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Preferential Flow Paths in Rice Systems as Hot Spots for Nutrient Cycling

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Abstract

After introducing upland crops like maize into permanent flooded cropping systems, soil conditions temporally change from anaerobic to aerobic. This promotes the development of desiccation cracks in the soil, which can act as preferential pathways. We analysed their role for the distribution of plant nutrients in a dye tracer experiment with Brilliant Blue on two separate fields in the International Rice Research Institute (Los Baños, Philippines). The fields were under maize-paddy rice cultivation. The dynamic of rice straw-C and fertiliser-N inside and outside the pathways was traced by applying ^{13}C-labelled rice straw and ^{15}N-labelled urea. The dye tracer was solved in the irrigation water and applied on the soil pits by a ponding pulse. The soil pits were excavated horizontally in 10 cm intervals and vertically in 5–15 cm intervals until 60 cm depth. The soil surface and profiles were photographed. Dyed and non-dyed soil samples were taken for analysis. The horizontal pictures showed decreasing areas of the dyed soil and with that decreasing proportions of the flow path areas. The typical plough pan could not be identified and it did not seem to inhibit the vertical flow of irrigation water. A direct comparison of flow paths (dyed soil samples) and bulk soil showed larger amounts of plant nutrients (C, N, Ca, K, Mg, Na) in the flow paths. The labelled straw and fertiliser could be traced down to 60 cm depth. The quantification and analysis of the microbial biomass is still in progress. Higher abundances and higher recoveries in the microbial biomass would emphasise the importance of the flow paths as important pathways for C-and N-input into the plant-soil system.

Keywords: ^{13}C-labelled straw, ^{15}N-labelled urea, desiccation cracks, dye tracer, flow paths, maize, paddy rice

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