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Mitigation of greenhouse gases emissions with the rice plastic mulch technology in southwest China

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To solve the problem of water shortage, an improved plastic film mulching rice cultivation (PM) has been developed and expanded in recent years in Southwest China. It is a promising alternative to the winter-flooded rice cultivation technology (WF). To explore effects of this technology on CH4 and N2O emissions from winter-flooded paddy fields, a field experiment was conducted in Ziyang, Sichuan Province, China from 2012 to 2015. Meanwhile, the effects of nitrification inhibitors (DCD and CP) were estimated. Results showed that annual CH4 and N2O emissions from winter-flooded paddy fields ranged from 205-738 kg ha^{-1} and 0.05-1.52 kg N ha^{-1}, respectively. Shifting the fields from WF to PM led to significant reduction 30-76% of CH4 emissions and 24-70% of 100-year GWP (CH_4+$N2_O$) though substantial increase of N_2O emissions (10-3975%). Decrease in CH_4 emissions was ascribed to the reduced CH_4 production potential while N_2O emissions were increased as a consequence of more suitable soil water content and single basal application of nitrogen fertilizer in plastic film mulching rice fields. Integrated assessments showed that PM relative to WF significantly enhanced the net ecosystem economic budget (NEEB: balance between the economic benefits: yield gains and input costs; and environmental costs: GWP costs), due to the input costs reduced greatly. If WF was all changed to PM in Sichuan Province, China, the mitigation of 0.53-3.89 Tg CO_2-eq yr^{-1} in 100-year GWP (CH_4+N_2O) and the increase of 1.60-3.32 billion CNY yr^{-1} in NEEB might be achieved. Applying CP under PM conditions reduced 1-10%CH_4emissions and 9-26%N_2O emissions and increased 1-5% grain yields, thus mitigating 6-10% 100-year GWP (CH_4+N_2O) and enhancing 29% NEEB. The results demonstrate that PM and PM+CP increased economic incomes and decreased environmental costs of the fields, which would be the effective management strategies in the regions where are water scarcity.

Biography

Guangbin Zhang major study was the processes of CH4 emission from rice fields with the stable carbon isotope technique combining with microbes (methanogens and methanotrophs) analyses. Recently, he had carried out field experiments to study the mechanism of CH4 emission from a special kind of rice fields that are permanently flooded with highest fluxes in southeast of China. In addition, pot and incubation experiments were performed to investigate the effect of nitrogen fertilization on production, oxidation and emission of the CH4 by measuring the stable carbon isotopes, methanogens and methanotrophs. Meanwhile, integrated effects of nitrogen fertilization and straw application on N2O emission from paddy soils were observed. He is very interested in Soil Ecology, Microbiology, Biogeochemistry, Environmental and Soil Chemistry, and his focus is on the cycling of C and N in the agricultural ecosystem and the responses to global climate change (CO2 concentration and temperature enrichment).

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