KINLEITH THINNING OPERATIONS OF N.Z. FOREST PRODUCTS LIMITED

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ABSTRACT

This paper assumes the decision has been made to carry out production thinning at various ages. It traces the scope and development of the thinning operations in the Kinleith forests since they were first started on a production scale in 1958. The evolution of extraction techniques is discussed as well as the significance of the thinning volume in the overall wood supply to the Kinleith integrated mills. Crew production is discussed and the way in which the contract payment rates are determined is described. A table of the thinning prescription is included. The various limitations on such an operation are dealt with as they occur in the forest, during loading and transporting, as well as in the mill yard and plant. So long as labour can be obtained for this work and costs can be contained by overall efficiency, the higher cost thinning wood will be acceptable in the total wood supply mix for the mill.

INTRODUCTION AND HISTORY

The original forest was planted in exotic pines during the 1920s and 30s, the major species being *Pinus radiata.* This paper deals with the thinning of both the first crop and the second crop, the latter resulting from re-establishment on the cutover areas or those new areas planted since 1944.

The first thinning operations were done in 1958 in stands 33 years old. This was salvage thinning, to eliminate possible future mortality estimated to exceed 280 m^3/ha, and was continued until 1972. It was considered necessary because most of the stands had 8 years or more to run before being clearfelled (Spurr, 1962).

Second-crop thinning commenced in 1959 in stands mainly 12-15 years old and has continued as a regular operation since. All 4 major subsidiaries of the company (Whakatane Board Mills Co. Ltd, Hutt Timber & Hardware Co. Ltd, Bartholomews Co. Ltd and Taupo Totara Timber Co. Ltd), carried out thinnings too, but these have not been considered here, unless they are within the Kinleith area since their takeover. It is interesting to note that part of Matakana Island (now T.T.T. Co. Ltd) was thinned for Whakatane Board Mills supplies as early as 1939.

Following examination of the growth and yield of the forests in 1962 by Professor S. H. Spurr it was recommended that large-scale thinnings continue as part of the forest management programme. He advised that the gross yield of the forest could be increased by up to 65% with the aid of a thinning programme, if mortality were to continue and a 50-year rotation were adopted (Spurr, 1962). This has proved not to be the case and increases of 10-15% are more likely on shorter rotations.

Extent of the Operations

The areas involved are shown in Table 1. Prior to 1958, only sample plots had been thinned on a trial basis.

TABLE 1—Areas of thinning operations (ha) by year from 1958/59; yields in volumes and as percentage of total cut

	1958/59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
A. **Mature Area Thinning** (years of establishment 1925-37)																
1925	20		26	297	531	60					42					
26					115	391	318	162	91	137		16				
27						344	198	27	184	59						
28					25	375	609	651	801	419	60	72	3			
29										250	191	60				
30										166	260			15		
33		184														
34					2	3			94	3						
35	8	32	263	131	141	193	151	132	27	109	112	140	175	39		
36	270	356	15						30	188		135	121	43		
37	58	76														
Totals: Annual	356	648	304	428	814	1,366	1,276	972	1,227	1,331	665	423	299	97		
Progressive	1,004	1,308	1,736	2,550	3,916	5.192	6,164	7,391	8,722	9,387	9,810	10,109	10,206			
B. **Burn Areas Thinning**																
1938						4	6	59	28							
43	2	35	32	1	16						55					
47				10	190	701*	904*	233	51	68	117	282	438	801	547	685
Totals: Annual	2	35	32	11	206	705	910	292	79	68	172	282	438	801	547	685
Progressive		37	69	80	286	991	1,901	2,193	2,272	2,340	2,512	2,794	3,232	4,033	4,580	5,265
C. **Immature Area Thinning**																
1940-45	103	91	71	57	37	14	4	5		56						
1946-50		12	17	32	79	144	77	92	67	60	123	145	121			
1951-55						11	59	67	237	602	610	943	971	324	236	427
1956-60										27			710	434	343	553
Totals: Annual	103	103	88	89	116	169	140	164	304	745	733	1,088	1,802	758	579	980
Progressive		206	294	383	499	668	808	972	1,276	2,021	2,754	3,844	5,646	6,404	6,983	7,963
D. **Total Thinning Yields ($m^3 \times 10^3$)**																
	84	204	181	227	340	374	368	363	385	456	261	235	317	207	139	173
Thinning Yield as a Percentage of Total **P. radiata** cut from Kinleith Forests																
								24%	27%	31%	17%	13%	16%	11%	7%	7%

* Including thinning to waste by machine crushing.

Mature Crop Thinning (planted 1926-35)

In 1958-9 356 ha were thinned and peak areas in excess of 1200 ha/yr were done during the period 1963-8. The operation was finished in 1971 when 10 230 hectares had been thinned. Logs from these thinnings formed a large proportion of the export log trade which the company entered in 1959. The average yield from this thinning operation was 280 m^3/ha. In spite of the fears, there has been almost no damage from wind (average height at thinning often over 40 m).

Thinning Burnt Areas (1947 establishment)

There was a particularly large fire in one of the company's blocks in 1946 when approximately 10 500 ha, mainly radiata pine, were burnt. The area became re-stocked immediately with natural regeneration and by age 3 there were over 1 million seedlings/ha. At first nothing was done to treat the high stocking and the block was virtually closed until the early 1960s. Thinning for post material began in 1962 but it was too slow, even though over 1 million pieces per year were produced by 1963. During 1963-66 a tractor crushing programme was embarked upon aiming at an arbitrary reduction of stocking to 500-600 stems/ha. It was done with a heavily protected Caterpillar D7 tractor. Approximately 1800 ha were treated during this time. Since 1970 production thinning has been speeded up in this block with approximately 400 ha/yr being done in which the stocking is reduced to 320-350 stems/ha. Pulp logs and fencing material are the major products (Parr, 1971).

Immature Crop Thinning

From 1962 every effort has been made to have all second crop and young stands thinned to schedule, concentrating at first on the untreated older stands known as "backlog". Once these were thinned the operation fell into a pattern of first thinning at 12-14 years and second thinning at 18-20 years, this being achieved by 1970. The annual programme often exceeds 600 ha/yr and will substantially increase in the future. Today, the prescription has been modified so that the time of thinning can be altered according to age stocking and height — *see* Table 2.

Wood from thinnings forms an important part of the total wood supply to the company's mills and receives priority in the logging programme. It has yielded all the round wood for preservative treating in the past, often reaching 1 million pieces per annum. A large proportion of the export volume in the early years of the trade came from thinnings and was a significant percentage of the total wood cut (*see* Table 1). When considering these percentages it should be noted that up until 1968 all wood used by the company came from its own forests, and today the percentage from our own forests is still very high. Thinning volumes produced are shown in Table 1.

METHODS

Techniques used for thinnings have evolved following orthodox lines. Horses, tractors, haulers and even portable wooden chutes for 1 m pulpwood, have been used (Harrison-Smith, 1955). Farm tractors and trailers were the first equipment for 2 m pulp, then crawler tractors of various sizes followed by rubber-tyred skidders—size and horsepower depending on tree spacing, tree size and ground slope. Average snig distance does not exceed 200 m. It has always been important to relate horsepower

TABLE 2—Thinning prescriptions (in stems/ha) for Kinleith Forests

Two-Thinning Regime				One-Thinning Regime —	
First Thinning; Age 13-15		Second Thinning: Age 19-21		Age 16-19	
Standing	Residual	Standing	Residual	Standing	Residual
1500	675	675	375	900	400
1400	650	625	375	850	475
1300	650	600	350	800	350
1200	650	575	350	750	325
1100	625	550	325	700	300
1000	600	525	300	650	300
950	550	500	300		
900	525	475	275		
850	500	450	275		

N.B.—The selected stands will be marked to a residual stocking dependent on their original stocking. The Marking Prescription table used for establishing check plots is as shown above. It is a target for marking and does not have to be rigidly achieved. Current planning uses thinning to increase uniformity over a whole timbershed.

to log or tree size and if possible, where volume per day is low, to use a machine which can do two or more jobs (Wren, 1965). With this end in mind a Drott with front log grapple loading was introduced.

Today short pulpwood (2 m) is cut and stacked at the stump, extracted in bundles with a rubber-tyred skidder and stacked in windrows at roadside. This permits optimum snig volume from small trees. It is then loaded with a rubber-tyred front end loader on to a specially designed truck deck for delivery and tipping into the mill stockpile.

For long-length thinning rubber-tyred skidders are used wherever possible up to 15° slopes and beyond that crawler tractors are used. Logging arches are not used unless they are an integral part of the machine as in skidders (Wyatt, 1971). Chainsaws are used for all felling, cross cutting and trimming.

No processor or truly multiple operation machines have been introduced but their development and application is being carefully watched. Dangers are seen in using sophisticated machines with multiple functions because of their inflexibility.

Thinning of steep slopes has always caused concern. For 2 or 3 years a small converted crane (RB10) was used for line thinning and proved very successful (O'Reilly and Mackintosh, 1973). The technique is now well proven but it needs a better machine for mobility, greater hauling distances (over 5 chains), speed of shifting and greater control of the logs. In the meantime this operation has been suspended but it is intended to restart it in 2 or 3 years' time when more area is available. A ski tow type of winch has also been tried but abandoned (Wilson, 1970).

Loading has always been done with either front end loaders or boom crane loaders on tracks. Little or no sorting is needed as the bulk of thinning wood goes to the pulp-mill. To assist loading and subsequent handling fixed log lengths are set for each dump plus the cutting of short ends which may either be mixed in with the long load

or loaded separately. The aim is to optimise loading, trucking, unloading, mill stockpiling and handling on to mill conveyors.

Areas are scheduled for thinning in the working plan on the basis of age. They are checked for stocking and height. If the thinning yield is below 56 m^3/ha it is postponed. A minimum yield is necessary to make the operation viable. Roads and loading dumps are planned and constructed where necessary. Marking is carried out by a Company gang using De Vilbis oil stream guns. Residual trees are marked with two spots of paint, one at ground level and one at eye level (McKenzie, 1970).

The marking prescription is indicated for each stocking class on prepared tables. The emphasis on first thinning is on vigour with spacing and form much less important. In second thinning spacing and form are given more recognition. The object of the marking in any stand is to help ensure that the thinnings will achieve their objective of maximising the harvest of usable wood from the stand. In applying the prescription it will generally be necessary to mark the trees which would be capable of adding to the stand's growth before the next thinning (Table 2).

Mechanical marking (strips, diameter limits, etc.) has been tried but has not been adopted (McKenzie, 1971).

Production is fitted into the logging programme against wood demands. Log quality and efficiency of production is controlled by the Logging Department. During thinning the stand is inspected by the Forestry Department to see that there is not excessive damage, trees are not poached and that there is a full clean-up.

Productivity

Currently all thinning is done on contract. Contractors are paid so much per tonne for wood prepared and delivered to the bush dump ready for loading. A system of rate setting prepared by W. D. Scott & Co. in 1961 has been largely followed ever since. It is based on costs of capital, return on capital, costs of labour, travel, administration, fuel, spare parts, R. & M. and so on, to arrive at a total annual turnover required. Against this is put the planned number of working days per year and the production expected per day for each major operation. It may be adjusted from time to time as costs and conditions change. The production rate is checked against the actual monthly and annual performances by each contractor and in the various conditions. It was originally based on work study methods and if necessary further work study checks are done especially if stand conditions change or the equipment changes drastically. Adequate allowances have been included for losses during wet weather and breakdown. The rates are considered very competitive but are made possible by allowing optimum production from each crew and its equipment, a practice rarely allowed in logging outside of the Company operations. Quotas are seldom imposed. The objective is to have the optimum combination of men and equipment to achieve the lowest unit cost. This can be achieved if those criteria are carefully equated to yield/ha, average piece size and permitted gang production per year (Wyatt, 1970; 1971). Some typical current contract rates are shown in Table 3.

The rates cannot be broken down into too many classifications for varying conditions because of the difficulties of control, recording and administration. Productions are processed every day through the computer, using data provided from the weighbridge area. The system could not cope with a multitude of changes. Operation classifications

TABLE 3—Current thinning rates (March 1975)

	Gang strength Men	Production tonnes/day	Rate $/tonne
1. Thinnings (30 yr Burn or backlog) 90 h.p. Skidder	4	56	3.42
2. 2nd Thinnings (18-20 yr) 90 h.p. Skidder	4	56	3.55
3. Thinnings 'A' (12-20 yr) 90 h.p. Skidder	4	49	4.10
4. Hauler Thinning (12-20 yr) R.B. 10 Crane	4	27	5.74
5. Short Pulp Extraction (up to 14 yr) 70-90 h.p. Skidder	3 + 10	71	6.38

(a) Rates are set for average conditions after considering the normal extent of variables.
(b) The above rates do not include stumpage or costs of roading and Company administration.
(c) These rates are payable to Contractors for felling, trimming, extraction and log preparation at roadside ready for loading, but not including loading.

and rates must therefore be averages which satisfy a reasonable range, subject to regular checks as mentioned above.

Labour

Marking for thinning is a very monotonous job, especially when large areas have to be done as will be the case in the future; hence the attempts to make it mechanical. However, these have been unsatisfactory and scattered marking is used to achieve as even a distribution as possible of those trees that are left. Staff need special training for this work and some variety in their work must be introduced. They are paid a bonus based on quantity and quality.

Production crews are all contract and this seems to result in the best relationships. Men on this work like the independence it affords which is particularly well illustrated by the ease of finding cutters for the short pulp thinning, most of whom are employed on piece work. However, the turnover of men is increasing and may be as high as 25% depending on the general supply of labour. Skilled men are difficult to employ so the contractor has to undertake some training. The Company prefers that the prime contractor is a member of the crew as this gives better leadership, contact, quality control, training and demonstration of safe working habits. All of these tend to result in better labour relations.

Restrictions and Limitations

There must be an adequate yield from thinnings to keep the costs acceptable and make it worthwhile for the contractor and his men to work happily.

The delivered cost of each type of wood must not upset the over-all cost average resulting from that mix.

Topography and soils restrict the ability to use processors or other sophisticated machines developed for rocky or more level ground overseas.

Up to date most second crop areas are not in lines as they result from natural

regeneration, aerial seeding or random blanking. Therefore they do not lend themselves to some equipment being developed for operating along rows.

Space in the forest may be too limited to allow some machines to work. This is why the short pulp operation is favoured even though it is labour intensive. Maximum recovery per hectare is an important factor too.

Mill site equipment will determine handling patterns at a later time. These cannot be overlooked if the total cost is to be kept down. For example, in the case of Kinleith Mills

(a) the barking drum handles 2 m lengths with a 10 cm minimum diameter
(b) the smallest ring barker on site will not handle wood under 15 cm in diameter
(c) The maximum small wood diameter is 40 cm
(d) the minimum length for efficiency of handling is 5 m, even though wood down to 3 m may be included
(e) the over-all wood range for optimum handling is up to 15 m length and 86 cm diameter, and down to 2 m length and 10 cm diameter. However, a limited amount of wood can be handled up to 120 cm diameter
(f) we supply 6 sawmills, the export trade, and the pulp mill which has 4 different barkers and chippers.

There is no common wood room, therefore the possible permutations and combinations if elaborate sorting were requested in the forest can be imagined.

As thinning wood is small in volume related to linear length, it must be presented in the best form possible at the right place in the mill yard if it is going to be used on occasions of temporary over supply in competition with large logs from clear-felling. This is another reason why stands in which trees removed as thinnings yielding predominantly less than .3 m^3/tree have the thinnings extracted as 2 m short pulpwood.

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