Technical Note:

Thinning Lodgepole Pine by Brute Force: Three Implements in a Decade's Perspective

by I.E. Bella¹

Abstract

Anchor chains, Rome disks, or shark finned barrels were dragged by a D8H tractor in one or two directions in dense, 9-year-old, fire-origin lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) stands in west-central Alberta. All three implements were equally effective in killing trees, although they also damaged a fairly high proportion. The two-directional treatments, with the second perpendicular to the first to approximate greater intensity of thinning, killed more than twice as many, or nearly 40% of mainly the larger trees. Large trees were also more damage-prone. In the 11 years after treatment the thinned stand recovered, and now the trees show virtually no signs of earlier damage. Their growth surpasses that of trees in the unthinned area. Treatments like these may be useful in dense lodgepole pine stands when thinning budgets are low and some reduction in usable yield, as compared to selective thinning, is acceptable.

Résumé

Un tracteur D8H a servi à tirer des chaînes d'ancre, des disques Rome ou des barils dentés dans une ou deux directions dans des peuplements denses de pins tordus latifoliés (*Pinus contorta* Dougl. var. *latifolia* Engelm.) de 9 ans issus d'incendies dans le centre-ouest de l'Alberta. Ces trois outils étaient tout aussi efficaces les uns que les autres pour éliminer les arbres, bien qu'ils aient également endommagé un fort pourcentage. Les traitements bidirectionnels — le second étant perpendiculaire au premier afin d'obtenir une éclaircie plus forte — ont permis d'éliminer plus de deux fois plus d'arbres ou près de 40 % des arbres, surtout les plus gros. Les arbres de plus fort diamètre étaient également sujets à être plus endommagés. 11 ans après l'éclaircie, le peuplement s'était rétabli et les arbres ne présentent maintenant presque aucun signe de dégât antérieur. Leur croissance surpasse celle des arbres du secteur non éclairci. De tels traitements peuvent s'avérer utiles dans des peuplements denses de pins tordus lorsque les budgets d'éclaircie sont faibles et qu'une certaine réduction du volume utilisable par comparaison à celui que procure une éclaircie sélective, est acceptable.

Introduction

Dense lodgepole pine regeneration needs thinning to reduce density and thus to ensure continued rapid growth and high yield of usable stem wood. Individual tree selection thinning with hand tools is expensive. Various mechanical multistem approaches, either as single treatments or in combination with selection thinning, provide opportunities to improve thinning productivity and reduce cost (Bella and de Franceschi 1982, Hedin 1988).

This paper describes an exploratory mechanical thinning trial, conducted in the foothills of west-central Alberta (40 km southwest of Rocky Mountain House, in the Rocky-Clearwater Forest) in the winter of 1976-77 in dense, 9-year-old, fire origin stands. Three implements were used: anchor chains, Rome disks, and shark-finned barrels. They were dragged by a D8H tractor through the study area in one or two directions (the second pass perpendicular to the first to approximate a greater thinning intensity). Similar implements are commonly used for site preparation following logging and are readily available. This note describes the effectiveness of these machines in killing trees, some negative effects of treatment, and tree growth and stand conditions 11 growing seasons following treatment.

Study Area and Methods

The topography was level to undulating, the soil was silty clay loam, and the fresh to moist quite uniform site was

considered to be above average in productivity for pine in the area. The original stand was killed by fire and salvage logged.

The primary treatments (implements) were assigned randomly in three blocks (1 to 4; 5, 6, 11, 12; 7 to 10; Fig. 1) and so were treatment intensities within, viz., one or two directional. The adjacent undisturbed area provided the control.

Fifteen sample plots (12 thinned, with two replicates per treatment; and 3 unthinned) were established in August 1977, i.e., the summer following thinning, to assess post treatment conditions and monitor stand development (Fig. 1). Plot sizes in the treated areas were 140-196 m² and were of sufficient size to include at least 25 healthy residual trees. Plots in the unthinned portion were 12m², and all had over 25 trees.

On each plot at least 25 of the largest trees were tagged and measured for height (nearest cm) and diameter at breast height (nearest mm), and their condition class noted (Table 2). Untagged trees were tallied by height and condition class. Insect and disease incidences were also noted.

Post Treatment Conditions

As a result of treatment, trees were severed or uprooted by the particular implement and were often dragged into piles of debris (Fig. 2). Thus, only a very rough estimate of the number and percentage of trees killed was possible. The one-way (single pass) treatment killed on the average about 15% of the trees, and the proportion of trees killed decreased slightly with stand density (Table 1). The two-way treatment was more than twice as effective in killing trees (38.4% vs. 15.2%) as the one-way treatment, but the proportion of killed trees here was independent of density. The relative

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Figure 1: Treatment and plot map of the study. Rome disk: One-way, plots 1 and 2; two-way, plots 3 and 4. Shark-finned: One-way, plots 5 and 11; barrel: Two-way, plots 6 and 12. Anchor chains: One-way, plots 7 and 9; Two-way, plots 8 and 10. Control: Plots 13, 14, 15.

effectiveness of the three implements was about the same for both treatments, though undoubtedly affected by the slash on the ground. In all treatment combinations, the biggest trees were most likely to get killed or damaged; smaller trees, being more flexible, were more likely to escape the blades (Fig. 3).

Mechanical damage among residual trees was as high as 50% and averaged about 40% (Table 2). Bent or leaning trees were the most common type of injury. Generally, the two-way treatments produced twice as many damaged trees. Yet, insect and disease incidence appeared low (under 1% of the residuals affected) in both control and treated areas.

Because the largest trees were most vulnerable, the treatment resulted in a substantial (nearly 50%; an average of 1m) reduction in mean height of the 1000 largest trees/ha (Fig. 3). Growth and stand statistics of these largest trees provide a good indication of the expected future crop.

Eleven Years Later

The most important observation is that the thinned portion of the stand, which looked like a battle ground after treatment, has achieved an extraordinary recovery (Fig. 4). During the ensuing 11 years, the trees that were damaged have generally recovered and caught up with those in the control area; so by 1988 the mean height of the largest 1000 trees/ha was essentially the same on the treated and the control (Fig. 3). This means that the largest crop trees on the treated areas had to grow faster than on the controls during this period, despite the injuries suffered in the former. It is also noteworthy that the two-way treatments with lower densities achieved slightly but consistently greater mean height

than the corresponding one-way treatments. This agrees with the current understanding of lodgepole pine growth-density relationships (Smithers 1961, Johnstone and Cole 1988).

The mean diameter at breast height (dbh) of the 1000 largest trees in 1988 showed much the same trend as that described above for mean height. As did mean height, the mean dbh of the treated area pretty well caught up with that of the control. Again, the two-way treatments had slightly but consistently greater mean diameter than the corresponding one-way treatments.

Control and treated areas experienced the same percentage of tree mortality (information available on request from the author), with the exception of the two-way treatment. The highest mortality occurred in the control areas, which had densities averaging nearly 40 000 trees/ha. Density there dropped by about 10 000 trees/ha. Mortality was quite variable on the treated areas; it was somewhat less after the two-way treatment, which also had the lowest post-treatment densities (Table 1).

Stem form was good in both the treated and control areas. Other than the occasional minor stem crooks near the ground, it was virtually impossible to detect any signs of the dramatic treatments that were done 11 years earlier. In the thinned portion of the stand with lower density, the trees had bigger crowns and showed a better separation into crown classes than in the unthinned area. This will mean continued self-thinning in the treated portion of the stand.

Insect, disease, and small mammal incidence and damage were generally negligible and were unaffected by treatment.

Figure 2: Mechanically thinned area one growing season after treatment. In the background is the dense, untreated stand. (Photo by J. Soos.)

Table 1. Summaries of living and dead trees by treatment in 1977 (trees/ha)

Treatment	One-way			Two-way		
	Living	Dead	%dead	Living	Dead	%dead
Rome disks	13546	1938	12.5	11301	5332	32.1
Shark-finned barrels	17755	4083	18.7	9872	8087	45.0
Anchor chains	17826	3010	14.4	9826	5740	38.2
Average	16376	3010	15.2	10153	6386	38.4

Conclusions

All three implements used for thinning young, dense, fire-origin lodgepole pine were equally effective in reducing density by killing a certain proportion of the trees. Two-directional treatments, i.e., dragging the implement a second time perpendicular to the first direction, just about doubled the number of trees killed, thus reducing density to about 10 000 trees/ha from the estimated original of about 20 000 trees.

Unfortunately, this kind of treatment tends to kill the biggest and most vigorous trees and damages many of the remaining live trees. Whether and how great an impact this negative selection would have on future yield of thus treated stands cannot be answered at this time. The present examination showed that within 11 years the remaining trees

completely recovered from their injuries, and the largest 1000 crop trees/ha actually caught up to those in the untreated areas. The trees in the treated area obviously had to grow faster in order to catch up and will likely continue their rapid growth because of lower density and better crown development.

This would suggest that treatments like these may be useful in dense stands when thinning budgets are limited, alternate mechanical treatments (e.g., strip thinning) are considered, and less than maximum usable yield is acceptable. Although mechanical strip thinning may be even cheaper than the treatments described here, it also has some serious drawbacks: (a) complete lack of stocking on the cut strips, and (b) the possible need for an expensive follow-up selective thinning treatment within the leave strips.

Multistem mechanical thinning, regardless of type or implement used, loses out on one of the main advantages of selective thinning: that is, improving the future stand by eliminating the slow-growing, suppressed, insect and disease prone individuals and thus favoring and enhancing the growth of the biggest, best-growing trees. Further measurements of these trials will show what gains, if any, in usable wood production these low-cost mechanical multistem treatments will achieve, compared with leaving the stand as it is. Because these trials and results apply to fire-origin stands with substantial ground slash, these treatments also need to

Figure 3: Mean height and diameter of the 1000 largest trees/ha by treatment in 1977 and 1988.

Table 2. Condition of tagged trees after the first growing season following treatment

Treatment		Trees by condition classes (in %)					
		Stem				Leader damage	Dying
		Healthy	Bent	Broken	Scarred		
Rome disk	One-way	71	20	1	1	4	3
	Two-way	49	40	1	1	5	4
Shark-finned barrels	One-way	74	23	1	0	1	1
	Two-way	51	43	2	1	1	2
Anchor chains	One-way	70	26	0	1	2	1
	Two-way	52	41	1	4	–	2
Untreated		99	NA ¹	NA	NA	NA	1

¹Not applicable.

Figure 4: Twenty-year-old lodgepole pine stand: (a) thinned; (b) unthinned.

be evaluated in young stands following harvest before they can be used operationally under such conditions.

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Announcement

Commencing with the February 1991 issue, the Editors of the *Forestry Chronicle* will be Mr. J.H. Cayford and Dr. D. Burgess.

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