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Soil and Crop Management During the Transition Season Improves N Balance and Productivity of Rice-Wheat Cropping Systems in Nepal

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Abstract

Under the prevailing low-input production conditions of Nepal a low productivity of rice-wheat rotations is generally associated with highly negative N balances. Previous work indicates that massive soil N losses during the dry-to-wet season transition period between wheat harvesting and rice transplanting may be responsible for the reported declining yield trends in the traditional production systems. A range of management practices, aimed at the conservation and/or replenishment of soil N during the transition season, were evaluated regarding year-round dynamics of soil N (mineralisation, nitrate leaching, nitrous oxide emissions), crop N assimilation (uptake, nitrogen fixation), cumulative grain yield (wheat + rice) and systems' N balances. Experiments were conducted on station and in several farmers' fields of the Terai region in Nepal between 2001 and 2004. In the traditional production system (bare or weedy fallow during the transition season), the occurrence of a distinct mineralisation peak at the onset of the rainy season was associated with losses of some 40 kg N ha^{-1} yr^{-1}, a cumulative grain yield of 2.8 Mg ha^{-1} yr^{-1} (rice + wheat) and a N balance of –78 kg N ha^{-1} yr^{-1}. Application of wheat straw, sole or in combination with various nitrogen-fixing and non-fixing transition season crops significantly reduced N losses compared to a bare fallow transition season field management and increased the cumulative grain yield to 3.1–5.4 Mg ha^{-1} yr^{-1}. While increasing the short-term grain production, the use of non-fixing transition season crops resulted in the most negative N balance of up to -93 kg N ha^{-1} yr^{-1}, indicating a possible long-term aggravation of the declining yield trends. Combining a temporary N immobilisation in the soil microbial biomass through straw incorporation with soil N uptake and atmospheric N assimilation by green manure legumes minimised soil N losses, provided a cumulative grain yield of >5 Mg ha^{-1} and showed near-neutral N balances. Implications for long-term systems management will be discussed.

Keywords: Green manure legumes, N assimilation, N balance, nitrogen fixation

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