

Theme: Diversified Species

Task No: F30105
Milestone Number: 1.05.32

Report No. : DS063

Comparison of Improved Seedlots of *Eucalyptus fastigata* at Age 7

Authors:
G T Stovold

Research Provider:
Scion

This document is Confidential
to FFR Members

Date: June 2013

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
MATERIAL AND METHODS	3
Genetic Material	3
TRIAL DESIGN AND ESTABLISHMENT	4
ASSESSMENT TRAITS	5
DATA ANALYSIS	5
RESULTS AND DISCUSSION	6
Volume per Hectare	8
CONCLUSION	9
ACKNOWLEDGEMENTS	10
REFERENCES	11

Disclaimer

This report has been prepared by New Zealand Forest Research Institute Limited (Scion) for Future Forests Research Limited (FFR) subject to the terms and conditions of a Services Agreement dated 1 October 2008.

The opinions and information provided in this report have been provided in good faith and on the basis that every endeavour has been made to be accurate and not misleading and to exercise reasonable care, skill and judgement in providing such opinions and information.

Under the terms of the Services Agreement, Scion's liability to FFR in relation to the services provided to produce this report is limited to the value of those services. Neither Scion nor any of its employees, contractors, agents or other persons acting on its behalf or under its control accept any responsibility to any person or organisation in respect of any information or opinion provided in this report in excess of that amount.



EXECUTIVE SUMMARY

In 2006 a trial was established in Kinleith forest to estimate volume per hectare production of seven different *Eucalyptus fasitigata* seedlots. Two of the seedlots were from South Africa and Australia, and there were five New Zealand seedlots ranging from felling select progeny test selections to a clonal seed orchard lot. The results showed significant differences for diameter (DBH) and individual tree volumes between seedlots, but due to the young age of assessment, low number of replications and some site variation, volume per hectare predictions were not statistically significant at age 7.

The New Zealand seedlots are generally performing better than those from overseas, and a recently grafted seed orchard based on selections from the New Zealand breeding programme will give growers the option of deploying the gains reported from this trial within the next few years once seed production begins.

The trial is starting to show trends at this young age and should be re-measured in 2-3 years to confirm seedlot differences.

This trial is important since of all the New Zealand seedlots tested, only the Kakarihi Rd lot is still available, but is likely to be felled in the next few years. The other seed sources have already been felled.



INTRODUCTION

In the late 1980s, the rate of *Eucalyptus* planting increased significantly as several companies looked to develop plantations for the production of short fibre pulp. *Eucalyptus fastigata* was one of the species chosen for this planting expansion, as it had already been successfully used for decades in the Kinleith region. Increased interest in the species prompted a new cycle of breeding^[1], culminating in two breeding trials being established in 1994 (Tylees, FR273 and Kakarihi road, FR237), and also a grafted seed orchard (FR363) in 1998.

Much of this new resource was established with seed from orchards and breeding programmes overseas, with no real knowledge of the seedlots' relative performance. To estimate the possible differences in volume growth between commercially available seedlots, a large plot trial (FR485) with seven seedlots was established in 2006 in Kinleith forest.



MATERIAL AND METHODS

Genetic Material

Seven seedlots were chosen for the trial. The origin and genetic quality of the seedlots varied from progeny test, family identified clonal seed orchard, and a New Zealand Landrace collection.

The Seedlots' origins are summarised below.

- A. Mondi Forests, 40 2nd gen. selections (imported seedlots from the South African Breeding programme with unknown New Zealand performance)
- B. Ex Kaingaroa Cpt 1227/8, 36 plus trees, Oakura descendent stand (Landrace, superior trees within the stand felled and seed collected)
- C. Tylees STP Progeny Trial, Taupo. Best tree collected from top 12 families of Jessievale S.O,origin (South Africa)
- D. Rossi, NSW provenance, 88/172 ex Proseed (Commercial collection)
- E. 1980 progeny trial, Kinleith and Kaingaroa, (24 provenance plus tree selections from within the trial)
- F. Kakarihi Rd Progeny Trial. Thirteen families (thinned individuals from within the trial)
- G. Clonal Seed Orchard, Waerenga. Twenty-six clone collection



TRIAL DESIGN AND ESTABLISHMENT

The trial is located at Leslie Rd, North of Putaruru (38°02'59.82S 175°54'43.13E). The site was previously in *Pinus radiata*, and was double v-bladed before establishment (Figure 1). The seedlings were raised in the Scion Nursery; the seed was sown into trays in February 2006, then pricked out into V150 cells after germination. Seedlings were sorted before being transported to the site, and planted in July 2006.

The trial was planted as three replicates of large tree plots (8 x 8 trees) at a spacing of 2.8 x 3 m (1190 stems per hectare).



Figure 1. Aerial view of trial site

ASSESSMENT TRAITS

Each plot had its inner 36 trees assessed (6 x 6 trees) in February 2013 for DBH (in mm), forking, and acceptability as a final group stem. A sample of heights over a range of diameters was taken to allow for the estimation of individual-tree volume.

DATA ANALYSIS

The analysis of variance was undertaken using Proc GLM of the SAS software package (SAS institute, 1989). A Tukey multiple range test option was used to test the significance of seedlot mean differences. Tree heights for all trees were predicted based on the relationship of the height of the sample trees to their diameters by PROC REG of the SAS statistical package, and tree volumes were predicted using

$$V = (0.19893 * (dbh07/10)^2 * pht07 / 10000) + (0.77713 * (dbh07/10)^2 / 10000) ;$$

This formula was supplied by the Scion mensuration group as being the most appropriate. Volume per hectare was subsequently estimated based on a plot size of 0.0301ha.



RESULTS AND DISCUSSION

The F-tests from the analysis of variance are shown in Table 1. No significant effect for replicates was seen for either DBH or individual tree volume. Seedlots were found to be significantly different from each other for DBH and tree volume.

Table1: F-tests and significance of effects in the model.

Source	DBH	Tree Volume
Rep	0.31ns	1.13ns
Seedlot	3.27**	7.82***
Rep*Seedlot	2.49**	2.81**
Error		

** significant at the level of $p \leq 0.01$

*** significant at the level of $p \leq 0.001$

The range of seedlot means (Table 2) for diameter was between 167.5 (Mondi seedlot) to 193.7 for the best seedlot (a mix of 24 selections from the 1980s Kinleith and Kaingaroa progeny trial). The Waerenga clonal seed orchard performed well, with a mean DBH of 187.6mm.

The trial at age seven has very high survival rates, with the worst seedlot standing at 94% of original stocking. This relatively young assessment is showing that the seedlots are separating for DBH and individual tree volumes. As *E. fastigata* is considered to be a slow starter, these results are encouraging, as the differences will likely continue to increase as the trees continue to grow. These trends will need to be confirmed in subsequent measurements.



Table 2: Seedlot means. Letters following means are from the Tukey test option of PROC GLM of the SAS statistical package. Differences between seedlots sharing a letter are deemed to be not significantly different at $p \leq 0.05$

Seedlot	No. Trees	Diameter mm	Tree volume	Forks (% of trees)	Height(m)	Acceptable stems	Volume/ha cm^3
Mondi Forests 40 2 nd generation selections	99	167.5 b	0.1 c	26.3%	12.9	57.6%	105.1
Kroa cpt 1227/8 36 plus trees, Oakura decendant stand	96	180.4 ab	0.13 abc	34.4%	13.2	49.0%	132.2
Tylees STP trial, Jessivale SO 12 families best individuals	94	171.6 b	0.1 c	18.1%	13.0	63.8%	102.9
Rossi, NSW prov 88/172 ex Proseed	99	172.3 b	0.11c	32.3%	13.0	53.5%	112.6
1980 prog trial Kin and Kroa 24 prov plus tree selections	99	193.7 a	0.14 a	25.3%	13.5	56.6%	146.1
Kahariki Rd prog trial 13 fams thinned individuals	101	179.5 ab	0.12 bc	19.8%	13.2	66.3%	122.8
Clonal SO Waerenga 26 clones	102	187.6 ab	0.14 ab	22.5%	13.4	64.7%	138.8
MSD		11.2	.097				62.31

Volume per Hectare

The raw means show large differences between seedlots (Figure 2). However, at this age (7) they do not appear to be statistically different. This is likely to be driven by the small number of replicates (3), the relatively young age, and some variability on some parts of the site. The Waerenga SO (SeedlotG) performed very uniformly over three replicates (Figure 1).

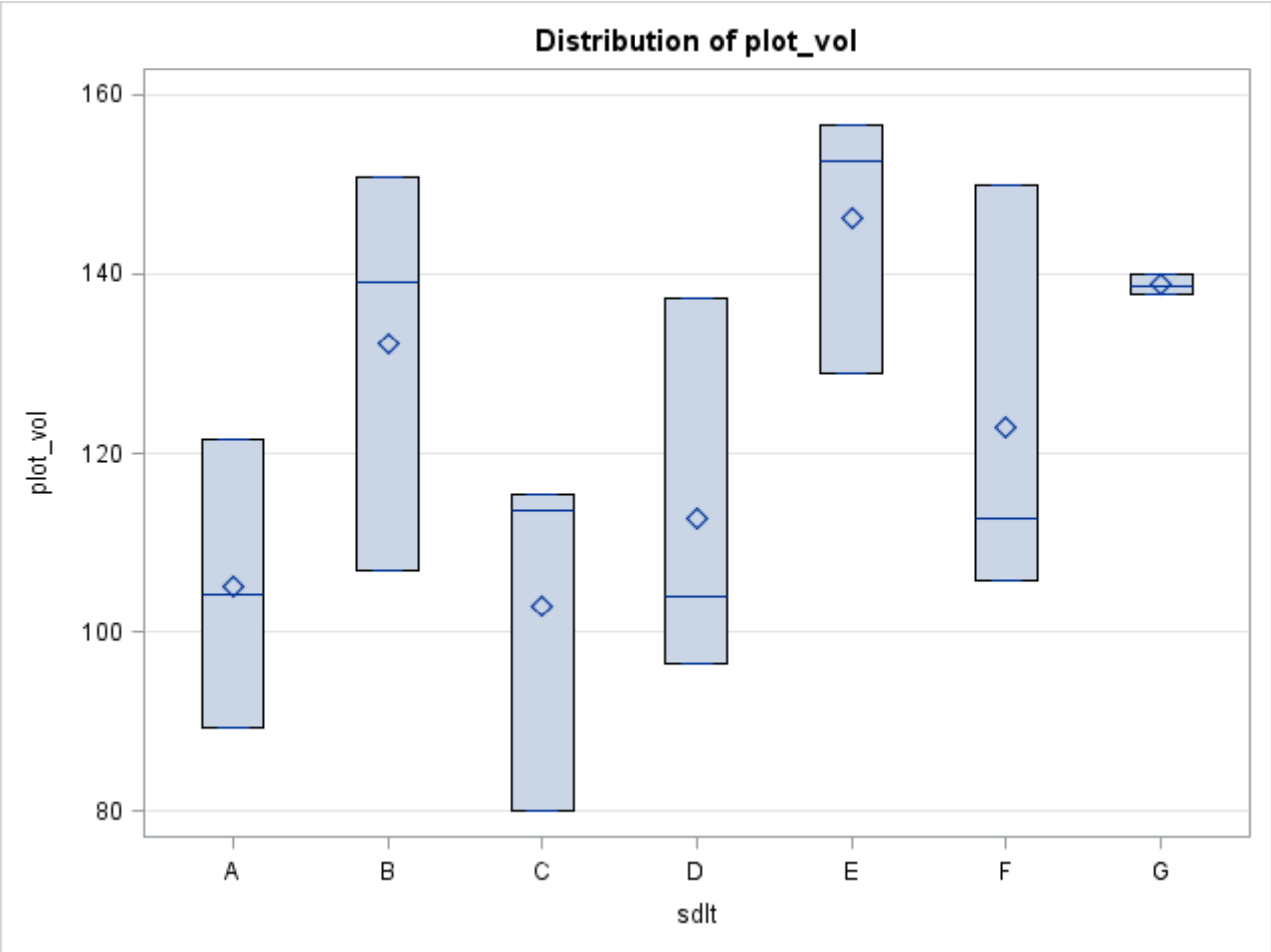


Figure 2. Distribution of plot volumes by seedlot



CONCLUSION

The trial is starting to show trends at this young age and should be re-measured in 2-3 years to confirm seedlot differences. The five New Zealand based seedlots are growing better than Rossi (Australia) and Mondi (South Africa) seedlots. Unfortunately, of all the New Zealand seedlots tested, only the Kakarihi Rd lot is still available, but is likely to be felled in the next few years; the other seed sources have already been felled. New grafted seed orchards of *E. fastigata* based on New Zealand progeny test selections, established by PROSEED in 2008 (Similar to seedlot F from Kakarihi Rd) will likely provide superior volume to imported lots.



ACKNOWLEDGEMENTS

Fred Burger of CHH for supplying the trial site, Ruth McConnochie for trial setup and establishment.



REFERENCES

1. Low, C.B., Dungey, H.S., Stovold, G.T., Nicholas, I.D., and Fleet, K., *A Breeding Plan for New Zealand Eucalyptus Fastigata* New Zealand Forestry Research Institute. (2008).
2. SAS Institute Inc, "*SAS/Stat Users Guide: Version 9.1*". Cary, NC, USA: SAS Institute Inc. (2006).

