



**Carbon and Nitrogen Mineralisation in
Tropical Peats: Role of Peat Properties and
Management Practices**

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Abstract

Carbon and nitrogen mineralisation in tropical peatlands has been shown to influence peat subsidence or loss of peat mass and nitrogen availability in the peatland ecosystem. The effects of agricultural practices on peat mineralisation and the relationship between physico-chemical properties of peat and carbon and nitrogen mineralisation were investigated in this study.

The relationship between water content, expressed as percentage of water-filled pore space (WFPS), and carbon and nitrogen mineralisation of three tropical peats varying in physical and chemical characteristics were examined in a laboratory incubation experiment. Carbon and nitrogen mineralisation for all peats were found to exhibit a parabolic response to increasing WFPS. Carbon mineralisation reached a maximum at a relatively narrow range of water content, 60-70% WFPS, whereas nitrogen mineralisation was maximised at 50% WFPS.

The influence of nitrogen addition and liming on carbon and nitrogen mineralisation were studied in order to understand the effects of agricultural practices on the loss of peat mass through carbon mineralisation. Addition of nitrogen to a peat with a high C/N ratio stimulated carbon mineralisation, but carbon mineralisation decreased for a peat with a low C/N ratio. Where nitrogen addition increased carbon mineralisation, maximum carbon mineralisation with and without nitrogen occurred at different WFPS. The WFPS level at which carbon mineralisation was maximised shifted to lower values as carbon mineralisation increased with nitrogen addition. This result confirmed that an understanding of the relationship between water content and carbon mineralisation is crucial to studies where the mineralisation of peat with substrate addition is to be assessed. Liming increased carbon mineralisation for all peats but the extent of mineralisation depended on the C/N ratio. Nitrogen mineralisation was observed to be reduced by liming.

The chemical nature of organic carbon in thirty tropical peats was characterised using solid-state ^{13}C NMR spectroscopy on the basis of type of C and estimated molecular composition inferred from the NMR spectra. Alkyl C and the aliphatic molecular component were found in the largest proportion in all of the tropical peats. The proportion of alkyl C changed significantly with increasing degree of decomposition, but no significant decreases in the proportion of *O*-alkyl C with increasing degree of decomposition was noted. Significant variation in the proportions of di-*O*-alkyl, phenolic and aromatic C were also noted.

Carbon mineralisation, nitrogen mineralisation and the kinetic parameters of carbon mineralisation were correlated with the chemical structure and composition of the peats. The use of peat chemical data derived from ^{13}C NMR data individually only explained a small proportion of the variation in carbon and nitrogen mineralisation between peats. Inclusion of additional data pertaining to other chemical and physical properties of peats improved the proportion of variation accounted for, suggesting that the extent of carbon and nitrogen mineralisation from tropical peats may be predicted using a combination of physico-chemical properties and carbon chemistry of peats.

Statement

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

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