COMPARISON OF LOW PRUNING SELECTION METHODS IN RADIATA PINE

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ABSTRACT

A possible explanation for the failure of much past pruning to achieve the objective of having all final crop trees pruned is that the method of selecting trees for pruning could have excluded many potential final crop trees. This study compares two variants (including and excluding missing trees) of six selection methods for low pruning (below **ca.** 2.4m (8 ft) in two stands of radiata pine (**Pinus radiata** D. Don).

As measured by the total number of normal dominants selected, the order of efficiency of the methods tested was: best of 2 trees in 4; best of 1 tree in 2, and 1 tree in 3 "Queensland" (both more or less equal); best of 1 tree in 4 "Queensland"; best of 1 tree in 3; best of 1 tree in 4. Even when perfectly applied no method could guarantee that every normal dominant would be selected. The only means of ensuring this would be to adopt a system in which all acceptable stems are selected irrespective of spacing. Including or excluding missing trees had little effect on the comparisons.

An analysis of the reasons for variations between experienced workers showed that misinterpretation of priorities was the most common fault. Also important were failure to see malformation, choices between trees of more or less equal status, and differences in the assessment of the relative significance of types of malformation.

INTRODUCTION

The object of this study was to compare the efficiency of various methods of selection in the low pruning of radiata pine.

Almost without exception selective pruning in the past has failed to achieve the objective of a final crop containing only pruned trees. The possible explanations are many, but, assuming subsequent thinnings were efficiently executed, the two most likely causes are:

(1) The method of selection excluded many potential final crop trees and wasted effort on malformed or low status trees.

(2) Selective pruning reduced the competitive ability of the pruned stems so much that they no longer remained in the dominant element.

The second aspect is currently being evaluated in a series of comprehensive trials (Sutton and Crowe, 1968).

With the increasing emphasis being given to early thinning, selection methods for the final lift, and possibly the intermediate lift, become of lesser importance, as deliberate releasing of the final crop trees can ensure their continued existence. What is important is that the method of selecting trees for low pruning ensures there are adequate quality stems for later selection. Low pruning every tree would ensure this, but it would be wasteful—100% pruning is probably only justified on the grounds of fire protection, which is normally not considered of major significance in New Zealand. Any other method of low pruning implies some method of selection.

STUDY DESIGN

Most methods of selection for low pruning radiata pine currently in use fall within the following range:

Select best of:

one tree in two = '1 in 2'
one tree in three = '1 in 3'
one tree in four = '1 in 4'
two trees in four = '2 in 4'
one tree in three "Queensland" = '1 in 3Q'
one tree in four "Queensland" = '1 in 4Q'

The "Queensland" method as used in New Zealand, can be defined as follows:

From the first three (or four) trees in a row select the best tree; then take the three (or four) trees immediately following the selected tree and again select the best, and so on.

The "best" tree is usually determined firstly by dominance, secondly by form, and thirdly by spacing. In the past, emphasis is reputed to have been placed on form rather than on dominance.

All of the basic methods have at least two possible variants, viz.:

(a) Including gaps—with obviously missing trees counting as a "tree" for selection.

(b) Excluding gaps—with only living trees being considered.

A comparison of all methods and their variants from the assessment of actual field applications was considered impractical as the trial area would be too large—at least 2.5 hectares (6 acres) for each operator. It was considered that since actual pruning of the trees was unnecessary (all that was required was a record of the individual trees selected) directly comparable results would be obtained by repeating the selection methods in an unpruned plot. This would also allow direct comparisons between operators.

STUDY METHODS

For the trial, two 0.2 ha (½-acre) blocks on the northern boundary of Kaingaroa Forest were selected at predominant mean height (PMH) of *ca.* 4.5 and 7.5 m (15 and 25 ft) respectively, representing an early and a late low pruning. Rows were designated A, B, C, etc., and all trees within a row were numbered consecutively. All trees were then assessed for diameter at breast height (d.b.h.), crown class, and the incidence, type, and severity of malformation.

Master plot sheets were prepared to show the nominal position of every tree and every gap. These were printed and used as the basic recording form for the study.

Each selection method and its variants was then "applied" to each plot by seven experienced operators. All operators were instructed that the basis of selection must be primarily on dominance and secondarily on form. Spacing was only to be considered where trees were similar in dominance and form. However, all operators did not test every combination of selection methods and plots.

The "excluding gap" variants were not applied in the late pruned block.

RESULTS AND DISCUSSION

The basic information on the two selection areas (all expressed on a per hectare basis) is summarised in Table 1.

TABLE 1—Study area characteristics

Plot	PMH*	Stems per Hectare						Total
		Dominants		Co-dom.		Sub-dom.		
	(m)	Normal	Mal.	Normal	Mal.	Normal	Mal.	SPH
1	4.5	281	227	277	370	204	237	1,596
2	7.5	637	395	341	346	79	168	1,966

* Predominant mean height

The differences in the composition of the two stands may be more apparent than real, for the data for the two plots may not be strictly comparable. The assessments were made at different times and limits of dominance and malformation may have been more strictly applied in plot 1. The operators concerned had already completed the study in plot 2, had worked on other pruning studies, and on a sawmill study of log malformation, all of which would increase their awareness of the importance of these aspects of assessment especially with the more intensive selection methods.

The number of trees selected by each method of selection is given in Table 2 together with a breakdown by dominance and malformation classes.

TABLE 2—Comparison of selection methods

Method of Selection	Dom. Norm.	Dom. Mal.	Co-dom. Norm.	Co-dom. Mal.	Sub-dom. Norm.	Sub-dom. Mal.	Total Selected*
	Stems per Hectare Selected						
Including gaps (PLOT 1)							
'1 in 2'	255	185	160	170	550	650	890 (420)
'1 in 3'	205	155	72	85	30	35	580 (275)
'1 in 4'	205	85	50	70	10	10	430 (165)
'2 in 4'	260	170	165	165	40	55	855 (390)
'1 in 3Q'	255	175	120	150	40	60	800 (385)
'1 in 4Q'	235	155	65	115	20	35	625 (305)
Excluding gaps (PLOT 2)							
'1 in 2'	245	170	150	150	35	60	810 (380)
'1 in 3'	210	130	80	95	20	30	565 (255)
'1 in 4'	185	95	60	50	10	30	430 (160)
'2 in 4'	280	170	170	145	35	40	840 (355)
'1 in 3Q'	240	155	100	100	15	40	650 (295)
'1 in 4Q'	220	110	75	80	15	20	520 (210)
Including gaps (PLOT 2)							
'1 in 2'	485	220	175	120	35	40	1,075 (380)
'1 in 3'	425	125	110	55	15	20	750 (200)
'1 in 4'	355	95	70	25	10	5	560 (125)
'2 in 4'	550	200	190	110	30	30	1,110 (340)
'1 in 3Q'	535	175	180	80	35	30	1,035 (285)
'1 in 4Q'	470	105	140	60	150	25	815 (190)

* Number of these malformed in brackets

Before discussing the results it must be stressed that they represent almost perfect application of the selection methods. Operators were not restricted by time and, after the first two or three selections, they would have become familiar with most of the trees in the plot. It would be unlikely that these results could be achieved in normal practice but this should not reduce the value of the study as any reductions in efficiency would influence each selection method equally.

Efficiency of Selection Methods

The efficiency of a pruning selection method can be measured in several ways but the two most practical indexes are:

(1) Percentage of normal dominants selected to total normal dominants;

(2) Percentage of normal dominants selected to total stems selected.

Comparisons are given in Table 3.

TABLE 3—Relative efficiency of selection methods

Method of Selection	Total Normal Doms S.P.H.	Percentage of total normal dominants selected	
		To total normal dominants	To total stems selected
Including gaps (PLOT 1)			
'1 in 2'	281	89.5	28.6
'1 in 3'		71.9	35.3
'1 in 4'		71.9	47.7
'2 in 4'		91.2	30.4
'1 in 3Q'		89.5	31.9
'1 in 4Q'		82.4	37.6
Excluding gaps (PLOT 1)			
'1 in 2'	281	85.9	30.3
'1 in 3'		73.7	37.2
'1 in 4'		71.9	47.7
'2 in 4'		98.2	33.4
'1 in 3Q'		84.2	36.9
'1 in 4Q'		77.2	42.3
Including gaps (PLOT 2)			
'1 in 2'	637	75.1	45.1
'1 in 3'		65.9	56.7
'1 in 4'		55.2	63.4
'2 in 4'		85.3	49.6
'1 in 3Q'		83.0	51.7
'1 in 4Q'		72.8	57.7

On the basis of the index of the percentage of pruned to total normal dominants the '2 in 4' is clearly the most efficient selection method, but it does not guarantee that every acceptable tree would be pruned. In Plot 2 (a representative composition) only 85% of the total acceptable stems were selected. A theoretical selection in this plot using the '1 in 2', "excluding gap" method, gave a similar result to the "including gap" method.

The commonly used methods of '1 in 2' and '1 in 3' were considerably less efficient than '2 in 4'. The '1 in 4' method, although clearly the least wasteful in terms of pruning poor quality stems, selected only 55%-70% of the best stems.

In terms of the total number of normal dominants selected the '1 in 3Q' method proved similar to the conventional '1 in 2', and the '1 in 4Q' similar to the '1 in 3', but in both cases the total number of stems selected was less. The '1 in 3Q' method was, however, still less efficient than the '2 in 4' method.

Inclusion of gaps should in theory improve efficiency, but in practice the improvement appears to be only marginal.

These results imply that the only means of ensuring that all suitable trees are pruned is to adopt the simple selection system of pruning every acceptable stem irrespective of spacing and other considerations. This is now the practice in many forests.

Analysis of the Differences between Operators

As might be expected operators did not consistently select the same trees. Possible reasons for disparities in selection were:

(a) Priorities misinterpreted—selection on form rather than dominance;

(b) Failure to see malformation—understandable in unpruned stands;

(c) Difficulty in choosing between trees of more or less equal status;

(d) Difficulty of assessing the relative importance of types of malformation.

An analysis of the disparities in selection for the "excluding gap" variants is given in Table 4. The "Queensland" methods were excluded, as, after the first selection, the choice might not be between the same set of trees.

As might have been expected the highest proportion of disagreement occurred in the selection method where the choice was greatest (i.e., '1 in 4'). The '1 in 2' selection method proved slightly less consistent than its near equivalent, the '2 in 4'. This suggests that the '2 in 4' selection may be easier in practice than the '1 in 2'.

Misinterpreted priorities generally proved to be the most common reason for disagreement.

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TABLE 4—Possible reasons for disagreement between operators

Selection method	Total S.p.h. selected	S.P.H. in total agreement	No choice*	Possible Reason for Disagreement: (a) Priorities wrong		(b) Malformation not seen		(c) More or less equla status		Malformation significancs		Disagreement Totals		
				by 1†	by 2+	by 1	by 2+	by 1	by 2+	by 1	by 2+	by 1	by 2+	all
'1 in 2'	810	505	25	65	55	20	75	50	25	10	5	145	160	305
'1 in 3'	565	320	30	55	45	45	35	20	25	10	10	130	115	245
'1 in 4'	430	185	20	40	50	85	20	20	55	5	25	150	145	295
'2 in 4'	840	595	60	35	50	35	20	10	35	25	35	105	140	245

* No choice = at end of rows where no selection was required.

† by 1 = only one of the seven operators in disagreement with other six.

by 2+ = where two or more in disagreement with the majority.