Modelling Water, Nitrogen and Carbon Fluxes during Decomposition of Crop Residues, Incorporated or left at the Soil Surface

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Reduced or no-tillage has been proved to be an effective strategy against soil erosion. Leaving a mulch at the soil surface minimises runoff and reduces changes in soil water content. Less is known about the implications of the change in crop residue localisation on carbon sequestration, nitrate leaching and the emission of greenhouse gasses, in relation to their biochemical quality.

Laboratory studies were conducted to evaluate the interactions of crop residue localisation and quality on soil physical and biological properties. Soil columns with $^{13}C^{15}N$-labelled rape or rye residues, left as mulch at the soil surface or incorporated homogeneously in the upper 10 cm, were incubated during 9 weeks at 20°C. They went through 3 dry-wet cycles, induced by the application of an artificial rain (2.5h at 12 mm/h), followed by a 3-week evaporation period (Recous *et al*., this conference).

The soil and residue moisture contents, the soil matric potential, the composition of the soil solution at different depths in the soil columns and the evaporation rate were measured during the incubation. Carbon mineralisation and residue decomposition were determined by measuring the CO_2-flux and the concentration of ^{13}C-CO_2 at the soil surface. At different depths, soil was analysed for total C and N (with their isotopic excess), soluble carbon, mineral nitrogen and microbial activity.

The experimental data were used to validate the PASTIS-model (Garnier *et al*., 2003), a mechanistic and one-dimensional model of transport and biotransformations in soil, and to test a 'mulch'- module that was added to this model (Reyes Gomez, 2002). PASTIS allowed to simulate the soil water evaporation, CO_2-fluxes, nitrate transport and the amounts of residual carbon in the soil during our incubation experiment. The C and N isotopes were measured and simulated to trace the residue-derived C and N in the soil. Modelling helped to identify and quantify the contribution of the various physical and biological processes to the resulting carbon and nitrogen dynamics.

References

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