UNDERSTOREY EFFECTS ON PHOSPHORUS FERTILISER RESPONSE OF SECOND-ROTATION *Pinus radiata*

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To the Memory of

My Late Parents (Pak dan Ibu)

For their enormous love, care and guidance

Abstract

The current silvicultural regimes of *Pinus radiata* plantations in New Zealand with wider initial tree spacings have created the potential for increased growth of understorey vegetation. A consequence of this is that the response of *P. radiata* to P fertiliser is expected to be more influenced by the interaction between the P fertiliser, the tree and the understorey vegetation than was the case in the past.

The objectives of this study were to investigate the influence of different rates of a soluble and a sparingly-soluble P fertiliser (Triple superphosphate and Ben-Geurier phosphate rock) and weed control, and their interactions, on soil P chemistry and the growth and P uptake of 4-5-year-old second-rotation *P. radiata* on an Allophanic Soil (Kaweka forest) and a Pumice Soil (Kinleith forest).

The results showed that the application of P fertilisers had no effect on *P. radiata* growth at both field trial sites two years after this treatment, although it increased radiata needle P concentration. However, at both sites, the understorey vegetation removal treatment increased tree diameter at breast height and basal area. At the highly P-deficient (Bray-2 P 4 $\mu g\ g^{-1}$) Kaweka forest, the presence of understorey (bracken fern and some manuka) reduced resin-P_i and Olsen P concentrations, but at the moderate P fertility (Bray-2 P 13 $\mu g\ g^{-1}$) Kinleith forest, the understorey (Himalayan honeysuckle, buddleia and some toetoe) increased Bray-2 P, resin-P_i, and Olsen P concentrations.

A glasshouse study on *P. radiata* seedlings was conducted to test the hypothesis that when ryegrass (*Lolium multiflorum*) is grown with *P. radiata*, it increases radiata needle P concentration, while when broom (*Cytisus scoparius* L.) is grown with *P. radiata*, it has no effect. The acid phosphatase activity in the rhizosphere of *P. radiata* was higher when radiata was grown with broom than that when it was grown with ryegrass. This is consistent with the higher P concentration in needles of radiata grown with broom than that of radiata grown with ryegrass, in the absence of P fertiliser addition. However, when P fertiliser was added (50 and 100 μg P g^{-1} soil) the needle P concentration of radiata grown with broom was lower than that when radiata was grown with ryegrass.

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