

Public Abstract

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Graduation Term: Fall

Graduation Year: 2006

Title: Use of slow-release N fertilizer to control nitrogen losses due to spatial and climatic differences in soil moisture conditions and drainage in claypan soils

Agricultural soils are a major source of nitrous oxide (N_2O) which can have a significant environmental impact on global warming and ozone depletion. As a result, many scientists have conducted research on the impacts of agriculture on N_2O emissions. However, there is little information on soil N_2O emissions under different soil water contents as affected by drainage and irrigation in claypan soils. Improved and cost-effective management practices to increase N use efficiency (NUE) and reduce environmental pollution are necessary. In addition, slow-release N fertilizers (i.e., polymer coated urea-PCU) have not been extensively tested for agronomic crops. The objectives of this research were to determine the relationship between soil N_2O efflux, temperature, soil NO_3^- -N, and soil water content and to examine the performance of PCU compared to conventional urea in relation to crop N uptake and environmental N loss under four drainage/irrigation treatments in a claypan soil in northeast Missouri. The treatments consisted of: 1) no irrigation or drainage (NIN), 2) no irrigation and drainage (NID), 3) subirrigation and drainage (SUB), and 4) overhead irrigation and no drainage (OND). The plots were split into N fertilizer treatments of pre-plant-applied conventional urea or polymer-coated urea at rates of 0, 140, and 280 kg N ha⁻¹. All N fertilizer was broadcast-applied and incorporated.

Measurements of surface soil N_2O efflux, soil water content, soil temperature, and soil NO_3^- -N were periodically collected for each treatment during the 2004 and 2005 growing seasons. Water samples from suction lysimeters installed at the 15 and 45 cm depths were also collected to measure NO_3^- concentrations.

At the beginning of the relatively higher rainfall year of 2004, significantly lower soil N_2O flux was measured with application of PCU under no drainage or irrigation and no drainage and overhead irrigation. However, no consistent differences in soil N_2O efflux between fertilizers were observed in 2005, probably due to the lower precipitation experienced that year. Higher NO_3^- -N concentrations were found in lysimeters under application of urea at the beginning of the 2004 growing season. In contrast, PCU led to higher NO_3^- -N concentrations in lysimeters later in the growing season. Generally, N fertilization increased crop N uptake, silage and grain yields. However, no differences were observed between fertilizer treatments in any of the two years.

The results of this study showed no improvement in N uptake with use of PCU, but suggest that PCU may be effective in reducing environmental N losses under relatively wet climatic conditions. However, no significant advantages were seen under low rainfall conditions. Therefore, further research is needed to better assess PCU performance under a range of soil characteristics and environmental conditions.