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Saving Water with Ground Cover Rice Production Systems at the Price of Increased Greenhouse Gas Emission?

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Abstract

Submerged lowland rice fields make a substantial contribution to global warming by emission of greenhouse gases, typically methane, CH_4. The impact of paddy rice production on nitrous oxide (N_2O) production is less clear. The strong anaerobic conditions of the bulk soil of paddy rice fields promote CH_4 production, while they might limit N_2O emission. Water-saving rice production systems have not been tested so far. Here we present an evaluation of the water-saving GCRPS for its impact on emission of methane and nitrous oxide.

Two Ground Cover Rice Production Systems using thin plastic film or straw mulch soil cover were compared to traditional paddy rice production in three major Chinese rice regions, Beijing, Nanjing and Guangzhou. There was a pronounced effect of water management. In the traditionally submerged rice fields, methane emission was dominant, and only during the drainage period before panicle initiation nitrous oxide emission were found. In contrast, methane emission from GCRPS was negligible in Beijing and Nanjing. Only in Guangzhou after heavy rainfall in the beginning of the growing period, both systems showed similar methane fluxes. N_2O emission generally increased with water-saving GCRPS, and emission events were clearly linked to fertilization. Considering the global warming potentials of CH_4 and N_2O, the compensation of reduced CH_4 emission by increased N_2O fluxes became evident. Our results show that, for Beijing and Nanjing, GCRPS led to a small increase in the total effect of GCRPS on global warming, while in tropical Guangzhou with high CH_4 emission from traditional rice system, GCRPS resulted in a small reduction.

Keywords: GCRPS, green house gases, global warming, rice production system, China

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