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**RHIZOSPHERE PROCESSES INFLUENCING SOIL  
AND FERTILISER PHOSPHORUS AVAILABILITY  
TO *PINUS RADIATA***

**A thesis presented in  
partial fulfilment of the requirements  
for the degree of  
Doctor of Philosophy in Soil Science  
at  
Massey University  
Palmerston North  
NEW ZEALAND**

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**2005**

# ABSTRACT

Production of *Pinus radiata* is a major contributor to New Zealand's economy and new plantings are a valuable carbon sink. Phosphorus (P) deficiency and high P fixing capacity of some volcanic ash soils (e.g. Allophanic Soil) may constrain radiata productivity. This thesis investigates the role of ectomycorrhizal (ECM) root processes in the acquisition of P by *P. radiata* from native soil and soil fertilised with two reactive phosphate rock (RPR) fertilisers.

The application of finely-divided RPRs to a P deficient Allophanic Soil significantly increased *P. radiata* seedling growth and P uptake in 10 month pot trials. RPR dissolution was high in this soil, and it was further enhanced by the radiata rhizosphere processes. The development and formation of ECM in radiata seedlings was stimulated by low rates of RPR application but was hindered in unfertilised soils and high rates of RPR application.

The *P. radiata* ECM roots induced acidification and increased oxalate concentration and phosphatase activities in the rhizosphere soil. These changes in rhizosphere biochemical properties were associated with enhanced solubilisation of fertiliser and soil inorganic P and increased mineralisation of organic P, leading to increased P bioavailability in the rhizosphere.

ECM inoculation of *P. radiata* roots with *Rhizopogon rubescens* and *Suillus luteus* stimulated production of phosphatase enzymes and oxalate and induced acidification in the rhizosphere. The extent of root-induced changes in the rhizosphere soils was associated with ECM hyphae length density.

A technique using pulse labelling of radiata shoots with  $^{14}\text{CO}_2$  showed promise in estimating the active ECM hyphae density. The  $^{14}\text{C}$  activity was highly correlated with ECM hyphae density measured by an agar film technique.

Overall, observations made in this thesis indicate that sparingly soluble forms of organic and inorganic P in soils low in plant-available P are readily solubilised and utilised for *P. radiata* growth through ECM rhizosphere processes.

## ACKNOWLEDGEMENTS

I wish to express my gratitude to the following people and organisation:

My chief supervisor, Dr. P. Loganathan, for his supervision, encouragement, friendship, morale support and patience throughout all stages of my study.

Co-supervisor, Assoc. Prof. M. J. Hedley, for his supervision, guidance, assistance, constructive criticism and friendship.

Co-supervisor, Dr. M. F. Skinner, of Forest Research (Institute Ltd.), Rotorua for his assistance, advice and care of my well-being.

Lance Currie, Bob Toes, Ian Furkert, Glenys Wallace, Anne West, Mike Bretherton, James Hanly, Carolyn Hedley (Landcare Research) and Hugh Nelson (Plant Science, Massey University) for their help with my laboratory work. Bob Toes, Ross Wallace and Brian Garnett (Pan Pac Ltd., New Zealand) for their help with the field work.

Ms Lynette Grace (Forest Research) for her assistance and advice on mycorrhizal identification and the collection of fungal sporocarps; Dr Harry Percival and Mr Brian Dale (both of Landcare Research) for their help with analyses of oxalate and DOC concentrations; Dr Roger Parfitt (Landcare Research) for his comments on Chapter 4; Dr Chris McLay (Waikato Environment) for his continued encouragement and care of my well-being.

The staff and my fellow postgraduate students, both past and present, for their friendship and morale support.

Massey University for awarding a Massey University Doctoral Scholarship; New Zealand Vice-Chancellor's Committee for awarding a Gerald Agnew Postgraduate Fellowship; New Zealand Forest Research Institute Ltd. for awarding a NSOF grant;

College of Science of Massey University for awarding a Johannes August Anderson Ph.D Scholarship.

Forest Research (Institute Ltd., New Zealand) for providing partial research funding to this study; Pan Pac Ltd. (New Zealand) and Carter Holt Harvey Forest for allowing me to conduct trials in their forest plantations.

Finally, my immense gratitude to my family members, most importantly to my mother, wife (Hong) and son (Lisheng). Thanks for all your support and understanding over the past four years.

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