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"Solidarity in a competing world — fair use of resources"

Seasonal Nitrogen Dynamics in Lowland Rice Cropping Systems in Inland Valleys of Northern Ghana

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Abstract

Rainfed lowland rice farmers in the inland valleys of northern Ghana are challenged with N deficiency as a major production constraint. With extremely low use of external inputs, there is a need to efficiently use systems' internal resources such as native soil N. Largest soil nitrate-N losses are expected to occur during the transition between the dry and wet season (DWT) when the soil aeration status changes from aerobic to anaerobic conditions. Technical options avoiding the build-up of nitrate are expected to reduce N losses and may thus enhance the yield of rice. A field study in the moist savannah zone of Ghana assessed the in-situ mineralisation of native soil N, the contribution of nitrate to the valley bottom by sub-surface flow from adjacent slopes, and the effects of crop and land management options during DWT on seasonal soil N_{min} dynamics and the yield of lowland rice. Large amounts of nitrate were accumulated during DWT with a peak of 58 kg ha^{-1} in lowland soils, of which 32 kg ha^{-1} was contributed from the adjacent upland slope. Most of this nitrate disappeared at the onset of the wet season, possibly by leaching and denitrification upon soil flooding. While the incorporation of rice straw (temporary immobilisation of soil N in the microbial biomass) had little effect on soil N conservation, growing a crop during DWT conserved 22–27 kg of soil N ha^{-1} in the biomass and *Crotalaria juncea* supplied an additional 43 kg N ha^{-1} from biological N_2 fixation. Farmers' practice of bare fallow during DWT resulted in the lowest rice grain yield that increased from 1.3 to 3.9 Mg ha^{-1} in case of the transition season legume. Growing a pre-rice legume during DWT appears a promising option to manage N and increase lowland rice yields in the inland valleys of northern Ghana.

Keywords: *Crotalaria juncea*, moist Savannah zone, nitrate, *Oryza sativa*

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