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FRI/INDUSTRY RESEARCH COOPERATIVES

MANAGEMENT OF IMPROVED RADIATA BREEDS COOPERATIVE

FOREST RESEARCH INSTITUTE
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ROTORUA

PERFORMANCE OF IMPROVED P. RADIATA BREEDS ON NEW ZEALAND SITES

M.J. CARSON

Report No. 4 September 1988

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Note : Confidential to Participants of the Management of Improved Radiata Breeds Cooperative

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EXECUTIVE SUMMARY

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Current models of growth and log quality are routinely used to evaluate management strategies and to justify purchase and planting of new land. However, recently developed improved radiata pine seedlots will grow differently from the unimproved seedlots that provided the database for the stand models of growth and log quality (as supplied in STANDPAK). This report provides interim estimates of adjustments that can be made to STANDPAK runs so that resulting predictions more accurately reflect the performance of improved seedlots. These adjustments are intended to be applicable over most New Zealand sites, but FRI staff can supply estimates tailored to particular regions (and models) if required.

Research in progress in both the Management of Improved Breeds and Stand Growth Modelling Cooperatives is being directed at improving current models and establishing trials to ensure that future models will be based on data applicable to the improved breeds.

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INTRODUCTION

Forest planners can confidently expect large improvements in growth and yield, and significant changes in log quality from use of improved radiata pine breeds. Breeds currently available include a Growth and Form (GF) Breed, a Long-internode (LI) Breed, a Dothistroma-resistant (DR) Breed, and a High Density (HD) Breed. Although understood in general terms, these genetic changes cannot yet be accurately predicted, partly because of a lack of data on mid- to end of rotation performance of the different breeds in different regions, and partly because of genetic variation among the unimproved "base populations" against which genetic gains must be measured.

Additional "genetic gains" in the form of cost reductions and increased profitability will arise from managers making appropriate decisions on how the improved breeds will be used, including:

* whether to extend limited supplies of top-quality seed through juvenile vegetative multiplication by cuttings
* whether to use "aged" cuttings to obtain early form advantages on highly-fertile sites
* correct choice of breed for site and end-use
* correct choice of initial stocking
* whether to prune, to what height, and on how many trees?
* how many thinnings, and to which final stocking?

DISCUSSION

Planning for areas not yet planted requires a "best estimate" of what genetic gains can be expected if good management practices are followed. Table 1 summarises an FRI current "best estimate", expressed in a form that can be used as input to current models of growth and log quality (e.g., STANDPAK).

In excess of 30% of establishment and tending costs can be saved by lowering initial stockings for radiata pine with GF ratings of 16 or above (Appendix 1). Initial stockings of 500-600 stems/ha are sufficient for direct sawlog regimes,and stockings of 600-1000 stems/ha should prove suitable for regimes with production thinnings. Highly fertile (often ex-farm) sites can cause form problems even when using improved stock. "Aged" cuttings from 3-4-year-old trees are preferred for such sites

Gains in growth rate for improved seedlots can be simulated using growth models developed for unimproved stands, by editing rotation-end values for growth parameters. Current research is aimed at improving the estimates in Table 1 (column 4 and 5) and determining whether improved seedlots have similar height/diameter and height/age relationships to each other, and to unimproved stands at comparable stocking.

The effects of leader malformation and stem sinuosity can be crudely simulated by altering the log sweep class in STANDPAK for a seedlot (column 6, Table 1). However, this change is probably conservative, since it only affects the conversion rate from roundwood to sawn timber, and takes no account of either:

(i) sweep of young trees, and its effect on clearwood production and/or
(ii) loss of merchantable volume/hectare due to stem malformation.

Changes in branch size and internode length (columns 7 and 8, Table 1) tend to be associated. They can have large effects on predicted log or sawn timber grade percentages, favouring clearcutting grades for long internode trees and framing grades for the more multinodal trees of the Growth and Form breed.

The percentage changes in wood density predicted for seedlots in Table 1 are small relative to changes in growth and form traits and their impact on profitability may also be small. However, a High Density breed has been developed, and a seedlot currently available should yield increases in average density of around 12 kg/m^3 in most regions.

Gains in dothistroma resistance should reduce aerial spraying costs as well as 'recovering' some of the growth lost to defoliation by this disease. The "% gain" figures shown are estimates of reductions in the average percentage of infected needles in an unimproved stand with approximately 30% infection. They probably underestimate the true gains from growing stands of resistant stock, for which the rate of disease increase will be less.

Table 1 - Recommended inputs to growth and log quality models for simulating gains from using improved seedlots.

Seedlot Class	GF rating 1]	Initial stocking/ha (direct sawlog regimes)	Change in site index (m)	Change in basal area (%)	Log sweep class2] (1-5)	Change in branch index (cm) 2]	Change in internode index/ metre2]	Change in Dothistroma resistance (%)	Change in wood basic density (%)
1. Growth and Form Breed. 1]									
Bulk-unimproved	1	1500	0	0	3	0	0	-	0
Climbing select	7	1200	1	+5	3	0	-0.05	-	0
"850" orchard (1973-87)4]	14	800	2	+15	2	-0.5	-0.10	-	-3
"268" orchard (1984-87)	16	600	3	+15	1-2	-1.0	-0.20	-	-1
Best O.P. collection5]	19	600	3-4	+15	1-2	-1.0	-0.20	-	-1
Best C.P.	23	500	4	+20	1-2	-1.5	-0.25	-	-1
2. Long-internode Breed. 1]									
"870" orchard	9	1200	1	+5	3	+1.0	+0.20	-	0
Best O.P. (LI) collection	13	1000	2	+15	2	+1.0	+0.20	-	0
Best C.P.3]	14	800	2	+15	2	+1.5	+0.25	-	0
3. Dothistroma-resistant Breed. 1]									
"850" orchard	14	800	2	+15	2	-0.5	-0.10	+5	-3
Best O.P. (DR) collection3]	16-19	600	3	+15	1-2	-1.0	-0.20	+10	-1
Best C.P. 3]	23+	500	3	+20	1-2	-1.0	-0.20	+15	-1
4. High Density Breed									
Best C.P	18-20	600	3-4	+15	1-2	-1.0	-0.20	-	+3

1] see the Seed Certification System, FRI Bulletin 134
2] log sweep class, branch size index and internode index are as defined in the STANDPAK User Manual
3] seedlots not available in 1988
4] "850" series seed orchard collections between 1966 and 1972 have a lower GF rating than shown here
5] O.P. refers to open-pollinated seed orchard seed, CP refers to control-pollinated seed orchard seed

CONCLUSIONS AND RECOMMENDATIONS

1. Use of seedlings or cuttings with a high improvement rating should always be preferred to use of lower-quality improved material.

2. Full realisation of genetic gains requires good management, and an appropriate matching of breed, level of improvement and silvicultural regime with forest site, management and market objectives.

3. Special-purpose breeds should be used to meet specific problems or markets.

4. Forest planning exercises should recognise the altered attributes of the improved breeds - particularly when using the models of growth and log quality currently available in STANDPAK.

5. Current FRI research is aimed at improving current models and their input estimates to better predict for improved breeds, while extending trial coverage to ensure that future models are developed from a representative database.

ACKNOWLEDGEMENT

The improved seedlots have been developed by many workers in the Genetics and Tree Improvement group (GTI) at the FRI. Genetic gain estimates have been obtained mainly from assessment by GTI and Exotic Forest Management (EFM) staff in trials established by GTI. Models involving early growth and log quality in STANDPAK were developed by EFM staff, while staff of Forest Management and Mensuration Systems developed the stand growth models. This report was prepared in consultation with Drs S. Carson, C. Goulding, G. Johnson, J. King, M. Menzies and C. Shelbourne, and Mr A. Firth, Mr T. Vincent and Mr P. Wilcox. The performance estimates given are considered to be a current "best estimate" based on Forest Research Institute work.

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APPENDIX 1 - P. RADIATA SEEDLOTS 1984 - 87

2	3	84	53	GF17	OP	Kaingaroa	Top 25 "268"
2	3	85	01	GF14	OP	Kaingaroa	"850" general
2	3	85	03	DR3(14)	OP	Kaingaroa	"850" Dothi resistant
2	2	85	04	GF11	-	Cpt. 1350 Kaingaroa	
2	6	85	05	GF19	OP	Kaingaroa	Top 16 "268"
2	6	85	06	GF16	OP	Kaingaroa	"268" general
2	3	85	12	GF14	OP	Waimihia	"850" general
2	1	85	15	GF6?	-	Rotoehu	
3	3	85	01	GF14	OP	Gwavas	"850" general
3	3	85	02	LI15(10)	OP	Tikokino	"870" general
6	3	85	01	GF8 GF14 if planted in Canterbury)	OP	Amberley	Canterbury "850"
6	3	85	02	GF10 GF13 if planted in Southland)	OP	Amberley	Southland "850"
6	3	85	03	LI12(6)	OP	Amberley	"850" South Is.
6	3	85	34	GF16	OP	Amberley	"268" general
2	3	86	20	GF14	OP	Kaingaroa	"850" general
2	3	86	21	GF15?	OP	Kaingaroa	"875" general
2	1	86	22	GF6?	-	Rotoehu	
2	3	86	23	DR3(14)	OP	Kaingaroa	"850" Dothi resistant
2	3	86	25	GF14	OP	Kaingaroa	"850" general
2	6	86	27	GF16	OP	Kaingaroa	"268" general
2	6	86	29	GF19	OP	Kaingaroa	Top 16 "268"
3	3	86	01	DR3(14)	OP	Gwavas	"850" Dothi resistant
3	3	86	02	GF14	OP	Gwavas	"850" general
3	3	86	03	LI15(10)	OP	Tikokino	"870" general
6	3	86	01	GF8 GF14 if planted in Canterbury)	OP	Amberley	Canterbury "850"
6	3	86	02	GF10 GF13 if planted in Southland)	OP	Amberley	Southland "850"
6	3	86	03	LI12(6)	OP	Amberley	South Is. "850"
6	6	86	47	GF19	CP	Amberley	Mid 268 x Top 25
6	6	86	54	GF21	CP	Amberley	Top 16 x Top 25 plus 5 good "850"
2	3	87	30	GF14	OP	Waimihia	"850" general
2	3	87	31	DR3(14)	OP	Kaingaroa	"850" Dothi resistant
2	3	87	32	GF14	OP	Kaingaroa	"850" general
2	3	87	33	GF15?	OP	Kaingaroa	"875" general
2	3	87	34	GF16	OP	Kaingaroa	"268" general
2	6	87	35	GF19	OP	Kaingaroa	Top 16 "268"
3	3	87	01	GF14	OP	Gwavas	"850" general
3	3	87	02	DR3(14)	OP	Gwavas	"850" Dothi resistant
3	3	87	03	LI15(10)	OP	Tikokino	"870" general
6	3	87	01	GF8	OP	Amberley	Canterbury "850"
6	3	87	02	GF10	OP	Amberley	Southland "850"
6	6	87	20	GF25 LOW DENSITY	CP	Amberley	"850" 55 x Top 16 "268"
6	6	87	21	GF22	CP	Amberley	"268" BCD x Top 16
6	6	87	22	GF19	CP	Amberley	"268" EFG x Top 16