

Biological nitrogen fixing capacity and biomass production of different understorey pastures in a *Pinus radiata*-pasture agroforestry system in New Zealand

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Abstract

Abstract Quantitative field measurements of biological nitrogen fixation (BNF) and biomass production by four different understorey pastures in a *Pinus radiata*-pasture agroforestry system were determined over a period of one year. The trees were two years old at the beginning of this study and the understorey pastures were being cut and removed for silage. The BNF was determined using the ¹⁵N dilution technique. Pastures of ryegrass+clover, cocksfoot+clover, phalaris+clover and lucerne were used. Substantial amounts of BNF were found (71 to 230 kg N ha⁻¹ year⁻¹) with lucerne showing the highest N fixation. However, lucerne derived only 71 to 72% of its N from the atmosphere (%Ndfa) during the spring/summer period compared to 83–97% with clovers, thus the net N demand from the soil was substantially higher with lucerne. This caused increased N stress to the trees. Clover in ryegrass+clover pasture fixed more N than the other grass+clover pastures. Although pasture position in relation to trees did not affect annual pasture total DMY and %Ndfa, pastures north of tree row grew better than those in other positions. Trees significantly affected the BNF of legumes and the botanical composition of pastures with highest BNF and legume production occurring in pastures midway between two rows of trees. These results suggest that it would be advantageous to evaluate different legumes and grasses for tolerance of shade and moisture stress in future studies. As the trees studied were only 1.5 to 3 m in height, their effects on BNF, seasonal pasture biomass production and botanical composition are expected to increase with tree dominance in the ecosystem with time. Amounts of N fixed were related to the productivity (i.e. dry matter and N yield) and seasonal persistence of the legumes. The productivity was high in spring and summer and low in autumn and winter.

Key words nitrogen fixation - ¹⁵N - %Ndfa - ryegrass+clover pasture - silvopastoral system