SCHEDULING SILVICULTURE AT KAINGAROA

J. W. SHIRLEY and R. J. COKER*

ABSTRACT

Procedures to assist the scheduling of radiata pine stands for silvicultural treatment at Kaingaroa State Forest are described. The scheduling system requires field measurements of individual stands to be taken at convenient times and input to a forest data base. Subsequently the data can be accessed at any time and used in a height forecasting system that models the monthly variation in height growth and estimates the expected predominant mean height over a 24-month period. The procedure ensures that forecasts of treatment dates are routinely based on the best and most recent data available.

INTRODUCTION

The annual programme of silvicultural tending at Kaingaroa State Forest involves scheduling and executing waste-thinning and pruning operations on some 35 000 ha of radiata pine. A total of about 600 stands are involved. In order to achieve the forest's silvicultural objective of producing sawlogs of large diameter with a small defect core, it is vital that each individual crop tree be pruned at an age which will minimise the defect core diameter with minimal effect on subsequent growth. In practice this involves determining the month and year in which each stand will reach the predefined threshold value of predominant mean height at which the next pruning treatment is due, and organising the treatment of the stand to coincide. This paper describes the procedures used to achieve this objective. It involves a field measurement to determine the condition of each stand, a data base system to store the data and make it available at any time for analysis, and a month-by-month height projection procedure involving site index curves applicable to radiata pine at Kaingaroa.

*Forest Officers, Kaingaroa Forest, N.Z. Forest Service.

ASSEMBLING THE DATA

Kaingaroa forest is fortunate in having access on the forest to a computer data base called the Stand Record System, which contains all the data describing the current condition and silvicultural history of each and every stand in the forest. The structure of this data base and the data items stored for each stand are described elsewhere (Shirley, 1984). For the silvicultural scheduling application, the following items of information for selected stands can be extracted and summarised at any time, as shown in Table 1:

Forest name (FRST)
Compartment number (COMPT)
Stand number (STD)
Species code (Spec)
Establishment year (Yr)
Net stocked area (NSA)
Month of last measurement (LMMONTH)
Year of last measurement (LMYEAR)
Predominant mean height (m) at last measurement date (LMHEIGHT)
Height model code (HMOD)

The measurement information can be amended at any time by processing a "Measurement or Thinning" transaction (as in Fig 1) through the data base's update system. In practice these transactions are processed prior to the first thinning treament, at about age four or five, and subsequently, immediately after each pruning treatment. In the former case the measurement is obtained by an extensive special purpose survey and thereafter during field supervision of the actual pruning operation. From this information the height model code identifies a set of site index curves developed by Garcia (1983) for radiata pine at Kaingaroa.

TABLE 1: DATA AVAILABLE FROM THE DATA BASE FOR USE IN TREATMENT SCHEDULING

FRST (CPT/STD)	*SPEC*	*YR*	*NSA*	*LMMTH*	*LMYR*	*LMHGHT*	*HMOD*
Kang (0037/05)	P.Rad	(79)	1.7	8	84	5.3	H30
Kang (0052/02)	P.Rad	(79)	16.2	8	84	6.5	H30
Kang (1157/01)	P.Rad	(80)	34.0	8	84	4.8	H30
Kang (1216/01)	P.Rad	(80)	15.7	8	84	5.7	H30

STAND RECORD SYSTEM

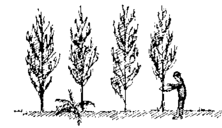
Mandatory entries are shaded

CROP MEASUREMENT OR THINNING

Transaction type and batch sequence number: 1 E M 1 | 4–9

Stand and Crop Identifiers: 10 Forest | 14 Compt / 18 Stand & 22 Species | 27 Year

Date of measurement: 29 Month / 31 Year



Measurement Event Code (applies to entire NSA): 33

- I - Independent Management Inventory
- W - Waste thinning
- Y - Yield thinning
- E - Establishment fail
- F - Fire loss
- G - Wind loss
- C - Other contingency (note)

Measurement Type Code: 34

- R - Rate setting quality control
- F - Firths
- Q - Qadi
- M - Marvl
- P - Perm - sample plot
- E - Eyeball

Crop stocking, basal area and top height (applies to entire NSA): 35 Stocking s/ha | 40 Basal Area m^2/ha | 44 Height m

Growth Model Identifiers (if change required): 48 Model | 51 Height/Age

Use height and age to recalculate site index? 47

- Y - Yes
- N - No

Thinning details: (if event W or Y): 54 Prior Stocking s/ha | 59 Area Treated ha (Default is NSA)

Notes: Keep notes brief! 1–40

N	
N	
N	

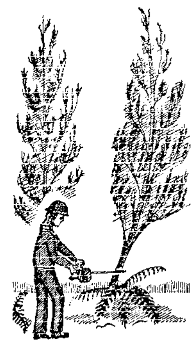


FIG 1: *Crop measurement or thinning.*

FORECASTING FUTURE HEIGHT

Increment in height growth of radiata pine at Kaingaroa varies from month to month. A peak in monthly height growth occurs in spring (Jackson *et al.,* 1976). Garcia (1979) has developed a procedure with which the annual increment in height growth, predicted as a function of age and site index using a site index function, can be apportioned to each month, thus allowing the monthly height increment of stands of varying site index to be estimated. This procedure is similar in principle and effect to that used by program EARLY in the SILMOND system (Whiteside and Sutton, 1984).

This month-by-month height increment prediction procedure has been incorporated into a computer program which accepts data as illustrated in Table 1 as input. The output from the program is illustrated in Table 2. For each stand selected from the forest data base, for which measurement data are available, a forecast of the predominant mean height at twelve one-monthly intervals is produced. For a second twelve-month period, a two-monthly prediction interval is adopted.

The base date for the two-year prediction period is the month and year in which the report is run, irrespective of the dates of measurement of the stands selected from the data base. By examining this report, the month and year at which each stand is expect-

TABLE 2: SCHEDULE OF FORECAST HEIGHTS
(SITE = ESTIMATED SITE INDEX)

FRST (CPT/STD)	*SPEC*	*YR*	*NSA*	*LMMTH*	*LMYR*	*LMHGHT*	*SITE*									
Kang (0037/05)	P.Rad	(79)	1.7	8	84	5.3	27.8									
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Jan	Mar	May	Jul
5.6	5.9	6.1	6.4	6.5	6.6	6.7	6.7	6.7	6.8	6.8	6.9	7.4	7.9	8.2	8.2	8.3
Kang (0052/02)	P.Rad	(79)	16.2	8	84	6.5	31.6									
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Jan	Mar	May	Jul
6.9	7.2	7.5	7.8	7.9	8.1	8.1	8.2	8.2	8.2	8.3	8.5	9.0	9.6	9.9	10.0	10.1
Kang (1157/01)	P.Rad	(80)	34.0	8	84	4.8	31.8									
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Jan	Mar	May	Jul
5.1	5.4	5.8	6.0	6.2	6.3	6.4	6.4	6.4	6.5	6.5	6.7	7.2	7.8	8.1	8.2	8.3
Kang (1216/01)	P.Rad	(80)	15.7	8	84	5.7	35.0									
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Jan	Mar	May	Jul
26.1	6.5	6.8	7.1	7.3	7.4	7.5	7.6	7.6	7.7	7.7	7.9	8.5	9.2	9.5	9.6	9.7

ed to require its next treatment can be determined. Field checks a month or two prior to the forecast date can then be planned to confirm the prediction.

Results so far indicate that the predictions of top height are very close to those measured in the field. The technique therefore has good field management support. The initial (age 4–5) height survey can be completed at a rate of about 300 ha per man-day. Subsequent top height measurements are collected at quality control time and have minimal impact on supervision costs.

CONCLUSION

Various methods of scheduling stands for silvicultural treatment at Kaingaroa have been used over the last twenty years, ranging from application of average growth rates for groups of stands in various parts of the forest, to the application of regional growth rates to measurements in individual stands. The large number of stands involved made these largely manual methods error prone and tedious. Stand specific data were rarely used. The technique described in this paper takes advantage of the order imposed by the availability of a computerised forest data base to forecast height growth for individual stands based on the most recent relevant data. Improvements in the timing of silvicultural treatments should result.

ACKNOWLEDGEMENT

The routines to forecast top height as a function of site index and age were written by J. V. Leitch and incorporated into the height prediction system by A. K. Campell.

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