



Yield sustainability, soil organic carbon sequestration and nutrients balance under long-term combined application of manure and inorganic fertilizers in acidic paddy soil

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ABSTRACT

Organic and inorganic fertilization management in intensive cropping system is important to achieve long-term high crop yield sustainability. We quantitatively investigated crop yield sustainability through soil fertility and nutrients balance in 34-years long-term experiment under double rice cropping system in acidic paddy soil. Seven treatments were studied: CK (no fertilization); NPK (Chemical nitrogen, phosphorus and potassium fertilizer); NPM (Chemical N, P and manure); NKM (Chemical N, K and manure); PKM (Chemical P, K and manure); NPKM (Chemical N, P, K and manure) and M (Manure). Manure was applied at the rate of 45,000 kg ha⁻¹. Results showed that crop yield and sustainability yield index under combined application of manure and chemical fertilizers was significantly higher than chemical fertilization and highest crop yield was under NPKM treatment. Long-term combined manure and chemical fertilization improved soil fertility as compared to CK and NPK treatments. Soil organic C sequestration rates under NPM, NKM, PKM and NPKM treatments were increased, while decreased under CK and NPK over the fertilization years. The uptake of N, P and K was increased over the fertilization years in all the treatments that received manure, compared with CK and NPK. Apparent K balance was negative in all the treatments. N balance (except CK and NPKM) and P balance (except CK) was positive in all fertilization treatments. P balance was exceeded the environmental risk threshold under combined application of chemical P fertilizer and manure. Boosted regression tree indicated that soil available N (AN), organic carbon (OC) and total N (TN) were the most influencing factors of crop yield, accounted 36.5 %, 17.8 %, 13.4 % of variations of relative yield, respectively. Path analysis showed that long-term fertilizer inputs increased soil nutrient contents and C input directly affected soil OC. C input and soil pH indirectly influenced the relative crop yield. This study concluded that long-term combined application of manure and inorganic fertilizers increased crop yield sustainability, organic carbon sequestration rate compared to the inorganic fertilization. But long-term combined application of manure and inorganic phosphorus fertilizer increased the P balance. Therefore, rate of P inputs should be reduced under combined application of manure and inorganic P fertilizers in acidic paddy soil.

1. Introduction

Sustainable crop production in China as well as in the world is needed to feed the ever-growing world population. Improvement in the field managing technologies has accounted a significant contribution to

increase the crop productivity (Deryng et al., 2011; Doltra et al., 2019). In China, during 1970–1990 the annual rice production was increased by 3.37 % (FAO, 2008), mostly due to the cultivation of high yielding varieties and high consumption of chemical fertilizers (Tong et al., 2003; Yuan, 1996). However, yield growth rate was dropped by 0.6 %

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