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Title
Nitrogen fertiliser increases LAI but creates carbon and water costs in *Eucalyptus nitens*

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Abstract

Leaf area index (LAI) is an important driver of primary productivity, and affects water and nutrient cycling. Extra leaves have both a cost and a benefit to a plant in terms of carbon and water balance and nutrient economics. Greater leaf area increases photosynthetic area, but also incurs a respiratory cost to the plant in terms of leaf construction and maintenance. Optimal leaf area is therefore influenced by the trade-off between carbon gains through photosynthesis and carbon loss through respiration, but is also influenced by transpirational demands. Furthermore, optimal leaf area responds to environmental factors such as nutrition, temperature and water supply. Using three field experiments across a rainfall and temperature gradient in Tasmania, I investigated the way in which nutrient supply influences the optimal leaf area of the globally-important plantation tree, *Eucalyptus nitens*.

Results show that the costs and benefits of extra leaf area depend on nutrient supply as well as site characteristics. Specifically, LAI was highest at intermediate nitrogen levels over the first growing season, with associated changes to maximum net photosynthetic rate, dark respiration and stomatal conductance. Thus, leaf area response to nutrition is decidedly non-linear in this system with corresponding influences on plant water use and physiology. These results will contribute to the development of efficient nutrition management of production forests through an improved ability to predict and model the impact of fertiliser on productivity.

Keywords
leaf area; nitrogen; fertiliser; Eucalyptus nitens; photosynthesis; stomatal conductance; temperature; dark respiration