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"Resilience of agricultural systems against crises"

Measuring and Modelling the Decomposition Dynamics of Diverse Crop Residues

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Abstract

In many tropical farming systems, organic sources play a dominant role in the cycling of nutrients in the soil-plant system. The quality of plant residues as indicated by C:N ratio, lignin, tannin and other indicators of quality has a profound effect on the decomposition patterns and in effect on the mineralisation/immobilisation dynamic of N. A closed chamber incubation experiment was conducted to measure the interaction of soil type and crop residue quality (canola, wheat, pea and *mucuna*) on decomposition. Briefly, residues were incorporated into 2 soil types (Alfisol and Calcaresol) and incubated at 25oC for 14 weeks. The production of CO_2 was measured in NaOH traps which were regularly titrated and renewed. A treatment that contained soil but no residues was included as a control. Over the entire period of the incubation, the C mineralisation was significantly higher in the Alfisol than in the Calcaresol soil. The rate of CO_2-C release in both soils decreased with time during the incubation, and the treatments containing *mucuna* residues released less CO_2-C than other residue treatments. Meanwhile, the mineral N in the 2 soils was initially dominated by the NH_4^+-N form, this declined within 14 days of the start of incubation and thereafter remained low.

To date there have been limited attempts to model the decomposition pattern of diverse plant residues in farming systems models such as APSIM, DSSAT and CropSys. This is a priority area of research for low input agricultural systems, which relies largely on crop residues and manures for nutrient input. Using the Surface Organic Matter (SurfaceOM) module in APSIM, the input of fresh organic matter (FOM) was adjusted to represent the residues used in the incubation experiment via the "FPOOL" which describe carbohydrate, cellulose and lignin like parameters of the residues. By adjusting these proportions from the typical 0.2:0.7.0.1 ratio with constant C:N ratio, to ratios which better match the measured quality parameters, we were able to better represent the results of decomposition processes of the residues inputs and importantly more closely simulate N mineralisation.

Keywords: APSIM, crop residues, decomposition, incubation, mineralisation modelling

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