LITTER FALL AND NUTRIENT INPUT BY THREE TREE SPECIES IN A SEMI-ARID TROPICAL SAVANNA

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INTRODUCTION

Studies in temperate and sub-tropical Australia indicate that trees play a major role in nutrient cycling e.g. Attiwell *et al.* (1978) and hence are important in maintaining system productivity and sustainability (Keith 1997). Trees access nutrients in deep soil layers and subsequently enrich the surface soil through litter fall and deposition, increasing nutrient availability to shallower rooted life forms like grasses. Leaf litter also increases soil faunal activity, further improving soil condition via increased hydraulic conductivity, aeration and nutrient cycling.

Trees are also likely to play a key role in nutrient cycling in the northern savannas. However, with the exception of McIvor (2001), this role has yet to be quantified. This is of concern given the dystrophic nature of these savannas and the ongoing controversy regarding broad-scale tree clearing. The present study was therefore initiated to quantify litter and nutrient inputs from three important tree species that occur on relatively nutrient poor soils in these savannas.

METHODOLOGY

The study was conducted at the 'Wambiana' grazing trial, near Charters Towers, North Queensland. Mean annual rainfall is 650 mm with a C.V. of 38 %. Tree species selected were silver leaf ironbark (*Eucalyptus melanophloia),* Reid river box (*E. brownii*) and brigalow (*Acacia harpophylla)*, which occur as local dominants on yellow kandosols, brown sodosols and cracking clays respectively. Leaf and fine twig litter were collected monthly using conical shade cloth traps (i.d. 70 cm) placed under the canopies of 13 - 14 individuals of each species. Selected trees varied in size and canopy density but covered the full range of typical adult to sub-adult trees in that area. For each species, groups of three to five litter traps were grouped into replicates. These replicates were separated by distances of between 200 to 1500 m. Samples were dried for 48 hours at 60° C, weighed and bulked by replicate for nutrient analysis. Litter weights are presented for the period November 2001 to March 2004 but nutrient data are only available for the first year of litter collection. Data were analysed via a repeated measures ANOVA on GENSTAT.

RESULTS AND DISCUSSION

There was no clear seasonal pattern of litter fall in any of the tree species although there was a trend for reduced litter fall in July-August and a tendency for increased litter fall during the summer months (Fig. 1). However, this trend was not as marked as that reported by McIvor (2001) or Burrows and Burrows (1992).

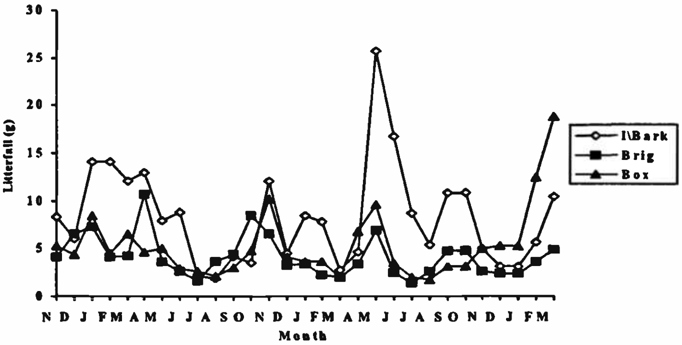

Fig 1: Monthly litter fall (g/DM/trap) for three savanna tree species at the Wambiana grazing trial. (Brig. = brigalow, I\Bark = ironbark)

There were however, marked species differences in average litter fall with ironbarks producing nearly twice as much leaf litter (8.5 g/month/trap) as box and brigalow (*c.* 4.5 g/month/trap). When extrapolated upwards to an area basis using canopy cover data for the site, total litter input varied between 500 and 780 kg/ha per annum depending on the species present and canopy cover. These figures are similar to those reported by (McIvor 2001) for a *E. drepanophylla* community growing on more fertile grano-diorite soils east of the study site.

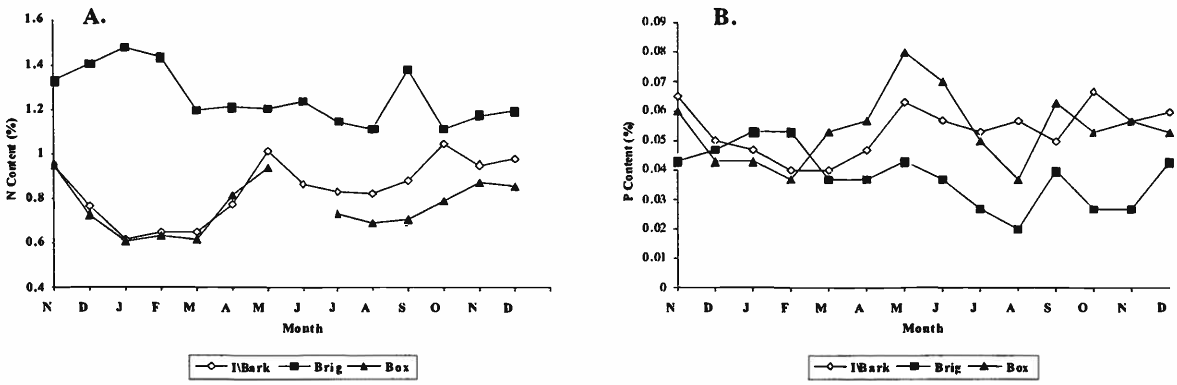

Fig 2: Change in N content (A) and P content (B) of litter fall from three savanna tree species at the Wambiana grazing trial. (Brig. = brigalow, I\Bark = ironbark)

There were marked differences in the nutrient content of litter collected from the three species (Fig. 2). Brigalow litter had a higher N content (mean: 1.25% N), on average, than litter from the two Eucalypt species (mean: 0.8% N): this difference was significant ($p<0.05$) in ten out of the twelve months compared. The relatively high N level of brigalow litter is logical given the ability of this species to form mutualistic relationships with N fixing bacteria. In contrast, ironbark and box litter (mean: 0.054% P) tended to have a higher P content than brigalow litter (0.038% P), although these differences were only significant ($p<0.05$) in six out of the twelve months compared. This trend is surprising given that brigalow grows on heavy clay soils with a relatively greater cation exchange capacity and P content than the relatively infertile kandosols and sodosols commonly occupied by the ironbark and box respectively.

Total nutrient input per area via leaf litter fall varied between communities depending upon the tree species involved. Overall total N input was lowest for box (5.0 kg/ha/yr), moderate for ironbark (6.0 kg/ha/yr) and highest for brigalow (8.7 kg/ha/yr) communities. Conversely, predicted P inputs were highest for ironbark (0.38 kg/ha/yr) followed by box (0.30 kg/ha/yr) and brigalow (0.27 kg/ha/yr) communities. These results indicate that trees are an important source of nutrients in these low fertility systems and are likely to have a major impact upon ecosystem processes in such communities.

ACKNOWLEDGEMENTS

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REFERENCES

Attiwell P.M., Guthrie G.B. & Leuning R. (1978). Nutrient cycling in a *Eucalyptus obliqua* (L'Herit.) forest. 1. Litter production and nutrient return. *Aust. J. Bot.* 26: 79-91.

Burrows D.M & Burrows W.H. (1992). Seed production and litter fall in some Eucalypt communities in Central Queensland. *Aust. J. Bot.* 40: 389-403.

Keith H. (1997). Nutrient cycling in eucalypt ecosystems. In: *Eucalypt Ecology: Individuals to ecosystems*'. Eds. Williams J.E. & Woinarski J.C.Z. Cambridge University Press, Cambridge.

McIvor J.G. (2001). Litterfall from trees in semi-arid woodlands of north-east Queensland. *Austral Ecol.* 26: 150-155.