

Field agronomists can measure ammonia volatilization losses

John Heard, Manitoba Agriculture, Food and Rural Development John.Heard@gov.mb.ca



Volatilization loss of ammonia (NH₃) from surface applied urea-based fertilizers or manure may be substantial.

A simple, low cost technique to measure losses would assist growers in making future 4R Nutrient Management choices to minimize losses, specifically Right Source, Right Placement and Right Time.

Such a technique has been developed by the University of Guelph¹ and has been used extensively by Ontario extension staff².

This technique was evaluated in a variety of Manitoba field situations in 2012 and 2013.

Method

The technique followed was based on experiences of Ontario extension staff.

1. Immediately after N application the zone is covered with a chamber with ventilation holes. In our case, "recycled" recycling boxes with 40-50 holes to allow air exchange (Figure 1).
2. Inside the chamber a glass "dosimeter tube or dositube" (#3D, Gastec Corporation) is held on a small stake, about 6" above the soil surface (Figure 1). Break off the tip of the tube to allow NH₃ to enter.
3. The dositube contains purple packing material (containing sulphuric acid) that turns yellow when it reacts with NH₃ in the air (becoming ammonium sulphate). The tube is marked in NH₃ ppm.hr which gives an index of NH₃ loss.
4. Tubes are read at 1-2 day intervals to give a cumulative total proportional to actual losses.
5. With an anemometer recording wind speed at a 30 cm (12") height, the NH₃ ppm.hr reading can be converted to lb N/ac using this formula:

Estimated Total Loss

$$(\text{lb N/ac}) = 0.89 \times ((0.217Dw) - (0.034D)) + 0.71$$

D = dositube reading

w = wind speed m s⁻¹ at 12" height the previous day

Since rainfall moves surface urea into the soil, boxes and fresh dositubes should be reinstalled to an adjacent area after each rainfall if one wishes to continue monitoring.



Figure 1. Installing chamber and reading the dositube.



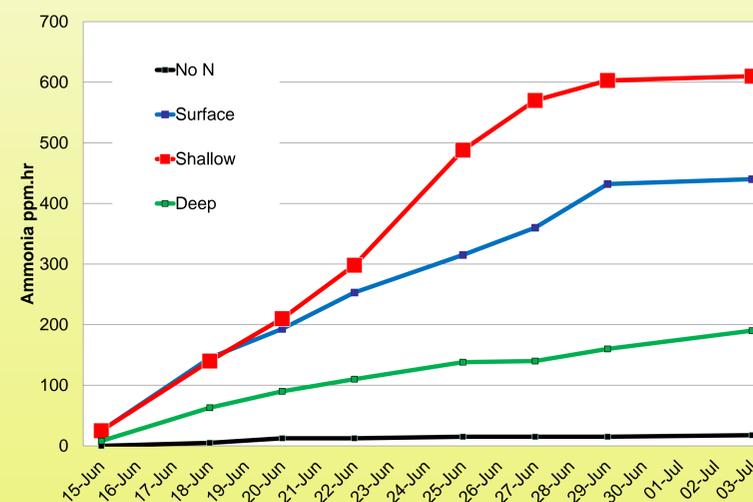
Figure 3. Solar powered data recorder and anemometer.

Following are 3 examples of field testing the technique in Manitoba. Additionally it has been used to compare losses from N sources broadcast in winter wheat and for surface applied manure.

A) Side-dressed UAN for corn, 2012.



Figure 4. Side dressing UAN in corn and the resulting NH₃ loss data.



The farmer cooperater questioned whether there were NH₃ losses when side dressing corn with UAN (28-0-0) @ 60 lb N/ac.

- Compared surface dribble, dribble into injection slot (shallow) or injected at 3" depth (deep).
- Volatilization risk factors were high: Almasippi sand, pH 8.6 with moist soil below the dry surface.
- Dribbling UAN into an open, moist slot had the highest relative loss.
- Result: Grower modified equipment to place N deeply

B) Surface applied urea, UAN and inhibitor at Carman Crop Diagnostic School, 2013

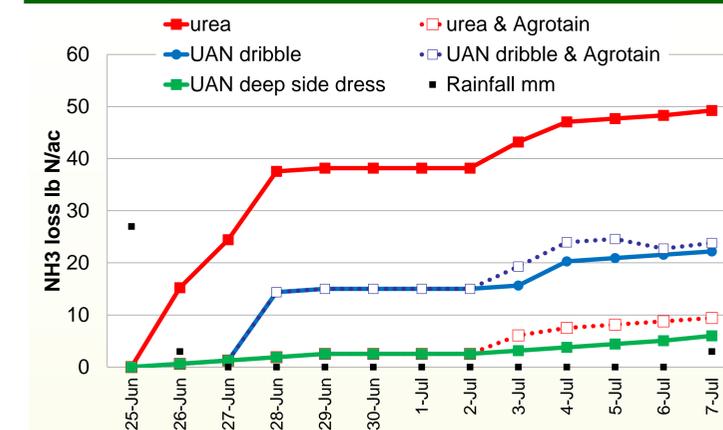


Figure 5. NH₃ losses, Carman, 2013.

With the anemometer (Figure 3), NH₃ ppm.hr were converted to lb N/ac.

•Volatilization losses were generally as expected based on source and placement.

C) Fall banded NH₃ into cloddy soil (2012-13)



Figure 6. NH₃ application to dry soil and injection depth.

Dositubes were placed where NH₃ was applied into dry soils by agronomists at Portage, Morden and Killarney.

•Little if any NH₃ was detected, suggesting NH₃ was either placed deep enough into moist soil, or that box placement may not be quick enough to detect NH₃ gassing out of poorly sealed slots in cloddy soil.

Summary

This is a simple low cost method that agronomists can use to help clients make 4R Nutrient Management decisions. Relative NH₃ losses can be determined with dositubes alone, but require windspeed measurement at box height (12") to determine losses in lb N/ac.

Acknowledgements

Koch Fertilizers for dositubes at Crop Diagnostic School. Dositubes cost about \$7-8 each, come in boxes of 10 and can be ordered through: Katie Gibb 519-781-6219 gibb.kt@gmail.com

References

- 1 van An del, Marijke. 2011. Development of a simple and affordable method of measuring ammonia volatilization from land applied manures. M.Sc. Thesis. University of Guelph. Advisor Dr. John Lauzon.
- 2 Stewart, G. 2012. Rethinking Nitrogen Losses. Crop Advances Vol.8 http://www.ontariosoilcrop.org/docs/v8crpadv_cor3-2011_rethinking_nitrogen_losses_-_2011.pdf