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The Dynamics of Residue Decomposition under Aerobic and Anaerobic Systems

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Abstract

In lowland rice cropping systems, soil water content may vary widely between aerobic and anaerobic conditions due to a shortage of rainfall or through management aimed at reducing water use. The effects of water content on soil chemistry and in particular carbon and nitrogen dynamics are profound but literature describing these effects on the dynamics of residue decomposition is scarce. Decomposition of residues mostly releases ammonium into the flooded soil. However, as soils become saturated with water, decomposition of residue is reduced due to limited aeration for microbial activity and concomitance enhances anaerobic metabolites such as volatile fatty acids, CH_4 and sulphide.

To determine the effects of aerobic and anaerobic conditions on dynamics of residue decomposition, a closed incubation system with treatments containing soil, soil + residues under aerobic or anaerobic conditions was conducted in the laboratory. Using 3 L incubation pots, 400 g of soil and 5 g of maize leaves were pre-incubated for 7 days and then measured for 19 days at a constant temperature of 25°C. To create aerobic soil conditions, soil water content was maintained at 50 % of water holding capacity, while to create anaerobic conditions, the pots were flooded with water to 2 cm above the soil surface. On days 1, 2, 3, 5, 8, 10, 12 and 19, incubation pots were opened and flushed with air and then closed for 1 h prior to the collection of gas samples from the headspace. The headspace was sampled at 0, 2, 4 and 6 hours and analysed by gas chromatography.

Treatments containing soil+residues had higher gas accumulation compared to control treatments (soil only). Accumulation of CO_2, CO_2+CH_4 and N_2O was higher under aerobic than anaerobic condition with the addition of residues but were similar in the control treatments. Of the total carbon added in soil and residues, 15 % and 13.5 % of carbon released from maize residues under aerobic and anaerobic conditions respectively over 19 days incubation. Further study is underway to further investigate the effects of aerobic and anaerobic condition on the dynamics of residue decomposition of diverse crop residues over longer periods.

Keywords: Closed incubation system, aerobic, anaerobic, gas chromatography, residue decomposition

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