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PIECE SIZE CHARACTERISTICS OF MANAGED STANDS AFTER FELLING

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INTRODUCTION

Large radiata pine trees, when felled by traditional chainsaw methods, break when they hit the ground. There are many reasons for this breakage, some of which have been identified by Murphy and Gaskin 1982 (crossing other trees, crossing stumps, sharp changes of slope). Other reasons, not yet fully understood, relate to the physical structure of radiata pine and the dynamic forces involved when a tree strikes the ground. Little can be done to prevent stem breakage when using manual techniques, although directional felling can minimise the damage.

The nature of the pieces into which a tree breaks defines the size of pieces which an extraction system must handle, and limits their subsequent processing options. That the old crop broke into several merchantable pieces on felling is common knowledge. It is also well known that our more managed stands now coming on stream will break on felling. Since the characteristics of these merchantable pieces are not well known, a small study on piece size was carried out by the Forest Research Institute. As only two stands were measured, one in Kaingaroa State Forest, the other in Kinleith Forest, the results do not lend themselves to broad generalisations. Stands outside the Bay of Plenty may have different breakage characteristics.

STAND DETAILS

Both of the study stands had received pruning and thinning treatments although the timing and intensity differed. The important stand details are in Table 1. The stands were the same age but a higher site index at Kinleith and its more intensive thinning history resulted in it having a larger average tree size than did Kaingaroa (3.3 m^3 vs 2.4 m^3, respectively).

A common feature of the two stands was their relatively even and flat terrain (at Kinleith the terrain rose gently at one edge of the stand). The results of this study should be relevant to breakage occurring on steeper terrain since slope steepness has been observed to affect neither the number of pieces into which a tree breaks nor its break height (Murphy, 1984). However, the amount of breakage in this study is likely to underestimate that for dissected terrain, as sharp changes in slope are an important influence on stem breakage.

Table 1 - Details on the age and size of trees in the two study stands

	Kaingaroa	Kinleith
Age (years)	31	31
Live stocking (stems/ha)	300	211
Mean tree height (m)	39.4	44.5
Mean tree dbhob* (cm)	47	53
Mean total tree vol. (m^3)	2.4	3.3

* diameter at breast height, over bark

FELLING TECHNIQUE

The two stands were being clearfelled at the time of measurement, using typical techniques and extraction methods. The fallers would fell blocks or strips of the stand, making a reasonable attempt to minimise stem breakage. Wedges were used to direct the more difficult trees although

Murphy, G.; Gaskin, J. 1982: "Directional Felling Second Crop P. Radiata on Steep Country". LIRA Report Vol. 7 No. 1.

Murphy, G. 1984: "Felling Breakage and Stump Heights of a P. Radiata Stand in Tairua State Forest. New Zealand Forest Service FRI Bulletin No. 57.

driving was used periodically. Ground skidding methods were used for extraction.

Figure 1 - Leaving more of the top pieces behind may not create significant problems in re-establishment

MEASUREMENT METHOD

The sample trees in each stand were measured after a block had been felled but before any pieces were extracted. The lengths, diameters, and qualities of each merchantable piece (not less than 2.4 m in length and not less than 10 cm in small-end diameter) from a broken tree were recorded. Total tree height was recorded where possible by reconstructing the stem from all of the broken pieces, both merchantable and unmerchantable.

The data on the characteristics of tree breakage were collected as part of a large-scale study of value recovery. Therefore details on the value characteristics could also be subsequently calculated.

RESULTS AND DISCUSSION

(a) First Breakpoint

All of the sample trees broke on felling. The break diameter at the first breakpoint was 10 cm or greater in almost all of the trees (Table 2). The mean first break diameters were 22 cm and 25 cm for the Kaingaroa and Kinleith samples respectively, both just under half (47%) of their average stand dbhob. The first break height matched the usual approximation in the Bay of Plenty, being about two-thirds tree height.

Table 2 - Characteristics of First Breakpoint

	Kaingaroa	Kinleith
No. sample trees	200	159
Average break diameter o.b. (cm)	22	25
(range)	8-35	10-42
Proportion that broke with diameter >9 cm	99	100
Average relative break height (%)*	0.66	0.65
(standard deviation)	(0.10)	(0.09)

* as percent of total stem height

(b) Number of Merchantable Pieces

As current harvesting systems for clearfelling require all merchantable pieces to be handled individually, the <u>number</u> of merchantable pieces into which a tree breaks is important. The number of merchantable pieces above the first break varied from 0 to 3 (Table 3) in both stands. Also, the structure of breakage was similar for both stands; about 40% of the broken trees did not produce an additional merchantable piece above the first break, another 40% produced only one additional piece, with remaining proportions generating two and three extra pieces.

(c) Relative Importance of Butt and Top Pieces

The butt and top pieces were quite different - a result of stem taper and that the tree generally first breaks at two-thirds of total height. The butt pieces had larger volumes and lengths, and therefore are more likely to produce the higher valued, larger dimension products. In contrast, top pieces, although numerically important, produce mainly pulpwood. Thus, the tree can be divided into two sections of widely differing volume and value; the single butt piece and the combined top pieces.

The butt piece contained about 96% of the total merchantable volume and about 99% of the value in the two samples (Table 4). Obviously, the relative values used for the different products will affect these results but in this analysis the on-truck values between high and low value products were not atypical.

Table 3 - Number of Merchantable Pieces Above the Break

	Kaingaroa		Kinleith	
No. of merchantable pieces above 1st break	No. of trees in sample	% of sample	No. of trees in sample	% of sample
0	75	38	65	43
1	88	44	59	39
2	33	16	25	16
3	4	2	3	2
	200	100	152	100

Note : As some of the top pieces of 7 trees could not be located in the Kinleith sample, the total numbers of trees presented here is less than that in Table 2 (152 vs 159).

Table 4 - Comparison of Butt and Top Pieces

	Butt Piece	Top Pieces
Kaingaroa Stand		
Sample size	200	166
Average length (m)	26.1	4.4
Average volume (m^3)	2.23	0.12
Average value ($)	127.9	1.5
Approximate value per ha ($)	38370	370
% total merchantable volume	95.7	4.3
% total merchantable value	99.0	1.0
Kinleith Stand		
Sample size	152	118
Average length (m)	28.1	4.5
Average volume (m^3)	2.99	0.15
Average value ($)	148.5	2.1
Approximate value per ha ($)	31340	340
% total merchantable volume	96.3	3.7
% total merchantable value	98.9	1.1

Figure 2 - These two butt pieces will contain about 99% of the total merchantable value able to be produced from all of the pieces into which these trees broke

CONCLUSIONS

Trees will continue to break during clearfelling if the industry persists with manual chainsaw felling, as is likely for at least the next five to ten years. Furthermore, according to this study, the 30 year old, managed stands in the Bay of Plenty region will continue to break at about two-thirds tree height during harvesting. Therefore about 45% of the merchantable pieces to be extracted will consist of top pieces, but this 45% will constitute only 4% of the total volume of wood available and 1% of its total value.

Such statistics lend weight to the argument that if productivity of the extraction system were the sole criterion for deciding what should be extracted, then all of the top pieces should be left in the bush. Calculations at the Forest Research Institute based on data collected during the harvesting of the Kaingaroa stand indicated a potential increase in production of 23% with an attendant 18% decrease in logging costs if the butt pieces alone were extracted (pers. com. M. McConchie, FRI). This increase corresponds to a reduction in logging costs of c. $1000/ha.

Increased re-establishment costs have the potential to offset the reduced logging costs. However, the effect of leaving an additional 25 tonnes of wood on each hectare is unlikely to markedly increase re-establishment expenditure. Even the worse case, of having to carry out a burn which otherwise could have been avoided, would only increase costs by about $150/ha (pers. com. P. Robin, Kaingaroa Forest).

A factor that can over-ride the considerations of both logging and establishment costs is a need for wood fibre in periods of wood shortage. Pulp mills demand a regular source of raw material and the top pieces represent a relatively easily exploitable resource.

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