8

Carbon/nitrogen ratio

The rate of decomposition of soil OM and the amount of humus formed are related to the soil's TOC to TSN ratio (C/N ratio). As decomposition of OM typically increases as soil C/N ratios decrease, the ratio of these two essential elements is recognised as a useful index of soil fertility (e.g. Owen *et al.* 1950; Jones and Parsons 1970; Post and Mann 1990; Knops and Tilman 2000). It follows that the C/N ratio of OM added to moist soil reflects the likely rate of OM decomposition and ultimately whether there is subsequent release (mineralisation) or immobilisation of soil N.

Organic matter breakdown is a complex process. Decomposition involves chemical alteration of OM, physical fragmentation and finally release of mineral nutrients. This process is facilitated by soil biota, including micro-organisms and earthworms, which are influenced by the amount of N present. Soil microbes that attack OM have a C/N ratio of ≈8:1.

Organic compounds readily decomposed by soil micro-organisms include amino acids and simple sugars. Cellulose, phenols, waxes and lignins resist decomposition, so remain for longer times and often accumulate in soils with wide C/N ratios.

Very high C/N ratios (>25–30) indicate OM accumulation is occurring or has occurred faster than decomposition. These high ratios are observed in peats and forest litters. Ligneous tissue of trees can have a C/N ratio up to ≈1000:1. Soil C/N ratios from ≈12–16 suggest OM is well broken down. Good cropping soils usually have a C/N ratio of 10–12. Ratios below 10 and as close as 5:1 are normally confined to subsoils containing 'fixed' non-exchangeable NH_4^+ (Cooke 1967), or may reflect very heavy fertilisation with N and/or inputs of N-rich materials such as poultry manure. For further information, see Brady (1990) and Millar and Donahue (1990).

Because reported soil concentrations of TOC (%C) and TSN (%N) are influenced by the methods employed, apparent C/N ratios, which are calculated on a weight rather than an equivalence basis, will also be affected. For this reason, it is important to give details of the analytical methods employed in the calculation of C/N ratio. Measurement uncertainty is a function of how well the C and N methods are analysed. It is usual to report C/N ratios as

Table 8.1. Summary detaÕs of laboratory and field methods described in this chapter.

Code	Technology	Test method	Notes
8A1	Calculation based on use of specified C and N methods	Total organic carbon/total nitrogen ratio	Best estimate of C/N ratio, subject to the quality of input data.
8B1		Organic carbon – Walkley & Black (W&B)/total nitrogen ratio	Approximate estimate of C/N ratio, subject to the quality of input data.