Rethinking Losses From Various N Application Methods

Purpose:

The purpose was to explore techniques for evaluating N losses from various forms of N and application strategies. This work focused on losses from ammonia volatilization.

Methods:

In 2010 we applied similar treatments to plots at three locations in conjunction with the Ridgetown Diagnostic Days, Elora FarmSmart Expo and the Eastern Crop Diagnostic Day in Winchester. The approach is relatively simple and has been developed by Dr. John Lauzon and his graduate students at the University of Guelph. The nitrogen is applied and then immediately covered with a chamber (full of holes) to somewhat trap the ammonia; in our case we used blue recycling bins (see Figure 1). Inside the chamber is a small glass vial which is packed with a material that reacts with the ammonia and produces a colour change indicating the amount of ammonia released into the chamber. The vial can be read periodically and gives a cumulative total over time.

Treatments included urea, ESN, and UAN applied differently, at various depths, and at 2 timings (at plant and side dressed).

Figure 1: Ammonia loss chamber

Results:

The treatments compared and the N loss index for each is outlined in Table1. For the pre-plant treatments surface applications of urea left unincorporated had the highest losses, as expected. We have expressed this as an index of 100 and our best estimates suggested that more than 50% of the total N applied was lost due to ammonia volatilization. ESN (Environmentally Smart Nitrogen) was also surface applied and the total N losses were significantly reduced but this data did not indicate the ESN losses would be zero if left on the soil surface for two weeks without rain. Of course the vast majority of urea in the province gets incorporated with tillage and the results indicate that this is quite effective at minimizing losses; even a single shallow pass (like you might experience with vertical tillage tool) reduced losses by 60% and a more aggressive single pass reduced losses by 84%. We then compared spraying UAN on the soil surface at planting. Since urea is subject to volatilization and UAN is comprised of roughly 50% urea we would expect losses to be cut by one half when compared to urea at the same rate. In reality losses were reduced by more than 50% when surface applied, but were still higher than urea moderately incorporated. The lowest losses (near zero) at all three sites were always the plots where UAN was surface applied and then lightly incorporated with tillage.

Table 1. Summary of Ammonia loss demonstrations at Ridgetown, Elora and Winchester in 2010

Treatment	Nitrogen Loss Index (%)
Planting time (late May) application of nitrogen	
Urea Surface Broadcast	100
ESN Surface Broadcast	62
Urea Broadcast - Shallow Incorporation (1 inch)	40
Urea Broadcast – Moderate Incorporation (2.5 inches)	16
UAN Flat Fan - Bare Soil	27
UAN Flat Fan - Shallow Incorporation (1 inch)	4
Side-dressed (mid-June) applications of nitrogen (Ridgetown and Winchester values only)	
UAN Side-dress Surface	100
UAN Side-dress Shallow (Depth: 1 inch)	112
UAN Side-dress (Depth: 3-4 inches)	6

At each location N was applied as UAN at side-dress time on another set of plots. We compared side-dressing where the injection was deep (3-4 inches) and the UAN completely covered to treatments where UAN was dribbled on the soil surface or where it was poorly injected, approximately an inch deep but where the UAN could often be seen at the bottom of the shallow trench. Consistently the losses from the deep injection were very low and the surface applied or shallow injection very high. The magnitude of difference between the shallow injection and deep injection were unexpected.

Summary:

1) It almost always took 4-5 days before ammonia losses were detected even from the surface applied urea under relatively warm conditions.

2) Even fairly modest amounts of tillage can significantly reduce the losses from surface broadcast urea. Although this may be less likely if surface plant residue levels are high.

3) Surface applied UAN seemed to be much less prone to loss than urea and a shallow incorporation of the UAN essentially dropped losses to near zero.

4) Surface applications of UAN at side-dress time or poor covering of the UAN by the side-dress applicator did result in much higher N losses than correct injection. Our numbers clearly suggest that it is worth the time to get the coulters and injectors working properly to cover the UAN.

5) For producers using spray rigs to apply UAN with streamer nozzles into 6 inch high corn in early June this work does pose reasons to at least consider timing, temperature and rainfall forecasts as tools to minimize potential N loss.

Next Steps:

Work will be repeated in future experiments to confirm some of the numbers and to arrive at more reliable estimates of actual N loss.

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