NITROUS OXIDE EMISSIONS FROM NITROGEN FERTILIZERS IN ILLINOIS

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Abstract

Nitrous oxide (N_2O) has a large global warming potential (GWP). Agricultural applications of nitrogen (N) contribute to N_2O emissions but it might be possible to mitigate such emissions through different N sources. We investigated the potential for anhydrous ammonia (AA), urea, and polymer coated urea (ESN) to mitigate N_2O emissions while enhancing corn (*Zea mays* L.) production. This three-year study was conducted in Champaign County, Illinois on highly productive mollisols during 2009 to 2011. Various N rates, up to 200 lb N acre^{-1}, were applied to measure corn response to N, with N_2O measured only in the unfertilized check every year and the 100 lb N acre^{-1} rate in 2009 and the 160 lb N acre^{-1} rate in 2010 and 2011. Nitrous oxide fluxes were measured during the growing season at a frequency of one to three times per week using vented non-steady state closed chambers. While N_2O emissions varied substantially by year, the temporal pattern for N sources were consistent across years, with most N_2O emissions during June and July. Across years and N sources, 2.85% of the applied N was lost as N_2O. Although cumulative N_2O emissions were 4.3 times greater with N fertilization, the unfertilized check emitted 1.33 lb N_2O-N acre^{-1}, illustrating the natural potential of these soils to emit N_2O. Every year, largest N_2O-N emissions occurred immediately after substantial (>3/4 inch) single or 2-3 day cumulative rains during June and July, dropping to near background levels thereafter. Only in 2010, the year with most favorable conditions for N_2O loss, we observed differences due to N source. In 2010, cumulative emissions in lb N_2O-N acre^{-1} were lowest for the check (1.97) followed by ESN (8.72), and ESN was significantly lower than urea (12.56) and AA (15.08). Across years, mean cumulative emission for ESN was 4.42 lb N_2O-N acre^{-1} and 39% lower than AA, while urea emitted intermediate amounts. Across years the check had the lowest grain yield, but no differences in yield occurred between N sources. However, N_2O-N emissions per unit of corn yield for ESN were similar to the check and 45% lower than for AA, while urea produced intermediate values. Our study showed that under conditions of high N-loss potential ESN could reduce N_2O emissions and increase agronomic N use efficiency relative to urea and AA. The fact that N_2O emissions were different between urea and ESN in 2010 but not across years highlights the need for further investigation on mitigating N_2O emissions with different N sources under different environments and growing season conditions.

PROCEEDINGS OF THE

42nd

NORTH CENTRAL EXTENSION-INDUSTRY SOIL FERTILITY CONFERENCE

Volume 28

November 14-15, 2012
Holiday Inn Airport
Des Moines, IA

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Published by:
International Plant Nutrition Institute
2301 Research Park Way, Suite 126
Brookings, SD 57006
(605) 692-6280
Web page: www.IPNI.net