forestry report

CANADIAN FORESTRY SERVICE • NORTHERN FOREST RESEARCH CENTRE

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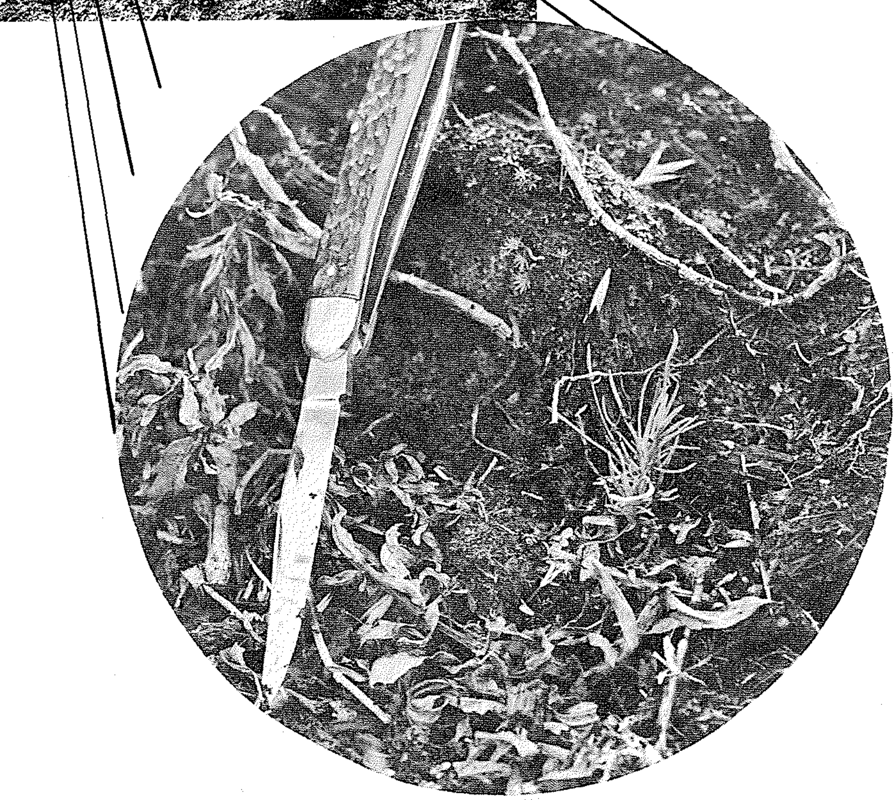
SILVICULTURE



Has Reforestation by Planting Been Successful in the Prairie Provinces?

This information is urgently sought by forest managers and researchers to critically examine on-going programs and to decide where research is required.

A special eight-man Canadian Forestry Service crew was organized to examine representative plantings in Manitoba, Saskatchewan and Alberta. 1, 4 and 6 year old plantations were sampled.

The survey was completed during the summer of 1971 in co-operation with the provincial forest services of the three prairie provinces. A detailed report is nearing completion and results will be available by early fall 1972.

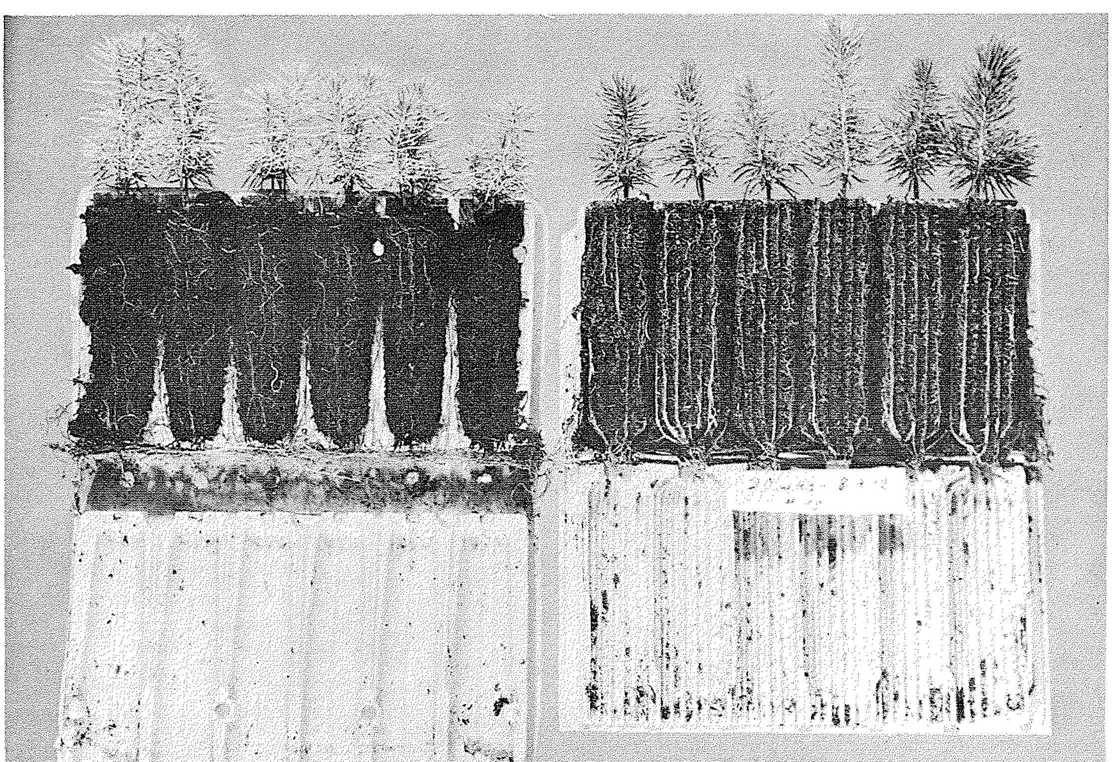
Indications are that with the exception of consistently good results in southeastern Manitoba, reforestation by planting has been largely unsuccessful although a small number of successes were noted.

In addition to a severe and unpredictable climate in the prairie provinces many factors have contributed to lack of success. To name a few -- planting in the rough, poor planting stock, improper handling and transportation and poor planting. It should be strongly emphasized that most failures can be traced to inadequate organization and planning and not biological problems. These operational problems start in the nurseries and extend through the transportation, handling and planting phases. With the proper planning, good planting stock and skilled planters, success can be obtained -- the results in southeastern Manitoba prove this.

Growth of "Plug" Type Seedlings During Rearing

Many users of container seedlings have changed over to "plug" type of some form or another ('styroblock, "Spencer Lemaire", Paperpots). Since these types were only introduced into the Prairies Region in 1970 we do not have much accurate information on rates of growth in the rearing period.

In response to requests for information on rates of growth, we have pooled all the information we have on the growth of lodgepole pine and white spruce reared in 'styroblocks' and expressed rates of growth in terms of smoothed curves of height and total dry weight. These curves are approximations and should be used to obtain only a general idea of performance. More accurate information will be available at the end of 1972. *(continued on page 3)*



This is one type of seedling container now in use. The case, hinged at the base, is folded to form six sockets which are filled with peat. Tree seed is then sown in each socket At planting time (14-20 weeks of age) the case is opened as shown and each of the seedlings planted complete with the 'plug' of peat in which it has grown. Ridges on the walls of the container on the right have directed the roots downward giving a more compact root system for planting than that on the left.

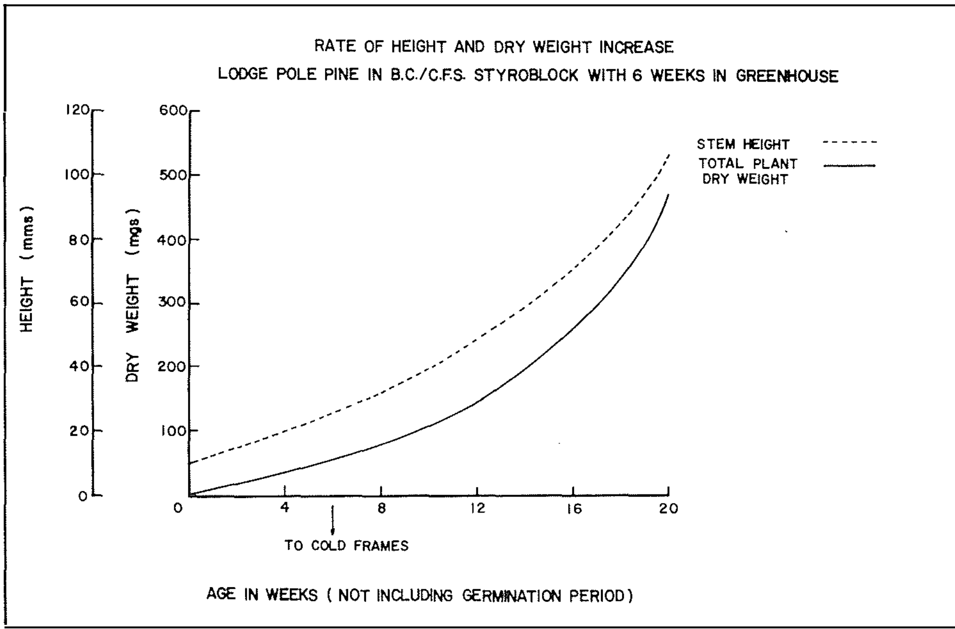
NOTES ABOUT THE CURVES

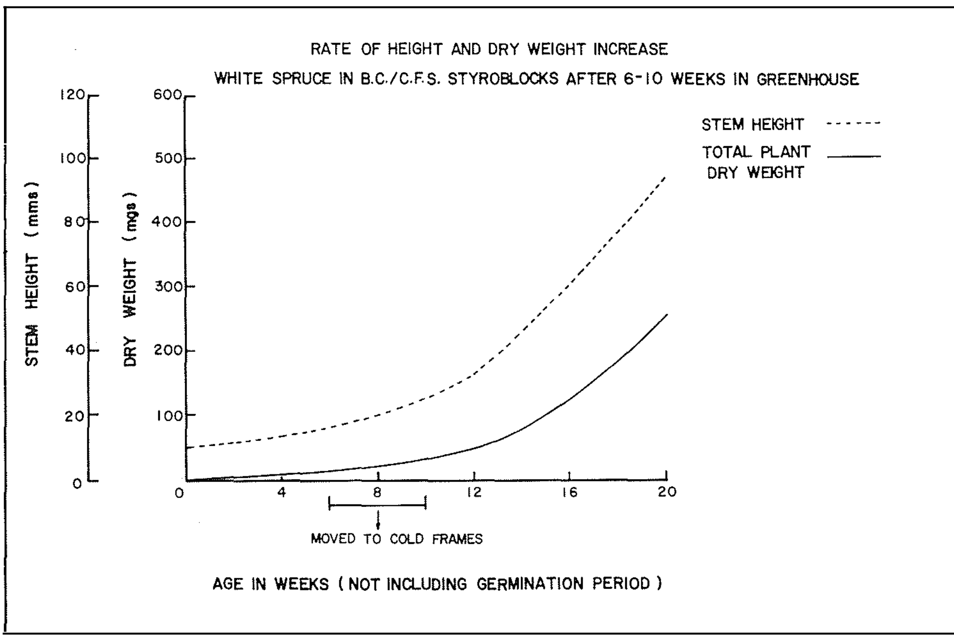
1. In all cases the seedlings analyzed were reared using the nutrient solution recommended by the C.F.S., Northern Forest Research Centre and having 112 ppm N, 31 ppm P, and 156 ppm K.

2. Age excludes the period required for germination and emergence, generally 7 - 15 days.

3. The curves are based on seedlings which had spent six weeks in the greenhouse with the remaining time outside in cold frames. Some data from seedlings having ten weeks in the greenhouse have been interpreted to help in drawing the curves. (A ten-week greenhouse period accelerates shoot growth but, as far as we can determine, at the expense of root growth.)

4. Rearing temperatures in the greenhouse were 70° F day and 50° F night. Photoperiod was 16 - 18 hours.





Seedbed Comparisons

Following clearcutting of jack pine (*Pinus banksiana* Lamb.) in southeastern Manitoba the harvested areas are scarified to facilitate regeneration techniques and increase survival and establishment. In the past the middlebuster plow, and more recently the shark-finned barrel scarifier have been used very successfully for scarification. Both types of equipment create essentially similar seedbeds, that is a furrow with an overturned sod ridge on each side.

Each year several million seedlings are planted on scarified areas in southeastern Manitoba. Jack pine, being indigenous to the sites, usually makes up 80% or more of the total with red pine *(Pinus resinosa* Ait.) filling out the remainder. With increasing scarification and planting costs however, management personnel are considering seeding as an alternative method of regenerating some sites.

Between 1962 and 1966 germination and survival of seeded jack pine and growth and survival of planted stock were studied on these sites which had been scarified by the middlebuster plow.

Germination was significantly greater on a fresh and moderately fresh site than on a dry site. The trough, the base of the south-facing slope, and the base of the north-facing slope of furrows provided the best seedbeds for germination. Mortality was significantly lower on the fresh site, with no significant differences among seedbeds. On the moderately fresh and dry sites, significant but inconsistent differences among seedbeds occurred.

Heat in combination with drought was the main cause of mortality on the dry and moderately fresh sites. Animal damage was also a potential hazard on the latter site. On the fresh site the causes of mortality were distributed with relative evenness.

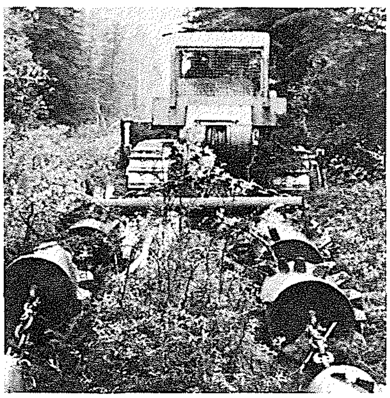
On the fresh site scarification followed by broadcast seeding with 4 to 8 ounces of seed should provide adequate regeneration. On the moderately fresh site the scarification method used in the study, followed by spot seeding on the trough and the base-of-north-facing-slope seedbeds with 12 ounces of seed per acre, is recommended. A method of site preparation designed to mix mineral soil and humus would probably provide better results and possibly allow broadcast seeding.

Regeneration on the dry site was not satisfactory. More detailed studies of this site have been completed and are currently being evaluated.

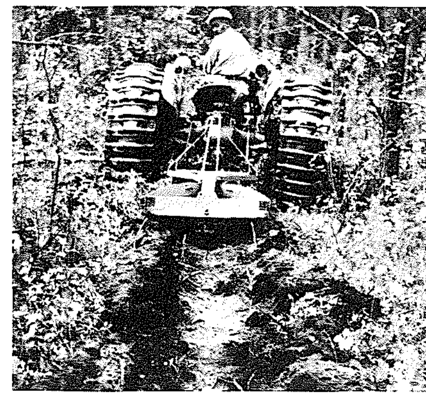
The favourable moisture conditions of fresh sites will probably provide for adequate planting survival on all seedbeds even in relatively dry years.

The entire furrow-bottom and undisturbed seedbeds of the moderately fresh and dry sites will all provide adequate survival of planted stock to three years. However, most cut-over pine sites in southeastern Manitoba eventually become overgrown with fairly dense lesser vegetation, particularly shrubs, grasses and large perennials. The mineral soil seedbeds may provide an extra period of protection against competition for moisture and space.

Three-year growth of planted stock was significantly greater on the fresh site than on the dry site. On the fresh and dry sites, seedbeds have no significant affect on height growth, root-collar diameter or oven-dry weight planted stock to three years. Browsing precluded meaningful growth measurements on the moderately fresh sites.



Shark Finned Barrel Scarifier



Middlebuster Plow

An Abstract of An Economic Analysis of Reforestation Costs in Alberta

The Forest Economics Research Group of the Canadian Forestry Service, with the co-operation of the Alberta Forest Service (A.F.S.) and the Horticultural Branch of the Department of Agriculture carried out an indepth study of all the costs associated with growing forestry seedlings (conventional and container), preparing planting sites, planting both types of stock and seeding. Costs researched were strictly related to reforestation of Crown land and were taken from the fiscal years 1968-69, 1969-70 and 1970-71.

FOREST TREE NURSERY PRODUCTION

In analyzing production costs, the Provincial Tree Nursery at Oliver was assumed to be a private, profit motivated firm producing seedlings as a cash crop. Under this assumption, land taxes and depreciation of capital assets were treated as actual costs incurred in the production process. The only costs not included were those for fuel, electricity and water.

The cost of extracting spruce and pine seed inclusive of cone collection charges and seed storage amounted to $6.40 and $13.65 per pound respectively.

Conventional 3–0 forestry stock f.o.b. "at the nursery gate" in the spring of 1971 cost $37.58/M seedlings. This cost was traced over a three year period, starting from the original seeding operation and terminating at the point where the 3–0 seedlings are completely loaded for delivery. The total cost was accumulated as follows: 1–0's in 1968-69 = $11.60, 2–0's in 1969-70 = $7.92 and 3–0's in 1970-71 = $18.06.

In analyzing container tubeling production (plug form), costing data for the year 1971 only, were employed. Three types of containers were being used at Oliver in 1971; the B.C./C.F.S. Styroblock, the Spencer-Lemaire and the Research Council of Alberta (R.C.A.) peat sausage. Cost per thousand tubelings was $29.27, $25.92 and $29.33 respectively.

SITE PREPARATION

It was assumed that the latest three years of data (1969, 1970 and 1971) would be sufficient in reflecting the current cost of preparing an acre of forest land for regeneration.

The most common method of site preparation employed by the A.F.S. was that of scarification with crawler tractors either equipped with blades or pulling tractor pads. The machine costs per acre for operating on a clearcut, partial cut and burn averaged $15.67, $14.59 and $12.59 respectively. Other costs associated with scarification projects averaged $2.02 per acre and were assumed to be the same regardless of the site condition.

PLANTING

Planting costs for the same three years were also analyzed. Assuming a stocking level of 500 seedlings per acre planting costs by various methods were as follows:

Planting conventional stock by machine on a treated area - $20.50

Planting conventional stock by hand on a treated area - $19.00

Planting container stock by hand on a treated area - $20.00

Planting conventional stock by hand on an untreated area - $26.50

Planting container stock by hand on an untreated area - $16.00

Even though seeding is still in the experimental stage costs were calculated purely for comparative purposes. The cost of aerial broadcast seeding 5.3 oz. of spruce seed per acre amounted to $3.65. The cost of hand broadcast seeding 2.6 oz. of spruce seed per acre amounted to $2.36.

The Growth and Management of Trembling Aspen

Research on trembling aspen in the Prairie Provinces dates back to the late 40s. Since that time a considerable amount of information has become available on the characteristics of the species, and it is possible to suggest some general guidelines for the management of the species.

Aspen is the fastest growing commercial species in the Prairies, reaching minimum pulpwood size (3.6 inches dbh) in 25 to 30 years. Merchantable volume at this age may be 20 cords and will increase to 40 or 50 cords at age 50 (3,000-4,000 cu. ft.). After this growth is much reduced.

The regeneration of the species presents no special problems (see Logging practices and the development of new aspen stands). Provided the ground surface after clearcutting is exposed to direct sunlight, residual roots will sucker profusely and sucker density per acre may be more than 100,000, but will quickly reduce during the next few years to 10 - 15,000. Whole-tree logging in early summer scarifies the surface and creates good conditions for suckering. Where the suckers are given an equal chance with competing vegetation, they will usually outgrow it.

Because trembling aspen reproduces by means of root suckers, stands consist of a mosaic of clones which may range in size up to several acres. Members (ramets) of a clone have similar and distinct growth and quality characteristics. Ramets of some clones may grow faster or may be of better quality than those of others. This may explain the large variation in decay which is often encountered over short distances in an aspen stand. Such decay is usually the result of trunk rot. There is no evidence that organisms responsible for this decay are transmitted through the roots to the new suckers. At any rate, where poor quality trees are left standing after logging, they will not contribute much to the formation of new suckers, since suckers tend to develop only from the roots of cut (and presumably better quality) trees. Residual culls will not be detrimental to subsequent suckering, provided they do not form a closed canopy. However abundant slash and dense residual ground vegetation should be avoided at all times.

Thinning studies have shown that only young stands, less than 25 years of age respond to release. However, thinning is not necessary when the objective is to increase total fibre production, and could be grown on a 30- to 35-year rotation. Thinning will increase, in some cases by close to 100%, the increment of residual trees. It may therefore be considered as a technique to increase the production of large trees but to be most beneficial, thinnings must be made in young (5 to 10-year-old) stands. At this age produce is unsaleable, and it is doubtful that the high cost of thinning can be recovered. Consideration is being given to mechanical strip thinning methods. The cost of such a technique would be only a fraction of that of conventional techniques and experience with other species (e.g. Jack pine) has been promising. Experience with fertilizing is lacking.

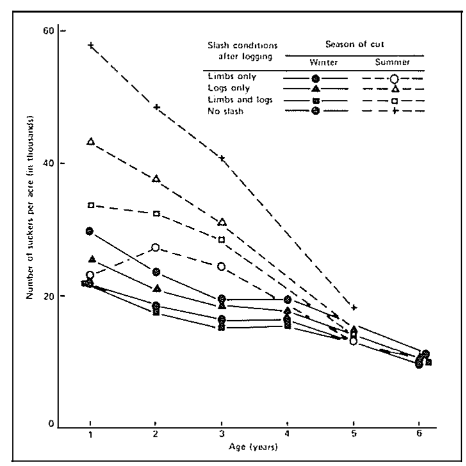
Logging Practises and the Development of New Aspen Stands

Increased harvesting of aspen in the Prairie Provinces brings up questions about the future use of logged-over areas. If they continue to be used for growing aspen, logging should be carried out so that it will ensure the regeneration of these cutovers and have a beneficial effect on the development of the new stands.

A study was undertaken in 1965 at Hudson Bay, Saskatchewan, by the Canadian Forestry Service in co-operation with MacMillan-Bloedel Sask. Ltd., to evaluate the effect of a season of logging (winter cut in March 1966; summer cut in June to mid-July and August 1967) and slash conditions (limbs only; logs only; limbs and logs; no slash) on the number of suckers produced, and on the early development of these young sucker stands. Two rectangular areas (one per season), of about four acres each, were located in 70 to 80-year-old aspen stands that were growing on fresh to moist sites with clay loam soils and flat topography. Chain saws and wheeled skidders were used for logging and all trees were felled.

Highlights of the results include:

1. Stocking of 97% and 100% (based on ½ mil-acre quadrats) were recorded two years after winter and summer cut. These percentages are averages for different slash conditions.
2. Initial sucker density was nearly twice as high after summer cut than after winter cut (an average of about 40,000 vs. 25,000 per acre), and it exceeded 100,000 suckers per acre where the amount of slash was small. (Although



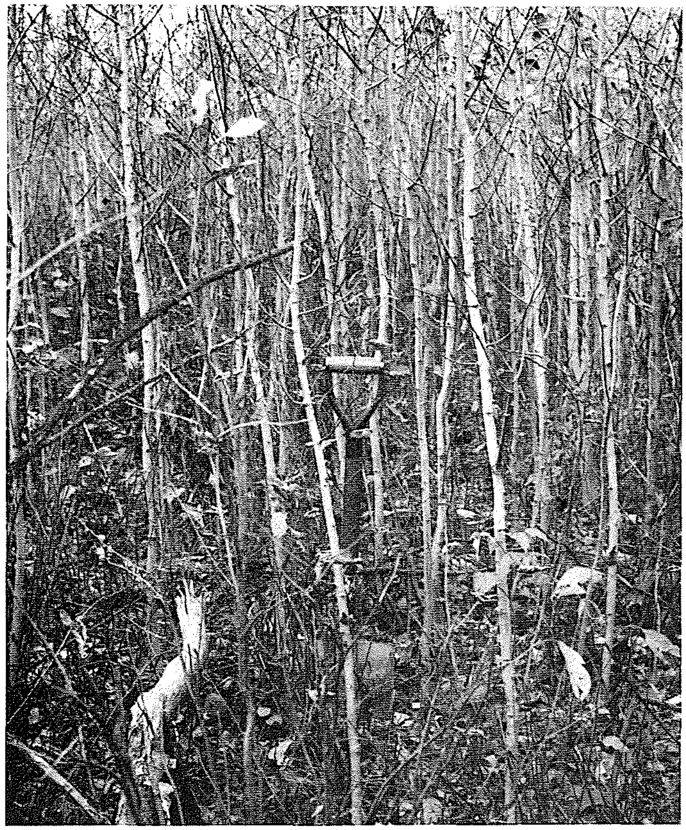
Number of suckers per acre (mainly aspen but includes some balsam poplar) by slash condition classes for summer- and winter- cut at ages one to six years.

(continued)

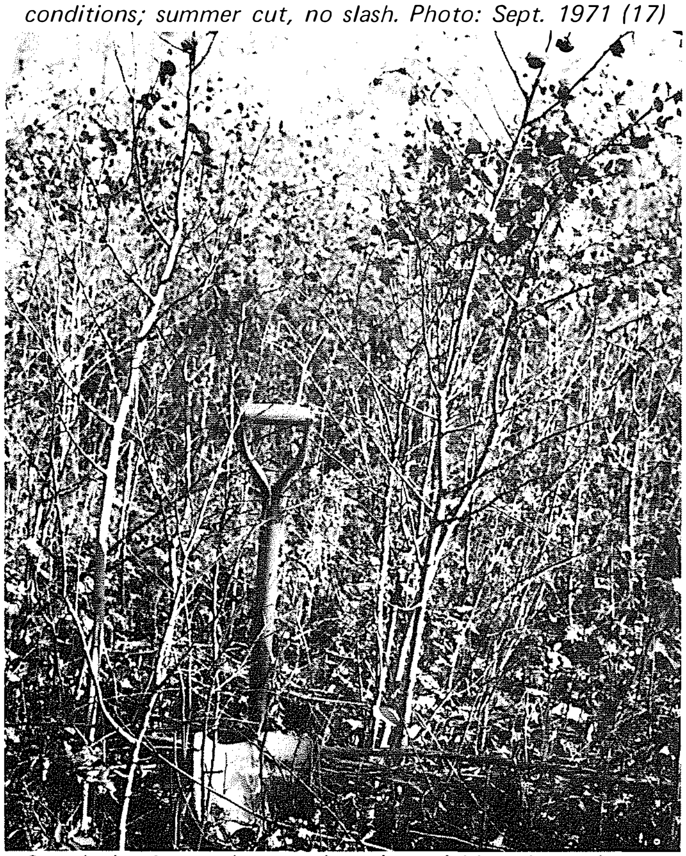
this contradicts other studies of aspen suckering, it has been attributed to the particular logging practices in the area.)

3. There was a much greater variation in sucker density after summer cut than after winter cut both within and between slash condition classes.
4. Greatest number of suckers occurred where slash was least. There were twice as many suckers after summer logging where no slash was present than on areas covered with limbs and logs. Differences in number of suckers after winter logging between the same slash conditions classes was much less, approximately 25%.
5. High initial sucker density was associated with heavy mortality of suckers, whereas mortality was more moderate where sucker regeneration was less dense. As a result, initial differences in sucker density all but disappeared by six years of age.
6. Season of logging and slash conditions did not appear to affect the species composition of the new stand.

These results suggest that neither the season of cutting nor slash conditions would have an over-riding influence on future stand density -- or possibly on growth and yield -- of second growth aspen. It could be advantageous to consider however, specific conditions of the parent stand when making cutting plans. For example, in stands with heavy shrub cover, usually hazel, summer logging may be more desirable because it would eliminate shrubs thus promoting aspen suckering and growth. On wetter sites with clay soils -- similar to conditions covered in this study -- where hazel is not a problem, winter logging may be more desirable both from a silvicultural and from an operational view; it would prevent excessive compaction and disturbance of the soil on logging trails. Such disturbances can result in unstocked patches in the future stand.



Vigorous 5-year-old aspen suckers growing under dense conditions; summer cut, no slash. Photo: Sept. 1971 (17)



Stand density and tree vigor is variable where slash is present; five years after summer cut. Photo: Sept. 1971 (18)

Partial Cutting Pays Off In Alberta's Spruce Aspen Forests

A 150-acre study block in the Slave Lake, spruce-aspen, Forest in Alberta was logged in 1951 by Swanson Lumber Company to provide a range of 8 cutting treatments for research officer J. Quaite of the Forestry Branch. The treatments were:

A. Control - no cutting
B. Heavy residual - leaving 7,680 f.b.m./acre - 47% removal by volume of spruce.
C. Medium residual - leaving 5,500 f.b.m./acre - 69% removal by volume of spruce.
D. Light residual - leaving 4,010 f.b.m./acre - 63% removal by volume of spruce.
E. Selection - leaving 3,800 f.b.m. per acre - individual tree marking 67% removal by volume of spruce.
F. Diameter limit - leaving 3,900 f.b.m./acre - 14 inch stump diameter limit - 61% removal by volume of spruce.
G. Seed tree - leaving 6 seed trees per acre - 99% removal by volume of spruce.
H. Clear-cut - removal of all spruce over 6 inches d.b.h. - 96% removal by volume of spruce.

The hardwood component of the residual stands amounted to 5,000 f.b.m. per acre.

The partial cutting treatments assigned to this study area were designed to provide a seed source and shelterwood for regeneration.

In 1961, stand growth and regeneration status were assessed for each treatment. Residual stand increment indicated that partial cutting had released many spruce stems, that there was a significant recruitment to the merchantable spruce size classes and that regeneration was satisfactory only where mineral soil was exposed. In 1970-71, winter removal felling was completed using tracked tractors and ground skidding and, in a smaller test area, using rubber tired tractors and arch skidding.

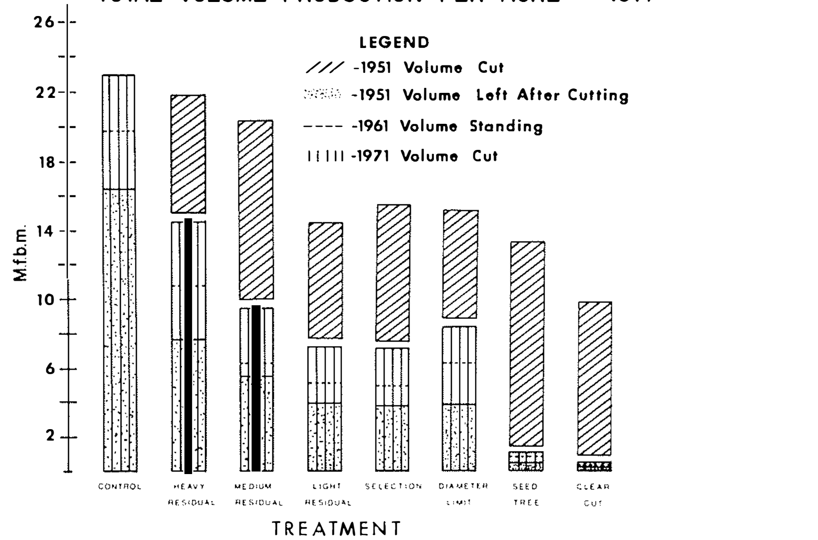
Total board foot volume production per acre is shown for the 8 cutting treatments. Increased growth after cutting has allowed the heavy residual and medium residual treatment blocks to make up total volume production equal to that on the uncut control blocks. Production on the other areas fell appreciably below control levels.

VALUE OF TIMBER PRODUCED

Total dollar value production per acre for each treatment is presented. While lumber prices fluctuate widely, a figure of $45.00 per thousand board feet of rough-sawn lumber has been assigned to the 1951 logging and a figure of $70.00 per thousand to the 1971 logging. Return on the investment of proceeds from 1951 production has been assessed at 6% compound interest. Whatever regeneration benefits there have been through natural seedfall might be added to all treatment values, but regeneration costs now, in the absence of shelterwood, would be higher than the costs accumulated over the 20 year regeneration period. These costs and benefits are not estimated here.

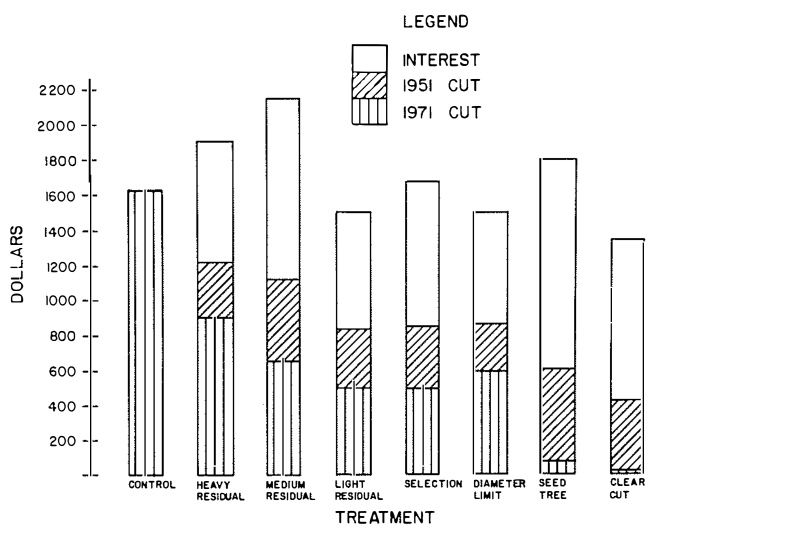
Value generated by the heavier cutting in 1951 is clear. Removal of up to 50% of the standing spruce volume can be recommended, but a spruce overwood can be left at least as long as 20 years. Seed bed evaporation is necessary and should take advantage of seed years to be followed by fill in planting as required.

TOTAL VOLUME PRODUCTION PER ACRE — 1971



Volume logged in 1951 is shown cut off from the top of the total volume columns. Volume logged in 1971 has 3 components.

TOTAL VALUE PRODUCTION PER ACRE — 1971



A 6% return on the value realized in 1951 has been compounded over 20 yars.

Can We Use the Dog Hair?

One of the problems in the management of lodgepole pine is overstocking. 500,000 stems per acre in young stands is not uncommon, and even as many as 100,000 stems per acre have been observed in a 70-year-old stand. Overcrowding reduces growth so much that stands containing in excess of 2,000 stems per acre at 90 years of age are unlikely to produce a reasonable 'merchantable' yield. Remedial measures, such as thinning or weeding, may be successfully undertaken in young stands to overcome stagnation and to increase the yield of usable material. In older stands such measures hold little promise and often the forest manager is faced with the expensive proposition of clearing off the existing stand (with little or no return) and then planting if he wants to bring the area back into immediate production. If the materials removed in these clearing operations could be economically converted to pulp, it might be possible to defray some of the clearing and reforestation costs.

Data was collected on the total standing crop of a 'stagnated' 100-year-old stand of lodgepole pine at the Kananaskis Forest Research Station, the characteristics of which are listed in Table 1. After removal of the branches, needles, bark, etc., it was estimated the oven-dry weight of the stem component was 51,553 lbs.

As a result of early stagnation, the trees were of a small size and because no future yield was forthcoming, the existing stand should have been cleared and the area seeded or planted. The purpose of this study (carried out in collaboration with Dr. J.L. Keays of the Western Forest Products Laboratory) was to determine the yield and quality of pulp potentially available from the clearing operation.

A mixture of chips from nine sample trees, covering a range of tree sizes, were pulped by the kraft process using the cooking conditions presented in Table 2. These conditions were selected to obtain an unbleached pulp permanganate number of close to 20.

The results presented in Table 3 show that the pulp yield of the suppressed pine is essentially the same as that of normally grown lodgepole pine. The quality of pulp produced from suppressed pine is similar to that of normally grown pine except the former develops its strength much more rapidly (Table 4). Commercial utilization of this wood resource in the manufacture of pulp is dependent upon economic harvesting and processing (i.e., barking and chipping), and not pulp yield and quality.

TABLE I.

Number of stems per acre	4,960
Basal area per acre (sq. ft.)	157
Total volume per acre (cu. ft.)	2,594
Mean diameter (in.)	2.2
Mean height (ft.)	18.7

TABLE 2.

Sulfidity (%)	25.0
Effective alkali (%)	17
Time to max. temp. (min.)	135
Time at max. temp. (min.)	80
Max. temp. (C°)	170
Liquor-to-wood ratio	4:1

TABLE 3

		Unadjusted yield (%)	Permanganate number	Adjusted yield (%)	Kappa No.	Screening
Ref. Stand:	mean	43.70	17.9	44.8	-	0.40
	range	43.65-43.76	17.85-17.90	-	-	-
Supp. pine:	mean	44.17	17.9	44.96	25.9	0.60
	range	43.88-44.36		44.67-45.15	-	-

TABLE 4.

		500 ml. C.S.F.				300 ml. C.S.F.			
		Beating time (min.)	Burst factor	Tear factor	Breaking length (m)	Beating time (m)	Burst factor	Tear factor	Breaking length (m)
Ref. Stand:	mean	62	99	105	13,600	96	104	101	14,000
Supp. pine:		27	94	103	12,750	71	107	93	14,150

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