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Examination of Microbial Contribution to Site Productivity

Summary

The ability to access resources from forest soils is fundamental to the productivity and commercial sustainability of plantation forestry. Soil microbes underpin the functioning of terrestrial ecosystems and have the potential to significantly affect plant productivity by manipulating nutrient availability, providing protection from pathogens and altering plant hormone activity. Consequently, soil microbes should be considered an important forest soil resource. To enable this resource to be better understood and managed, soil microbial parameters such as phytohormone production will be measured at 26 previously established *Pinus radiata* trial plots. Comprehensive records of management and productivity have been maintained for these plots, allowing any relationships between stand productivity and microbial characteristics to be identified across a range of soil and landform types.

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Background

The stability of terrestrial ecosystems is largely a product of the activity of soil microbes (Kennedy and Gewin 1997). Processes such as biogeochemical cycling are dependent upon the activity of soil microbes (e.g. Balogh-Brunstad *et al*. 2008) while various soil microbial species have the potential to directly influence plant productivity by manipulating the activity and expression of plant hormones (Glick *et al*. 1998, Smaill *et al*. 2010). In order to optimise productivity at a given location, the impact of the various environmental factors needs to be known. This includes the contribution of soil microbial communities.

The potential for soil microbes to influence plant productivity has been known for many decades, and has enabled the development of techniques to capitalise on the activities of beneficial soil microbes. Current examples of this include the inoculation of tree seedlings with beneficial mycorrhizal species (Chu-Chou and Grace 1988) and the use of biofertilisers (Chanway *et al*. 2000) containing desirable soil microbial species. However, further research is required to determine how unmodified populations of soil microbial communities interact with plantation species such as *Pinus radiata*.

To address this knowledge gap a new study was established to assess the relationships between productivity in *P. radiata* and characteristics of the naturally occurring soil microbial community that are linked to plant growth. The full details of this study are provided in the work plant for Task 1.1 (IO1). This technical note presents the trial sites which will be used to accomplish the objectives of the study and the rationale for the selection of these sites.

Site Selection

In order to make the results of this study applicable across New Zealand, the 35 permanent sample plots installed as part of the Site Quality plot series (established from 2000 to 2002) were investigated for potential use. These plots were established over a wide geographical and climatic gradient, allowing the effects of variations in these parameters to be determined. All site quality plots also contained a weed control treatment, with one half receiving blanket weed control and the other receiving none.

Fig 1. A permanent sample plot established as part of the Site Quality trial series immediately after installation. Note the effect of weed control on the left side of the plot.

The most critical criterion for site selection was the numbers of surviving *P. radiata* in each half of the plot. The relative effectiveness of the weed control

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treatment with regards to understory development was also an important factor. The ability to apply a uniform soil sampling strategy across all sites was also considered, as soil collection at extremely rocky sites would necessitate different methods, which may bias results. The evaluation of each site was based on examination of growth records, documentation of treatment history and, in some instances, visual inspection. From the 35 candidate plots, 26 were chosen for inclusion.

LOCATION	SOIL TYPE	SOIL ORDER
Longwoods	silt loam	Allophanic
Waimarino	steepland	Allophanic
Karioi	sandy loam	Allophanic
Tairua	silt loam	Allophanic
Tekapo	fine sandy loam	Brown
Eyrewell	stony sandy loam	Brown
Catlins	clay loam	Brown
Taringatura	stony silt loam	Brown
Otago Coast	stony silt loam	Brown
Rai Valley	clay loam	Brown
Golden Downs	silty clay loam	Brown
Aniseed Valley	stony silt loam	Brown
Bulls	black sand	Brown
Mahia	sandy loam	Brown
Ngaumu	fine sandy loam	Brown
Kaniere	stony silt loam	Brown
Ashley	silt loam	Pallic
Okuku	clay loam	Pallic
Pine Valley	silt loam	Pallic
Karatia	sand	Podzol
Hochstetter	humic silt loam	Podzol
Mawhera	humic silt loam	Podzol
Tikitere	sandy loam	Pumice
Bottle Lake	sand	Raw
Woodhill	sand	Recent
Riverhead	clay loam	Ultic

Table 1. Location, soil type and soil order of the 26 Site Quality plots selected for examination of site productivity and soil microbial community characteristics.

Soil Sampling Strategy

Multiple soil samples will be taken from within each half of the plots to enable any effects of the weed control treatment to be identified. All samples will be taken to a depth of 100 mm. Soil samples will be used to provide genetic and catabolic profiles of the microbial communities. The production of phytohormones by the soil microbial community will also be assessed. At the completion of the initial round of sampling across all 26 sites, selected sites will be identified for additional sampling to explore results of interest.

Fig 2. Recent photo of a permanent sample plot showing thinning residues.

References

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