Improving Nitrogen Use Efficiencies in Rice-Wheat Rotations in Southeastern China

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Introduction

Excessive use of mineral nitrogen (N) fertilizer is a common practice in rice-wheat rotations in southeastern China. At the same time N use efficiencies (NUEs) in these rice-based cropping systems are very low (Peng et al., 2006). The consequences are high N losses from arable land to water bodies (surface- and groundwater) and to the atmosphere (Richter and Roelcke, 2000). To investigate the scope and scale of reductions in mineral N fertilizer inputs, demonstration field experiments on farmers’ field sites were conducted for three consecutive winter wheat-summer rice double crop rotations in two counties of Jiangsu Province from 2008 to 2011. Results from the first two years are presented here.

NUEs

Nitrogen balances

Conclusions

- No significant differences in grain yields were observed in the “reduced” N fertilization treatments compared to the farmers’ N practice for any year and crop location.
- NUEs could be improved by reducing the N application rate by 25-30% for both crops and years, with a greater increase in winter wheat than in summer rice, and a stronger effect in Huai’ an than in Yixing.
- Calculated N balances for Huai’ an showed a clear decrease in annual N balance surpluses in the “reduced” N fertilization treatments compared to farmers’ practice.
- As recommendations to farmers, reductions in N fertilizer application rates by 15-20% to rice and 20-25% to wheat are recommended.

References


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Materials and Methods

Locations and experimental design

Starting with the winter wheat crop 2008/09, demonstration field experiments on farmers’ field sites were established in the two counties of Yixing (31° 37’ N, 119° 53’ E) and Huai’an (33° 02’ N, 118° 53’ E), Jiangsu Province, China. The experimental design was according to the so-called “3+x” approach with three different N fertilization treatments (farmers’ N fertilization practice (N-FP), “reduced” (by 25–30%) (N-red.) and zero-N application) and two agronomical (“x”) treatments within each N treatment. Grain yields were determined, N balances calculated and NUEs derived according to the following equations:

(Apparent) Recovery efficiency:

$$\text{RE}_{\text{w}} [\text{kg kg}^{-1}] = \frac{(U_{\text{w}} - U_{\text{a}})}{F_{\text{w}}}$$

Agronomical N efficiency:

$$\text{AEN}_{\text{w}} [\text{kg kg}^{-1}] = \frac{(Y_{\text{w}} - Y_{\text{a}})}{F_{\text{w}}}$$

Results

Grain yields