Litter nitrogen release in tropical agroecosystems

Plant litter decomposition based on its physical and chemical composition (quality) and environmental factors could play a key role in determining the productivity of natural and agroecosystems. In a review, Palm and Rowland[1] have suggested a minimum data set for the universal characterization of plant quality for decomposition, nutrient release and soil organic matter formation. Their ultimate aim is to couple indices from the data set with decomposition models in order to recognize a few quality parameters that could replace the need for detailed decomposition studies, in global predictions. Among other parameters, they have included nitrogen (N), because it is essential for microbial growth; but values less than 2% are considered to be associated with net immobilization, due to scavenging of N from the background. They recommend soluble polyphenols as a parameter for the decomposition, but only when the plant N content is greater than 1.8%. Lignin is important for both short and long-term decomposition. They have based these indices on the literature in which researchers have conducted incubation studies with a limited number of observations.

I recently compiled a large, comparable data set (102 observations) for the topics extracted from the literature[2]. I clearly observed that plant materials with less than 2% N concentration show both immobilization and mineralization, irrespective of their type (species), physiological state (fresh and litter) and position in the soil during decomposition. Plant N governs the mineral N release of added plant residues when their N concentration is between 0 and 2%, but beyond this range carbon (C) and other nutrients determine the rate of the process.

Soluble polyphenols are important determinants of the N release, only when plant N concentration is less than 1%. This was also observed for pine litter that normally contains N concentration of less than 1% (refs 3 and 4). However, plant residues rich in N (i.e. greater than 1%) have also shown significant relationships between polyphenolic contents and the N release[5]. This is attributed to a lack of continuity in the range of data due to relatively small number of observations made in the past incubation studies, as is clearly seen from my data compilation. Lignin is not important as a determinant of the N release. I found that the C/N ratio is the best predictor of plant N release. These observations imply that under low nutrient conditions, it is the nutrients in the added plant residues, which limit the action of diverse decomposer community with varying limiting factors that govern decomposition and N release. Hence, it is clear that the added plant nutrients, which affect microbial enzyme kinetics, are important parameters with respect to decomposition and N release. The critical concentrations of nutrients with respect to decomposition and N release are a function of the species composition of microbial decomposers in any ecosystem, which is determined by the soil, vegetation and climate[2]. Therefore, if these critical levels could be established for different agroclimatic regions, it would help in improving global predictions of N release from tropical litter. The conclusions should be revised as follows. Plant residue N is a determinant of residue N release when the N concentration is less than 2%. An N concentration of greater than 1.8%, which is considered to be the critical level for the interference of polyphenols in the N release should be replaced by an N concentration of less than 1%. In my study, those indices were independent of litter and soil decomposition properties and hence are universal determinants of the litter N release in the tropics.

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Metabolic synthesis of water in plants and its physiological implications

Plant cells have an array of enzymes to metabolize oxygen using a variety of substrates. The activity of some of these enzymes increases several fold when the plant experiences stress situation(s) or enters a developmental phase[1–3]. The most evident being two indirect oxidases, namely cyanide-sensitive cytochrome a–a_3 oxidase and cyanide-insensitive alternative oxidase, and three direct oxidases, namely peroxidases (ascorbate peroxidase in particular), catalases and ascorbate oxidase. While cytochrome oxidase is unquestionably an important component of the electron transport chain which is involved in fulfilling the energy demand of the cell by way of oxidative phosphorylation, several roles have been assigned to alternative oxidase