



MANAGEMENT OF EUCALYPTS COOPERATIVE

**FOREST RESEARCH INSTITUTE
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The effect of site factors on the growth of
Eucalyptus regnans in Kinleith Forest.

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Note: Confidential to participants of the Management of Eucalypts Cooperative. This material is unpublished and must not be cited as a literature reference.

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EXECUTIVE SUMMARY

Concern about the variability in growth pattern of *Eucalyptus regnans* at a stand level was raised by the members of the Management of Eucalypts Cooperative. Environmental factors were suggested as important determinants of the growth pattern and a study designed to investigate the effects of environmental and soil factors on *E. regnans* growth. Growth within the Kinleith region was found to be affected predominantly by aspect and landform with topsoil depth and pH also important. There was also a relationship between growth and soil nitrogen and phosphorus supply and a weak implication of calcium and possibly magnesium in the growth pattern. These variables are far less important than the aspect and landform however. Stocking over the study site had been affected by site, and although the reasons for this are unknown, micro climatic factors are likely to be important. Multiple regression models developed to predict growth contained easily measured soil and site variables and the models should be tested further in the Bay of Plenty. Future studies should concentrate on climate, soil pattern and the development of a productivity map for the region.

The effect of site factors on the growth of *Eucalyptus regnans* in Kinleith Forest.

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ABSTRACT

Concern about the variability in growth of *Eucalyptus regnans* at a stand level was raised by the members of the Management of Eucalypts Cooperative. Environmental factors were suggested as important determinants of the growth pattern and a study designed to investigate the effects of environmental and soil factors on *E. regnans* growth was undertaken. Growth within the Kinleith region was found to be affected predominantly by aspect and landform with topsoil depth and pH also important. There was also a relationship between growth and soil nitrogen and phosphorus supply and a weak implication of calcium and possibly magnesium in the growth pattern. These variables are far less important than the aspect and landform however. Stocking over the study site had been affected by site, and although the reasons for this are unknown, micro climatic factors are likely to be important. Multiple regression models developed to predict growth contained easily measured soil and site variables and the models should be tested further in the Bay of Plenty. Future studies should concentrate on climate, soil pattern and the development of a productivity map for the region.

INTRODUCTION

New Zealand has only a small planted resource of eucalypts, the total area planted being approximately 15,000 hectares. Large scale plantings of eucalypts occur in other countries such as Brazil, South Africa and Australia, and these plantings are commonly of high production value. In New Zealand comparable uniformly high levels of productivity have not been achieved. Growth has been characterised by considerable variability, even within the same stand, and generally lower than expected productivity.

A number of eucalyptus species are planted in New Zealand, the most common being *Eucalyptus regnans*, with approximately 8000 hectares established; 80% of the resource concentrated in the Bay of Plenty region. Growth of *E. regnans* varies over the region, however of more concern is the large variation in growth within stands, where considerable fluctuation in basal area and height has been recorded over short distances. Such variation within stands poses problems for management of the stands as a production unit, and the variation at a scale of less than 100 hectares was addressed in this study. While variation in growth can be caused by a number of factors such as disease, genetic characteristics of the trees, or silvicultural history; it appears that in this instance it is the environment into which *E. regnans* has been planted that is the cause of much of the noticed variation in growth. One dominant factor appears to be aspect (R. van Rossen *pers. comm.* 1991), and another landform. The study is being conducted as part of the research program of the Management of Eucalypts Co-operative.

Conditions for growth of *E. regnans* both naturally and in plantations has been summarised by Turnbull and Pryor (1984). It occurs naturally in Victoria and Tasmania between latitudes 37 and 48°S, the altitudinal range is 120-1100m in Victoria and 30-610m in Tasmania. The range of natural climatic conditions is narrow. Cochran (1969) summarised these conditions as a moist environment with mean annual rainfall of over 1200 mm, with a winter maximum, absence of long periods of water stress, shelter from strong winds and free air drainage to reduce the effects of frost. Best development occurs on deep fertile loamy soils which are moist and well drained. *E. regnans* also occurs on podsoils, upland and mountain podsoils and kraznozems. Where soil fertility and rainfall are lower, stands may be confined to valleys and along water courses. It grows poorly on permanently saturated sub soils. Ellis (1968) shows *E. regnans* to be more sensitive to site conditions than *E. obliqua*, *E. sieberi*, or *E. radiata*.

E. regnans has been planted in trials at high altitude in a number of tropical countries and also in South Africa, Brazil and Zimbabwe. However, despite the good performance of some of these trials, other species with a wider tolerance of site conditions have been selected for commercial planting except in New Zealand (Lembke 1977). This suggests that the variation in growth noted in New Zealand plantations is not unexpected.

The climate of the natural habit of *E. regnans* is similar to New Zealand's (James 1988) and its New Zealand site range includes most of the North Island south of Auckland, and the Nelson, Westland, Canterbury and Otago regions in the South Island. Most important site characteristics appear to be a sloping site with adequate moisture all year, good soil drainage and protection from salt winds.

Poole (1979) reported on *E. regnans* established in Kinleith forest. Ideal sites would be north facing sheltered slopes with good air drainage, if possible the sites should have a history of grazing and a good sward of legumes. However he suggested that no such sites were available at that time and so the company endeavoured to find the best compromise when establishing *E. regnans*.

It is clear that in the following years *E. regnans* was planted on the best available sites, but subsequent assessment of growth showed that even these sites appeared to be unacceptably variable. Reasons for this variability were sought by the members of the Management of Eucalypts Co-operative and results of the research are reported here.

METHODS

• **Site Description and Stand Histories.** Sites were chosen in four blocks of Kinleith Forest located within 10 km north of Tokoroa (Figure 1). Topography was mainly rolling with short slopes of about 20 degrees. Altitude was approximately 260 m.a.s.l. The Kinleith area has a mean annual rainfall of 1508 mm, uniformly distributed throughout the year. All areas accessible to a bulldozer had been v-bladed and mounded after clear felling of the previous crop. Stands were planted in 1980 with *E. regnans* seedlings of Franklin, Tasmania, seed origin. Initial stocking ranged from 1152 to 1496 stems ha⁻¹. It is likely that an initial 30g of Urea was applied per tree on the plant line and another 60 g between the lines. An aerial application of 250 kg Urea ha⁻¹ was applied in the second