-388,000	Cotoneaster	- 871,000
Maples	-115,000	Lilacs	- 350,000
Birches	-114,000	Caraganas	- 328,000
Apples	- 94,000	Roses	- 236,000
Willows	- 77,000	Junipers	- 121,000

Seventy two per cent of the trees and shrubs were obtained from commercial nurseries and 28% either from friends or directly from the forest. Approximately 50% of the trees and shrubs were found to be in excellent condition. Insects - principally the birch leaf miner and pear slug - were the most common (37%) problems encountered. Pruning and trimming to improve the aesthetic appearance was recommended for 14% of the trees and shrubs.

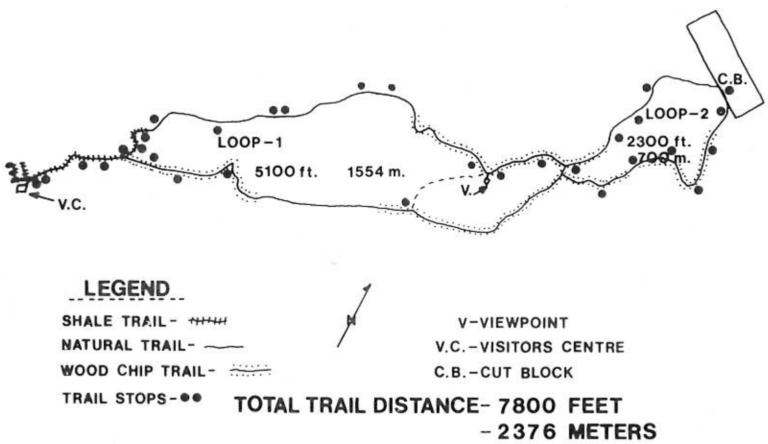
It was estimated that residential owners spent $4,700,000 on their trees and shrubs in 1974, including 0.9 million on planting, 3.0 million on maintenance, and 0.7 million on the control of insects and diseases. Individual expenditures, in both time and money, averaged $50.00 per household. Species replacement value of the 3.7 million trees and shrubs based on 1974 nursery stock costs only was $26,000,000; replacement value based on species, size, and condition amounted to $63,000,000.

The survey revealed that the most common sources of horticultural information for urban dwellers were friends (20%), books (15%) and newspaper columns (12%). Approximately one-quarter of the residential owners felt there was a need for more hand-out publications relating to insect and disease control, pruning, trimming, and other cultural techniques (16%). In partial response to this need the Northern Forest Research Centre has initiated a Pest Leaflet series designed to make up-to-date information readily available to park managers, district agriculturists, university extension offices and others as well as the general public. A more detailed report on the tree and shrub survey is being prepared and will soon be available from the Northern Forest Research Centre.

PUBLIC AWARENESS PROGRAM AT KANANASKIS

The Canadian Forestry Service will introduce a public awareness program at the Kananaskis Forest Experiment Station, near Seebe, Alberta in the summer of 1975. The main objective of the program is to increase public understanding of the use and management of forests and forest land. The program is based primarily on research which has been carried out at Kananaskis and on information contained in a management plan for integrated use of Station resources.

RESOURCE MANAGEMENT TRAIL K.F.E.S.



The program is aimed primarily at family groups on day trips out of Calgary. Facilities include a Visitors' Centre (complete with displays, a parking lot and toilet facilities) and a self-guiding interpretive trail. An illustrated pamphlet will also be provided.

The interpretive trail is designed on the loop principal. The first loop, with a viewpoint deck as a focus, is about 1554 m long. It interprets various aspects of forest land and resources including a mountain watershed, typical subalpine forest vegetation, the role of fire in forest ecology, wildlife habitat, local climate and insects and diseases of the forest. There is an alternate return trail within this loop. The second loop, which is 700m long focuses on forest management, with emphasis on the silviculture and management of lodgepole pine. There are exhibits of forest soils, thinning and pruning, harvest cutting or logging, and reforestation by planting and from seed.

We believe that the program will be unique in the region, and that it will provide a valuable public service for residents and tourists alike. The trial program will be available in both French and English.

Further information on the Public Awareness Program at Kananaskis may be obtained from the Northern Forest Research Centre, 5320 - 122 St., Edmonton, Alberta.

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