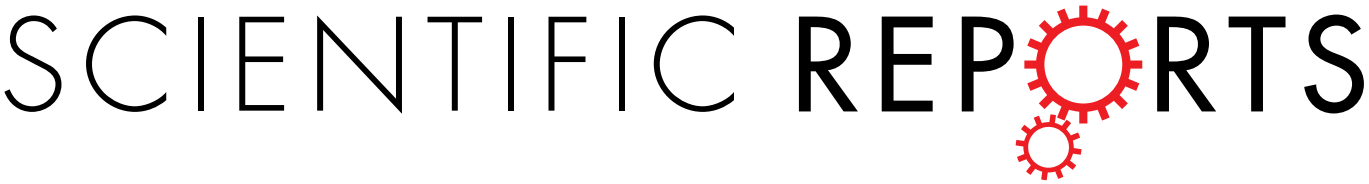

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Effects of straw application on nitrate leaching in fields in the Yellow River irrigation zone of Ningxia, China

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Shiqi Yang[1,2], Yongsheng Wang[3], Ruliang Liu[4], Quanxin Li[5] & Zhengli Yang[1,2]

A five-year field experiment was conducted to investigate the effects of straw application on nitrate leaching loss. Treatments included soil that was not treated (control), soil treated with straw at a low rate (4,500 kg ha^{-2}, T1) and soil treated with straw at a high rate (9,000 kg ha^{-2}, T2). Nitrate-nitrogen leaching in the 10, 20, 30, 60, and 90 cm soil layers was measured using the resin-core method. The results indicated that straw application could reduce soil nitrate leaching losses in the 0–30 cm layer. In this layer, the nitrate leaching values for T1 (13.76 kg ha^{-2}) and T2 (13.74 kg ha^{-2}) were both significantly lower than those of the control (15.76 kg ha^{-2}) ($P < 0.05$); the soil nitrate leaching losses decreased by 12.71% and 12.84% for those two treatments, respectively. However, no significant differences in losses were observed ($P > 0.05$) between T1 and T2. The effects of straw application were apparent only in the ploughing layer (30 cm-depth soil layer). In the deeper layers (60 and 90 cm), no significant differences were observed between the treatments and the control, and the same results were observed in the topsoil layers (10 and 20 cm).

Agricultural nonpoint source pollution has dramatically impacted water quality in China. The total nitrogen (TN), total phosphorus (TP) and chemical oxygen demand (COD) from agricultural sources are approximately 2.7, 0.28, and 13.24 million tons per year, respectively, accounting for 57.2%, 67.4%, and 3.7% of total emissions, respectively[1]. For the top ten rivers in China, 10.2% are considered inferior class V, and 20.9% are class IV-V. In China, 24 of 61 key lakes and pools have a water quality below class III, and nearly 0.3 billion people in rural regions drink unsafe water[2]. The Yellow River irrigation zone of Ningxia is the 4th largest irrigation zone in China by area, yet it is a black box in terms of water pollution because of its nonpoint source pollution. Ammonium-nitrogen concentrations in drainage channels are often 20–30 mg L^{-1} (maximal concentration of 70 mg L^{-1}). Only 38.3% of the water tested meets the Chinese national standard, and many of the samples are below class V. The water quality of the Yellow River in Ningxia is usually class V all year round. In the tenth Five-Year Plan for China, the acceptable level for ammonium-nitrogen concentrations in the water was increased from 2.57 to 3.94 mg L^{-1}, yet only 38.3% of surface water met the national standard during the eleventh Five-Year Plan of China. The nitrate concentration of almost half of the shallow groundwater in China exceeded 10 mg L^{-1} [3]. Similar problems occur in other irrigation zones in China. More than half of the groundwater in 14 investigated counties in the North China Plain have nitrate concentrations that exceed 10 mg L^{-1} [4]. The nitrate concentration in 7.4% of the groundwater in Beijing suburbs exceeds the national standard for groundwater[5].

Many studies have addressed the relationship between organic matter (OM) applications and soil nitrate losses. Some scientists believe that OM can reduce nitrate losses[6,7], but excess straw can result in increased nitrate leaching[8–10]. OM compost can reduce mineralization rates and nitrate losses[11,12]. OM practices typically aim to

[1]Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Beijing, 100081, China. [2]Key Laboratory of Agro-Environment and Climate Change, Ministry of Agriculture, Beijing, 100081, China. [3]Key Laboratory of Regional Sustainable Development Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, 100101, China. [4]Institute of Agricultural Resources and Environment, Ningxia Academy of Agro-Forestry Science, Yinchuan, 750002, China. [5]Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing, 100081, China. Correspondence and requests for materials should be addressed to Q.L. (email: liqx258369@163.com) or Z.Y. (email: yangzhengli@caas.cn)