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Losses of nitrogen during prescribed burning in a *Eucalyptus pauciflora* forest

Abstract

A prescribed burn in E. pauciflora forest consumes 12-15 t ha^{-1} of organic material and results in the transfer of 70-95 kg N ha^{-1} to the atmosphere. There is also potential for direct volatilization of N from organically-enriched surface soil if burning is carried out when fuels and surface soils are very dry. Replacement of lost N by inputs in rainfall is slow, and preliminary studies suggest that biological fixation of N may be insufficient to balance losses of N where burning is repeated at intervals of 6 years.

Prescribed burning which is now widely used in eucalypt forests may alter both nutrient balance and nutrient cycling processes (1,2). However, there are very few reports of the quantitative effects of prescribed burning on nutrient cycles or on the long-term growth and stability of Australian eucalypt forest communities. Some of the nutrients contained in litter and understorey vegetation will be transferred to the atmosphere during combustion; the greatest losses are likely to be for N which volatilizes at low temperatures. This report describes the losses of N occurring during an autumn prescribed burn (3) in a sub-alpine forest of E. pauciflora, and discusses the possible effects of repeated burning at intervals of 6 years (the current management practice) on the N balance of the site. Methods used have been briefly discussed elsewhere (4).

In a single fire 12-15 t ha^{-1} of organic material is combusted, and a total of 70-95 kg N ha^{-1} is lost from the site (Table 1). About one third of the loss of N results from combustion of understorey vegetation (mostly Daviesia mimosoides). The amount of fuel (litter + understorey) burned represents 45-60% of the weight of litter falling during the interfire period of 6 years, and the loss of N represents a similar proportion of that contained in litterfall (Table 1).

Table 1. Fuel dynamics, litter N cycle and N losses during a prescribed burn rotation (6 yr) in E. pauciflora forest. Litterfall and accumulation represent the sum over a 6 yr interfire period. Consumption and loss are for a single fire applied 6 years after the previous prescribed burn.

	Fuel (t ha^{-1})			Nitrogen (kg ha^{-1})		
	Litterfall	Accumulation	Consumption	Litterfall	Accumulation	Loss
Litter	25	12	10-12	140	85	50-65
Understorey	1	2-3	2-3	10*	35	20-30
TOTAL	26	15	12-15	150	120	70-95

* 20 kg N ha^{-1} on unburnt sites where litterfall is not interrupted by burning.

In addition to losses of N from combusted litter, there is potential for volatile loss of N from organic matter in the surface soil during prescribed burning. Temperatures may reach 600°C for about 0.1 h at the soil surface when fuel and soils are dry (authors, unpublished). Temperature gradients are very steep in the soil so that the upper few mm will be heated above the temperature at which N volatilizes (200°C). Burning when the lower litter layer and surface soil are moist will reduce the risk of N loss from the soil.

Inputs of N in rainfall (3-4 kg ha^{-1} yr^{-1}) in this area could replace only about 25% of the N lost under a 6 year burning cycle. Biological fixation of N by Daviesia is the only other likely significant source of N to the forest. Preliminary studies indicate a low density of nodules and low rates of N fixation by Daviesia (McColl and Edmonds, pers. commun.). Even if all the N added in understorey litterfall (10 kg ha^{-1} between fires, Table 1) represents that fixed from the atmosphere, this input still only represents about 15% of that lost during burning. If the rate of N fixation by Daviesia is to be sufficient to balance losses incurred during burning, most of the input of N clearly must occur directly (i.e. not via litterfall) into the soil.

References

(1) Raison, R.J. (1980). Aust. J. Ecol 5, 15-21

(2) O'Connell, A.M., T.S. Grove and D. Lamb (1981). Proc. Aust. Forest Nutrition Workshop, Canberra. pp 277-290.

(3) Woods, P.V., R.J. Raison and P.K. Khanna (1982) Proc. Ecol. Soc. Aust. 12,

(4) Raison, R.J., P.K. Khanna, P.V. Woods and A. Godkin. (1981) In 'Managing the nitrogen economies of natural and man made forest ecosystems'. (ed. R.A. Rummery and F.J. Hingston) (CSIRO Divn. Land Resources Management). pp 291-2.

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