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Fluids Shine in Ammonia Volatilization Comparisons

Tests in no-till corn fields in central Pennsylvania compare UAN with urea.

Summary: In 1992, we initiated a field experiment to determine if a new, simplified micrometeorological method could be used to measure ammonia volatilization losses from surface-applied urea-containing fertilizers. The measuring devices were rotating ammonia samplers set at one height in the center of large circular plots. Losses from these fertilizer sources were checked against losses measured by comparing yields and N uptakes from treatments receiving different sources and/or methods of application. In 1993, measurement of the volatilization losses by the samplers was much more precise. Ammonia volatilization loss over a 16-day period, afier application of 120 lbs/A broadcast uWinter 1994*rea-N applied to no-till corn, was 26 to 29 lbs/A. This was signi-ficantly more than the approximately 13 to 15 lbs/A lost from dribbled UAN. The loss from sprayed UAN was 20 lbs/A, which was signifi-cantly less than from urea when outlier plots were eliminated. There were no significant differences in yields or N uptakes among the N source/ method treatments, which substantiates the increased precision in estimating ammonia volatilization loss when using the simplified micrometeorological ammonia sampler.*

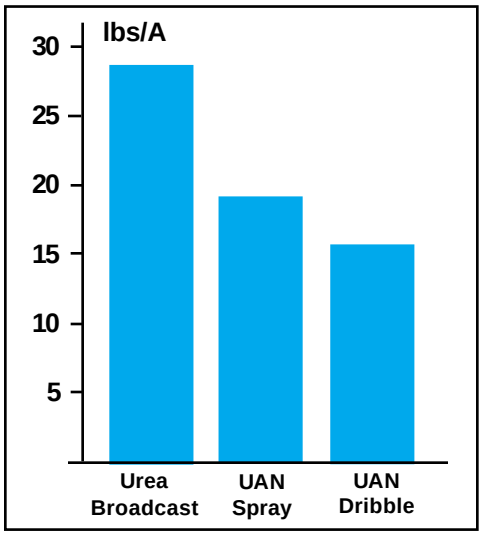

Figure 1. Total ammonia loss over 16-day period using different sources/methods, with outlier plots, Fox and Piekielek, Penn State, 1993.

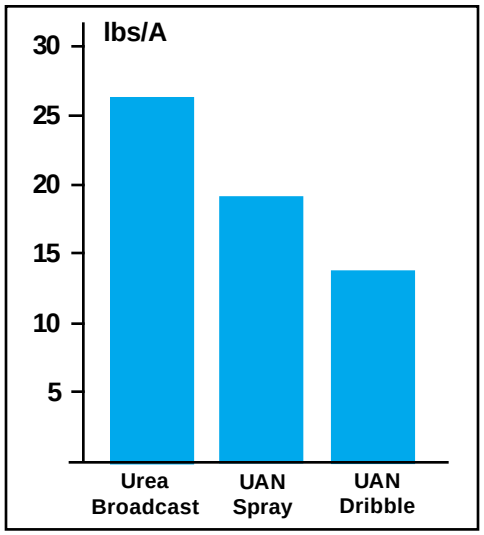

Figure 2. Total ammonia loss over 16-day period using different sources/methods, elinimating two outlier plots, Fox and Piekielek, Penn State, 1993.

With recent emphasis on converting to no-till agriculture in order to increase organic C levels and reduce the rate of increase in atmospheric CO_2 concentration, the need to understand factors controlling ammonia volatilization loss from surface-applied urea-containing fertilizers has intensified. This article reports on studies examining a simplified micrometeorological approach to measuring ammonia volatilization losses from two urea sources, using different placement methods.

Including outlier plots

There was a total of 7 to 16.6 lbs/A of N as ammonia trapped in the background samplers over a 16-day sampling period. When the background value for the individual replication was subtracted from the ammonia-N in each of the treatment samplers, total amount of volatilized ammonia over the 16-day period ranged from 15 to 29 lbs/A of N. The least loss was from dribbled UAN and the most from broadcast urea (Figure 1). Ammonia loss from the 120 lbs/A of N applied ranged from 13 percent for dribbled UAN to 24 percent for broadcast urea.

Loss from urea was less and losses from UAN treatments were about the same as observed in 1992. Measuring total amount of ammonia N volatilized among 1993 treatments showed loss from broadcast urea was significantly greater than losses from dribbled UAN. However, since most of the loss in the broadcast treatments occurred in the first week, there were no significant

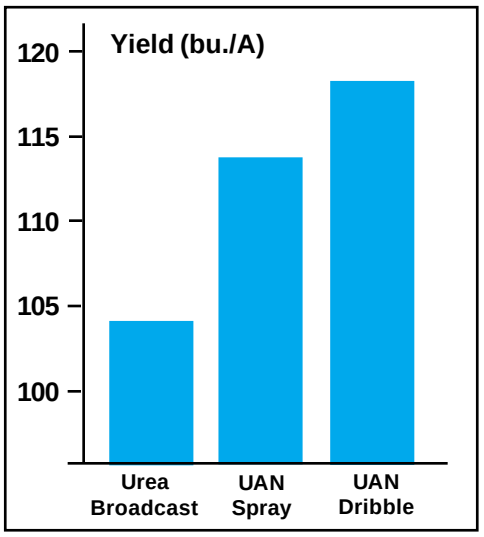

Figure 3. Corn Yields at early dent stage as function of N fertilizer source and method of application, Fox and Piekielek, Penn State, 1993.

differences in losses among the three source/methods beyond seven days after application.

Excluding outlier plots

In two of the fertilizer treatments (urea-three replications, UAN-two replications), the total amount of ammonia trapped in one of the three replications was significantly greater than the other two. Using the Q test, it was shown that there was greater than 80 percent probability that these two replications were outlier plots. By eliminating these outlier plots in these two N source/method treatments, the least significant difference for the total amount of ammonia N volatilized dropped from 6.5 to 1.0 lbs/A. This also resulted in significant differences among all three treatments in the total amount of N volatilized (Figure 2).

If the outlier plots are excluded from the average, total ammonia volatilization lost from urea dropped to 25.9 lbs/A and dribbled UAN dropped to 13.1 lbs/A. Loss from urea was 21.6 percent of the 120 lbs/A applied. Loss from UAN was only 10.9 percent. Again, the most significant difference in losses among the three source/methods occurred during the first seven days after application.

Stress hurts

During the 1993 trials, rainfall in April was excessive with over eight inches-twice the normal. May, June, July, and August were very dry with approximately two inches of rain per month-roughly half the average for May, June, and July, and two-thirds the average for August. Thus, stress caused by dryness and varying depth to bedrock were responsible for the low and varying yields as seen in Figure 3. Weed competition was also severe because of the ineffectiveness of herbicides. Dribbled UAN again exceeded all other source/methods, this time in yield returned.

Precision counts

Ammonia samplers were placed in the center of the 50-meter (164-foot) diameter plots. One background sampler was placed at the edge of each of the three treatment fields, at least 100 meters from the nearest urea-containing treatment.

Soils in all fields were Hublersburg silt loams. Fields had been in no-till for at least two years. Available P and K levels and soil pH were in the optimum range. Nitrogen fertilizer was applied at the rate of 120 lbs/A on May 12 when corn plants were one to two inches tall. Soil surface covered with crop residue when treatments were applied ranged from 60 to 80 percent.

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