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Managing Seasonal Soil N Dynamics in Rice-Wheat Cropping Systems of Nepal

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Abstract

The rice-wheat annual double cropping system occupies some 0.5 million ha in the Himalayan foothills of Nepal. Alternating soil drying and wetting cycles characterize the 6–10 week-long dry-to-wet season transition period (DWT) after wheat harvesting and before wetland rice transplanting. Mineral fertilizer use in the predominant smallholder agriculture is low and crops rely largely on native soil N for their nutrition. Changes in soil aeration status during DWT are likely to stimulate soil N losses. The effect of management options that avoid the nitrate build-up in soils during the eight weeks DWT by N immobilization in plant or microbial biomass was studied under field conditions in Rampur, Nepal in 2002. Treatments included bare soil (farmers' practice), green manure (*Mucuna pruriens* var *utilis*), grain legume (*Vigna radiata* L.), wheat straw ($5\,\mathrm{Mg\,ha^{-1}}$) and combinations of straw application and transition season crops. The gradual increase in soil moisture with the onset of the rainy season resulted in a nitrate peak of about $60\,\mathrm{kg\,N\,ha^{-1}}$ that rapidly declined and nearly completely disappeared with soil moisture levels exceeding 46 % water-filled pore space. Incorporation of wheat straw and/or N uptake by green manure crops reduced nitrate accumulation in the soil to $< 30\,\mathrm{kg\,ha^{-1}}$ (temporary N immobilization), thus reducing the risk for N losses to occur. This "saved" N benefited the subsequent crop of lowland rice with increases in N uptake at least $37\,\mathrm{kg\,ha^{-1}}$ and corresponding grain yield increases from 1.7 to $3.0\,\mathrm{Mg\,ha^{-1}}$. While benefits from improved soil N management on lowland rice are obvious, possible carry-over effects on wheat and the feasibility of proposed options at farm level require further studies.

Keywords: Biological nitrogen fixation, denitrification, *Mucuna*, *Oryza sativa*, *Triticum aestivum*, *Vigna radiata*

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