CHOOSING YOUR NITROGEN FERTILIZERS BASED ON AMMONIA VOLATILIZATION

Donald A. Horneck, Jess Holcomb, Dan Sullivan and George Clough
Oregon State University, Hermiston Agricultural Research and Extension Center and Corvallis

Introduction

Until recently we have not been able to measure ammonia volatilization without impacting the surrounding environment. In the past we have used closed chambers with acid traps. These closed chambers did not reflect surrounding weather conditions, at the minimum both temperature and wind were influenced. The use of the vertical flux method allows ammonia in the air to be monitored and modeled to reflect ammonia loss without any interference of the surrounding environment.

The loss of ammonium nitrate as a common fertilizer and the increased cost of sulfur for ammonium sulfate has left urea as the primary dry nitrogen fertilizer in the agricultural industry. The change to urea has caught many dealers and growers "off guard". Where other fertilizers can be left on the soil's surface for an extended period of time with little risk for loss Nitrogen loss, urea cannot. Urea, because of hydrolysis and the unfavorable increase in pH it creates around the fertilizer pellet, has a higher risk of losing nitrogen to the air as ammonia than most other fertilizers. This loss into the air is critical from several view points, NUE (nitrogen use efficiency), air quality and carbon footprint.

NUE is decreased when nitrogen escapes from the reaches of plant roots, this can occur via leaching, volatilization and denitrification. Leaching the loss of nitrogen to areas below the roots and generally assumed to groundwater will not be discussed here. The two loses into the air are denitrification and volatilization. Denitrification is generally considered an anaerobic process where wet soil cause the conversion of nitrate into nitrous oxide (NOx). Volatilization is the loss of ammonia into the air. Volatilization can occur from the application of any ammonia based fertilizer. Volatilization into the air means fertilizer is escaping and dollars are being lost, either from the need to apply more to compensate for volatilization or from the reduced yield that the applied nitrogen was expected to create.

Ammonia in the air creates two main problems; first is smog and the second is nitrogen deposition. Ammonia creates smog in the air by combining with NOx and SOx in the air. The Columbia River Gorge has been determined to be ammonia limiting for smog. This means there is plenty of NOx and SOx from other sources such as automobiles, barges and trucks. This smog or haze creates particles in the $PM_{2.5}$ and PM_{10} range that impairs the visual standard and creates particles that get into lungs that are difficult to remove.

Nitrogen is considered one of the carbon largest footprint items that a grower has. With the current clamor over climate change and the consumption of fossil carbon with the release of carbon dioxide into the air, anything that can reduce our carbon footprint is a step politically worth taking.

Ammonia volatilization is a function of several climatic and soil properties. These include: soil moisture, soil pH, wind speed, temperature and surface residue. Recent work would indicate that temperature is not as critical as once thought. We are showing volatilization losses as high as 60- 70% of nitrogen applied when temperatures are 50 F.

Our research has been looking at ammonia volatilization, for the last several years, of different fertilizer products that are surface applied under irrigation. Figure one shows how different product can influence volatilization. Urea lost near 30% of the 150 lb N/a applied where as UAN and CAN-27 lost significantly less. Agrotain is a urease inhibitor that is applied to urea. The use of agrotain significantly reduced the amount of ammonia loss, effectively eliminating volatilization for the time frame measured.

Figure two shows ammonia volatilization loss for an application made in the spring of 2010 on a pivot irrigated wheat field. The field was uniformly pre-irrigated, fertilized then a series of irrigation treatments applied. Where no irrigation water was applied volatilization losses were almost 70% of N applied. The more irrigated water that was applied the greater the reduction in volatilization losses.

When nitrogen is applied as urea to the soil surface and left for a period of time it should be protected from volatilization so that NUE can be maximized.

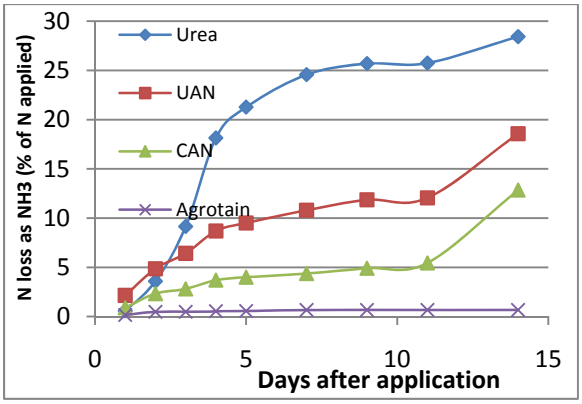

Figure 1. Loss of ammonia from four fertilizers applied to grass seed field in the fall of 2010.

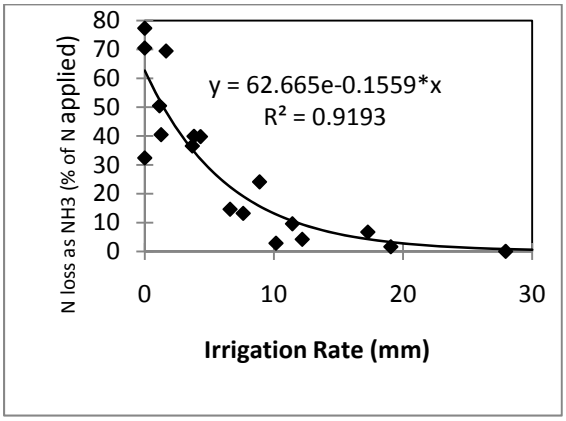

Figure 2. Loss of nitrogen from a urea application applied to a wheat field in the spring of 2010 as a function of irrigation rate.

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RENO, NEVADA

Program Chair:
Robert Flynn, Program Chair
New Mexico State University
67 E Four Dinkus Road
Artesia-NM 88210
(575) 748-1228
rflynn@nmsu.edu

Coordinator:
Phyllis Pates
International Plant Nutrition Institute
2301 Research Park Way, Suite 126
Brookings, SD 57006
(605) 692-6280
ppates@ipni.net