Study provides a first look at ammonia volatilized from surface applied urea

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The question of how much nitrogen is lost from fertilizer urea when it is applied to the soil surface comes up with growers and fertilizer dealers every season and is the focus of a Montana Agricultural Experiment Station investigation being conducted in northern Montana.

Fertilizer urea is an excellent source of nitrogen, but we know it to be susceptible to volatilization losses where it is applied to the soil surface and not incorporated via tillage or rain. The volatilization occurs after the fertilizer dissolves and urea changes to form ammonium carbonate. This process decreases soil acidity (an increase in soil pH), causing ammonium to convert to ammonia gas, which then can escape to the atmosphere.

Surface applications of urea are common in Montana. In winter wheat production systems, applications are often applied after seeding during the fall, winter or early spring. This year, we began a study to quantify what these losses are for dryland winter wheat producers in Montana.

Ammonia losses are estimated using a micrometeorological technique referred to as the integrated horizontal flux method. The method uses a mast with shuttles or passive samplers placed at five heights above the soil surface. Each shuttle consists of a cone front, a cylinder made of PVC pipe with mounting pivots, and fins to keep the shuttle aligned into the wind. The inside of each shuttle contains a stainless steel spiral that is coated with oxalic acid. As ammonia escapes from the soil surface and into the air, it blows into the shuttle via the entrance hole. Once inside

shuttle, the air is stripped of its ammonia by adsorption to the oxalic acid treated spiral. The trapped ammonia is later analyzed in the lab.

This spring, the system was employed for the first time in Montana at Les and Terry Kaercher's farm about 10 miles west of Havre. Mast and shuttles were placed in the middle of circular plots, each 130 feet diameter, established within a winter wheat field. Urea was broadcast on the soil surface at a rate of 90 pounds of nitrogen per acre on April 3 and the shuttles were exchanged at weekly intervals up through May 28.

The ammonia loss results showed that 8.4 percent of the applied urea nitrogen volatilized during the eight-week gas sampling campaign. No significant fertilizer induced ammonia losses occurred during the first 14 days following fertilization, because it never rained and there was insufficient humidity to dissolve the fertilizer. The first significant precipitation occurred April 19, 16 days after fertilization, when we received two-tenths of an inch of precipitation as snow. This small amount of precipitation dissolved the fertilizer prills beginning the hydrolysis process, but was insufficient to move the urea below the soil surface. Because of this, urea was susceptible to volatilization and ammonia emissions began to be observed. The highest losses occurred during the fourth week following fertilization (April 23-30) after air temperatures warmed above 40 degrees Fahrenheit at the field site. Ammonia volatilization for this week was equivalent to 2.8 percent of the applied nitrogen rate for the urea treatment.

The results from our first look at ammonia volatilization of broadcast urea were somewhat surprising in that we showed significant losses occurring for many weeks following fertilization. This was likely a result of the extreme drought conditions experienced during the first seven weeks of this study. Precipitation totaled only 1.1 inches for this period. It was not until May 21 that seasonal and more normal rains returned to the field location. The study was terminated one week later when

ammonia emissions from our fertilized plots returned to background levels. Although the nitrogen losses we observed would not likely result in large yield reductions, they are potentially significant given current high fertilizer nitrogen prices. It needs to be kept in mind that this study was based on only one field site and will be repeated this coming fall. It is our intent to continue this study for three years and to contrast ammonia volatilization losses from surface urea applications made in the early fall, late fall and early spring.

Source: Montana State University