



Comparison of Ammonia Volatilization from Surface Applied Fertilizers on High, Neutral, and Low pH Soils

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Nitrogen (N) loss by ammonia (NH_3) volatilization has received attention due to the increased use of urea fertilizers. The intensity of ammonia volatilization is dependent upon many factors including the form of fertilizer N, soil texture, temperature, and other environmental factors. Urea and ammonium based fertilizer are susceptible to rapid loss via ammonia volatilization immediately following fertilizer application, but ammonia volatilization losses can be reduced if the fertilizers are incorporated. In pasture and no-till operations, fertilizer incorporation may not be possible, leaving the fertilizer susceptible to rapid ammonia volatilization from the soil surface. The fertilizer industry has developed new N fertilizer products and urease and nitrification inhibitors that may reduce the rate of ammonia volatilization of urea and ammonium based fertilizers. These products include an ammonium sulfate-nitrate fused fertilizer (FUSN™) and NutriSphere-N® (N-N), which is a urease and nitrification inhibitor.

FUSN is a new, dry granular ammonium sulfate nitrate fertilizer made from a patented Honeywell process that chemically fuses ammonium sulfate and ammonium nitrate to produce an entirely new and highly stable molecule (26-0-0 14S fertilizer). Independent research on a range of agronomic and vegetable crops has shown that the new fertilizer is safe and effective for agricultural use compared with traditional nitrate-based fertilizers. FUSN is compatible with other fertilizers in prescription blends and safe to transport, handle and store. However, research is needed to document the effectiveness of decreasing volatilization of FUSN as compared to urea and urease inhibitor fertilizers when surface applied.

Objective:

Compare NH_3 volatilization rate from different fertilizer types and varying pH soils over a seven-day incubation period. As well as comparing total NH_3 volatilization rates.

Procedures:

The experiment was conducted under laboratory conditions within temperature range of 23–25° C. Soil type was an Eginbench Sandy Loam with three different pH levels (5.9, 7.0, 7.8). Statistical design was a randomized block set with four replications and seven treatments including control, ammonium sulfate (AMS), ammonium sulfate N-N, urea ammonium nitrate (UAN), urea, urea N-N, fertilizer rates were 112 kg ha⁻¹. Soil moisture content was adjusted to field capacity, and soil was placed in a tray (20 x 30 x 8 cm) to a depth of 5 cm. A 20 mL boric acid with bromocresol green-methyl red indicator was placed on the soil's surface, and boric acid traps were removed and replaced every 24 hours for seven days. Ammonia volatilization was determined by titration of the boric acid trap with 0.1 M H₂SO₄.

Results:

Ammonia volatilization measured over a seven-day period showed that volatilization peaked on the second or third day after fertilization (Fig. 1). The largest increase in NH_3 volatilization was from the urea fertilizer. The delay in the NH_3 volatilization is most likely due to the lag in urease enzyme production by microbes. Among the fertilizers, urea had the highest amount of NH_3 volatilization over the seven-day period (121 mg NH_3) followed by urea N-N (102.51 NH_3) and UAN (26.32 mg NH_3) (Fig. 2). The non-urea fertilizers had the lowest amounts of NH_3

volatilization (AMS = 4.08, AMS N-N = 2.96, and F \bar{U} SN = 2.46 mg of NH $_3$ +, Fig. 2). NutriSphere-N reduced the total amount NH $_3$ + volatilization for the urea fertilizers, but not for the AMS fertilizers. These results suggest NutriSphere-N may be inhibiting urease, but not preventing the conversion of NH $_4$ + to NH $_3$ +. The 5.9-pH soil had lower ammonia volatilization (28.46 NH $_3$ +) than the 7.0-pH soil (39.83 mg NH $_3$ +) and 7.8-pH soil (43.85 mg NH $_3$ +) (Fig. 3). Ammonia volatilization was different among the three soil pH classes. In the 5.9-pH soil, urea and urea N-N had the highest total NH $_3$ +. Volatilization from UAN was not different among AMS, AMS N-N, and F \bar{U} SN (Fig. 3). The 7.0-pH soil, urea had the highest volatilization followed by urea N-N (Table 1). Volatilization was not different between the other fertilizers. The 7.8-pH soil, urea had the highest volatilization followed by urea N-N (Table 1). Volatilization was not different for the other fertilizers. The 7.8-pH soil urea and urea N-N had the highest total NH $_3$ + (Table 1). Among the non-urea fertilizer, UAN had more NH $_3$ + volatilization than AMS, AMS N-N, and F \bar{U} SN.

Conclusion:

F \bar{U} SN is a potentially good N source for crop production, because it had significant lower NH $_3$ + volatilization than urea and UAN, and higher N analysis than AMS. NutriSphere-N showed some potential to reduce NH $_3$ + volatilization through urease inhibition, which means it may only be effective for urea or urea-containing fertilizers.

Acknowledgments:

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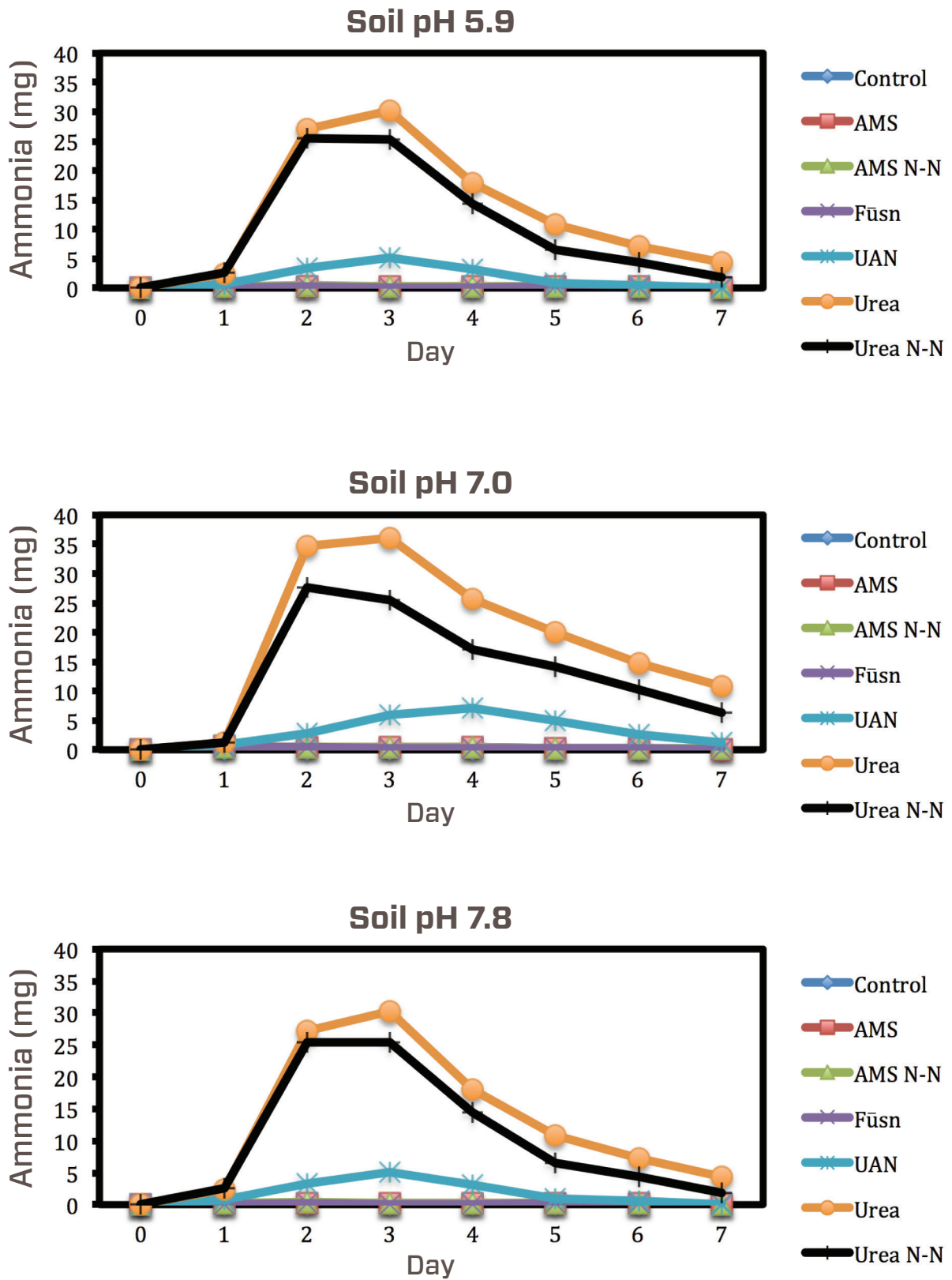


Figure 1. Daily ammonia volatilization amounts from different fertilizers applied to soils with three different pH levels (5.9, 7.0, and 7.8) over a one-week incubation period.

Mean Ammonia Volatilization of Seven N Sources

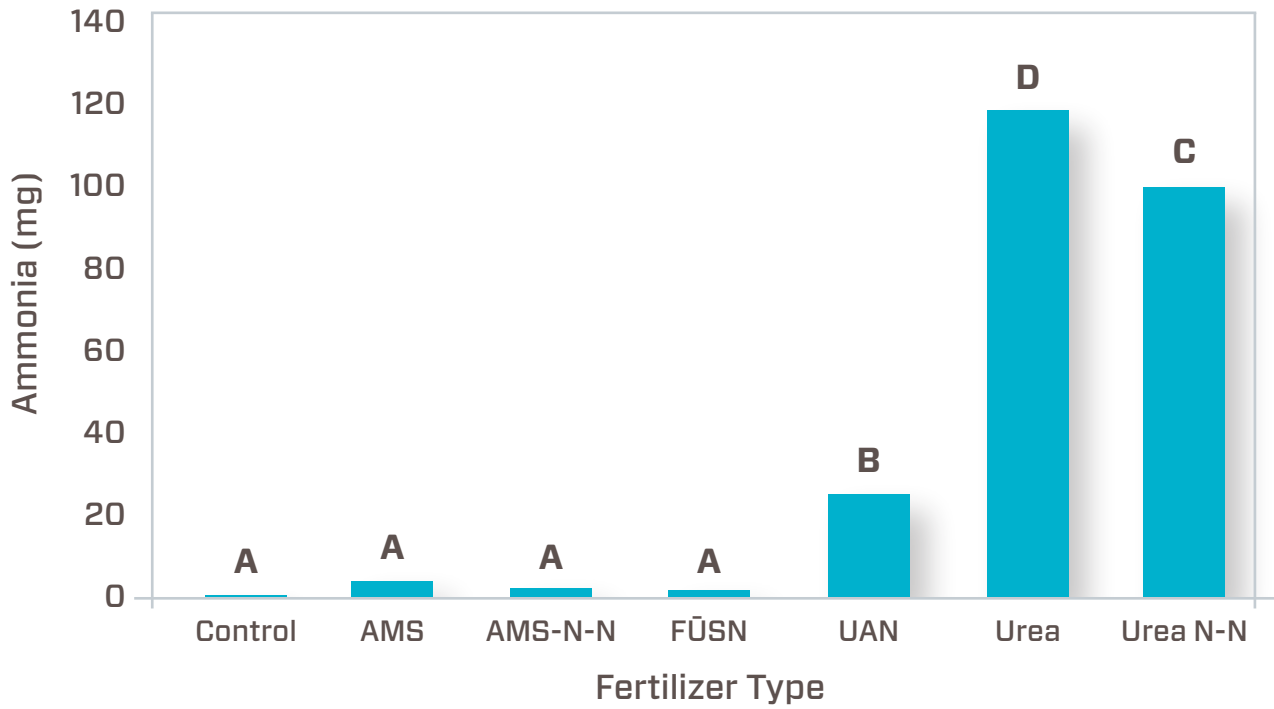


Figure 2. Comparison of total ammonia volatilization over a one-week incubation period. Letters denote differences among means at an alpha = 0.05.

Mean Ammonia Volatilization for Three Soil pH Levels

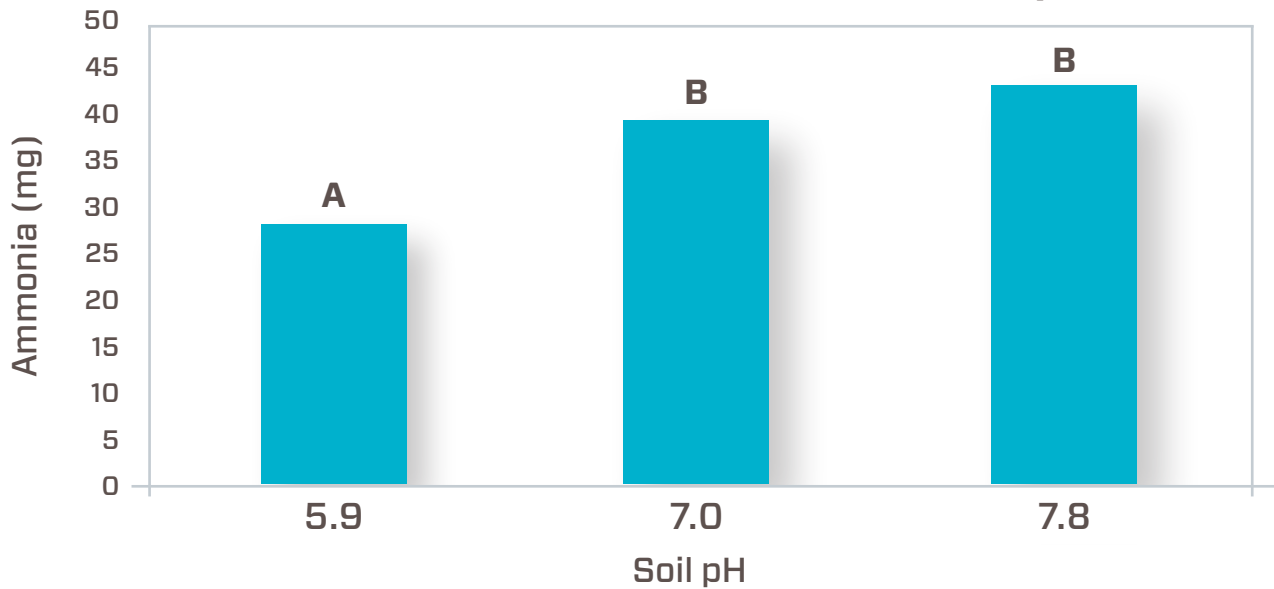


Figure 3. Comparison of ammonia volatilization from different soil pH levels over a one-week incubation period. Letters denote differences among means at an alpha = 0.05.

Fertilizers

Soil pH	Control	AMS	AMS N-N	FUSN	UAN	Urea	Urea N-N
	mg ammonia						
6	0.15 A	1.47 A	1.65 A	1.10 A	13.97 A	100.28 B	80.60 B
7	0.02 A	2.72 A	2.86 A	2.20 A	25.74 A	143.16 C	102.07 B
8	0.05 A	8.05 A	4.36 A	6.52 A	39.27 B	120.34 C	124.87 C

Table 1. Ammonia volatilization by fertilizer type and soil pH. Letters denote difference among different fertilizer types for each soil pH using Tukeys means comparison.

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