FURTHER NOTES ON WOODHILL RADIATA PINE PRUNING TRIAL A.383

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SYNOPSIS

In the interval between low pruning radiata pine at predominant mean height (pmh) 5 metres and first thinning at pmh 14 m, individual stems show marked changes in dominance. Pruned dominants in a high density pruning treatment display greater diameter growth than pruned dominants in a low density pruning treatment, the greater growth occurring on the larger-diameter trees. At about pmh 12 m and with relative spacing of 19%, canopy closure is complete, and associated with more intense crown competition there is a fall from 990 to 430 dominant stems per hectare. Unless thinning occurs at this time to release pruned stems from competition with unpruned dominants, suppression of pruned stems may follow.

INTRODUCTION

At the time of selection for second or third stage pruning, rapid change in crown dominance of young radiata pine has on occasions forced the selection of a proportion of stems which were not pruned at the first pruning lift. Furthermore, at the time of first utilization thinning, many unpruned dominants may be retained as the future main crop at the expense of pruned codominants. From an investigation conducted at Woodhill Forest to study the change in the pattern of crown dominance of radiata pine following pruning, Armitage (1970) found that change of dominance did occur, with a marked tendency for vigorous codominants to grow into and enlarge the dominant class, and with an indication that the movement of pruned codominants into the dominant class is proportional to the density of pruning. Further, as expected, there was an inverse relationship between pruning density and mean diameter of pruned trees, whilst pruned dominant trees in a high density pruning treatment displayed greater diameter growth than dominants in lower density pruning treatments. The greatest amount of diameter growth upon pruned trees was found on the largest diameter trees. Armitage also found that amongst all stems there is a tendency for the larger codominant and subdominant trees to grow into the next dominance class upwards. These results are illustrated along with more recently derived data in Tables 1 and 2, and further results of the investigation into the pattern of crown dominance change are presented in these notes.

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TABLE 1: RELATIVE FREQUENCY DISTRIBUTION BY DOMINANCE CLASS OF HIGH PRUNED TREES OR TREES MARKED FOR HIGH PRUNING

			Distribution (%)					
	Date	*pmh (m)*	*Control 620 stems/ha marked only (a)*	*300 stems/ha one lift to 5.5 m (b)*	*300 stems/ha Two lifts (c)*	*620 stems/ha Two lifts (d)*	*1240 stems/ha Two lifts (e)*	*Distribution All Stems, All Plots*
Dominant	Nov. 1967	7.3[1]	100	100	100	74	44	34
	Nov. 1968	9.5	98	100	100	76	51	47
	Sep. 1969	11.0[2]	100	100	100	100	100	52
	Dec. 1970	13.0	67	58	66	47	62	20
Codominant	Nov. 1967	7.3	0	0	0	26	53	39
	Nov. 1968	9.5	2	0	0	24	48	35
	Sep. 1969	11.0	0	0	0	0	0	34
	Dec. 1970	13.0	33	38	34	53	38	54
Subdominant	Nov. 1967	7.3	—	—	—	—	3	26
	Nov. 1968	9.5	—	—	—	—	1	16
	Sep. 1969	11.0	—	—	—	—	—	12
	Dec. 1970	13.0	—	4	—	—	—	22
Suppressed	Nov. 1967	7.3	—	—	—	—	—	1
	Nov. 1968	9.5	—	—	—	—	—	2
	Sep. 1969	11.0	—	—	—	—	—	2
	Dec. 1970	13.0	—	—	—	—	—	4

[1] 0 to 2.4 m pruning carried out in Nov. 1967, hence first two measurements refer to all pruned stems.
[2] 2.4 to 5.5 m pruning carried out in Sep. 1969, last two measurements refer to high pruned stems only.

TRIAL DESIGN

The trial was designed to examine the extent of the change in the pattern of tree crown dominance following pruning and the relationships, if any, between changes in tree dominance with stem diameter. The trial was replicated in two different stands of radiata pine planted in 1962, and each consists of a series of five plots of 405 m². The trial areas had a mean stocking of 1932 stems/ha when the trial began. Treatments were as follows:

(a) Control — no pruning, but the stand marked to simulate pruning at 620 stems/ha.
(b) 300 stems/ha given a single pruning lift 0 to 5.5 m.
(c) 300 stems/ha pruned to 2.4 m and later to 5.5 m.
(d) 620 stems/ha pruned to 2.4 m and later to 5.5 m.
(e) 1240 stems/ha pruned to 2.4 m and later to 5.5 m.

Stems were pruned to 2.4 m in 1967 at predominant mean height (pmh) of 7.3 m, and to 5.5 m in 1969 at pmh 10.7 m. In the absence of well-defined units of dominance class, the ranking of crown class at periodic assessments formed the basis of the study, trees being classified according to their crown level relative to surrounding trees.

RESULTS

Changes of Dominance for All Trees

Change in the pattern of dominance at subsequent assessments is illustrated in Table 1.

In general the proportion of dominants has increased by 10 to 14% between pmh 7.3 m and 9.5 m, and by 18 to 22% by pmh 11.0 m. However, between pmh 11.0 m and pmh 13.0 m there has been a dramatic fall in the number of dominant stems from 990 to 430 stems/ha. This is a reflection of the intense canopy competition that has followed canopy closure. It occurred at about relative spacing of 19%, and is associated with marked increases in the numbers of subdominant and suppressed trees and the occasional dead tree, in both trial areas.

TABLE 2: GROWTH OF PRUNED STEMS BY DIAMETER CLASSES

Diameter class (cm) at pmh 7 m	*Growth in dbh (cm) at pmh 9.5 m*
8	1.7
10	2.1
12	2.3
14	2.5

TABLE 3: MEAN DIAMETER (cm) OF HIGH PRUNED TREES, OR TREES MARKED FOR HIGH PRUNING

Treatment	Nov. 1967[1]			Nov. 1968[1]			Sep. 1969[2]			Dec. 1970[2]		
	Dominant	Codom.	Subdom.	Dominant	Codom.	Subdom.	Dominant	Codom.	Subdom.	Dominant	Codom.	Subdom.
Control (620 stems/ha marked)	12.4	9.9	—	15.2	14.2	—	17.5	16.0	—	19.6	17.8	—
300 stems/ha one lift to 5.5 m	11.9	—	—	14.5	—	—	16.3	—	—	17.0	16.8	15.5
300 stems/ha	12.9	—	—	15.5	—	—	17.0	—	—	18.0	17.3	—
620 stems/ha	12.7	10.7	—	15.0	12.2	—	16.8	—	—	18.0	17.3	—
1240 stems/ha	11.9	9.7	8.4	14.2	11.4	9.4	16.8	—	—	18.3	16.3	—

[1] 0 to 2.4 m pruning carried out in Nov. 1967, hence first two measurements refer to all pruned stems.
[2] 2.4 to 5.5 m pruning carried out in Sep. 1969, last two measurements refer to high pruned stems only.

Change of Dominance for Pruned Trees and Trees marked for Pruning

It is clear that a pattern of movement exists between dominance classes for pruned trees and trees marked for pruning, even during the relatively short periods illustrated in Table 1. This shift is minimal for the 300 stems/ha and control treatments, but in the 620 stems/ha and 1240 stems/ha low pruning treatments there has been a substantial increase in the percentage of pruned dominant trees. The relative frequency of pruned codominants has correspondingly decreased; there have been changes in the proportions of trees in each class; and substantial interchange between dominance classes has occurred especially with the 1240 stems/ha treatment.

At about pmh 12 m there is a marked reduction in the number and proportion of pruned stems in the dominant class. The reduction in pruned dominants is about 33% greater than the decline in the number of dominants overall, and at least some of the pruned dominants have been outgrown and replaced by fully crowned (unpruned) codominants. Table 1 shows that 47 to 60% of the high pruned trees retain dominant status at pmh 13 m, and this amounts to only 140 to 200 of the original high pruned crop stems/ha. It is probable that a thinning designed to release high pruned stems from competition and given immediately after high pruning would have prevented this suppression.

Relationship between Changes in Tree Dominance with Stem Diameter

Economics of pruning are dictated by the amount of clearwood produced under any particular pruning regime, hence the need to examine relationships between tree dominance and stem diameter. Armitage found, as expected, an inverse relationship between the diameters of pruned trees and the number of stems pruned per unit of area. However, the magnitude of the difference between mean diameter of the pruned stems at each pruning intensity was found to increase with time, confirming that in general the largest pruned stems have the greatest diameter growth. This is illustrated with data from the two 1240 stems/ha plots shown in Table 2.

Tracing the movement of individual trees between assessments indicates a trend for larger diameter codominant and subdominant trees to grow into the next class upwards and the smaller diameter dominant and codominant trees to be outgrown and reduced to lower crown status.

After high pruning of 300 stems/ha in each of the treatments in 1969 it became apparent that the high pruned stems in the higher density pruning treatments were growing more rapidly than those of the low density pruning treatments. This is illustrated in Table 3.

The 620 stems/ha which were marked but not pruned in the control plots have throughout maintained the highest growth rate. While there has also been a noticeable reduction in the number of dominant stems per hectare at canopy closure, it should be realized that, whereas data for other treatments refer to 300 stems/ha following high pruning, the

data for the control plot in all cases refer to 620 marked stems per hectare.

The conclusion is that, while unpruned trees are likely to undergo change in dominance, primarily during the reorganization in the canopy at canopy closure, most change in dominance is due to pruning. Removal of part of the crown reduces the ability of the pruned tree to compete. At high pruning frequencies most of the pruned trees' neighbours are also pruned and the likelihood of the more dominant trees being suppressed is reduced. In the 1240 stems/ha treatment, the majority of the dominant and codominant stems were pruned as also were several of the subdominant stems. The chance of unpruned subdominant and suppressed stems successfully competing with, or dominating, the pruned stems is then small. Conversely, the single 0 to 5.5 m pruning lift on 300 dominant stems in the second treatment has left these stems vulnerable to suppression by the remaining unpruned dominant and codominant trees. The result was that several of the high pruned stems in this later treatment were severely suppressed.

DISCUSSION

Armitage has established change in dominance of young radiata pine stands with a marked tendency by codominants to move into and enlarge the dominant class, and with an indication that the movement of pruned codominants into the dominant class is proportional to pruning. At about the time of high pruning this trend reaches its maximum, being followed by a sudden decline in the number of dominant stems per hectare. During this period up to 50% of the high pruned stems assume positions of lower dominance in the canopy. It is probable that a thinning designed to release high pruned stems would prevent this suppression and any subsequent loss of increment.

The change of dominance following low pruning is also notable; unpruned trees grow more rapidly than pruned trees and are thus found in higher dominance classes, while pruned trees lag behind. The ability of the pruned trees to compete is greatest at the higher pruning intensities, and at each intensity it is the larger diameter stems which grow fastest. A tending regime which prevents pruned stems from coming into direct competition with unpruned stems, such as the Rotoehu schedule (thinning to 740 stems/ha immediately following low pruning) would minimize the risk of pruned tree suppression and of reduced diameter growth rates.

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REFERENCE

Armitage, I. P., 1970: A study of change in the pattern of crown dominance following pruning in radiata pine stands at Woodhill Forest. In *N.Z. For. Serv. For. Res. Inst. Symp. No. 12.*