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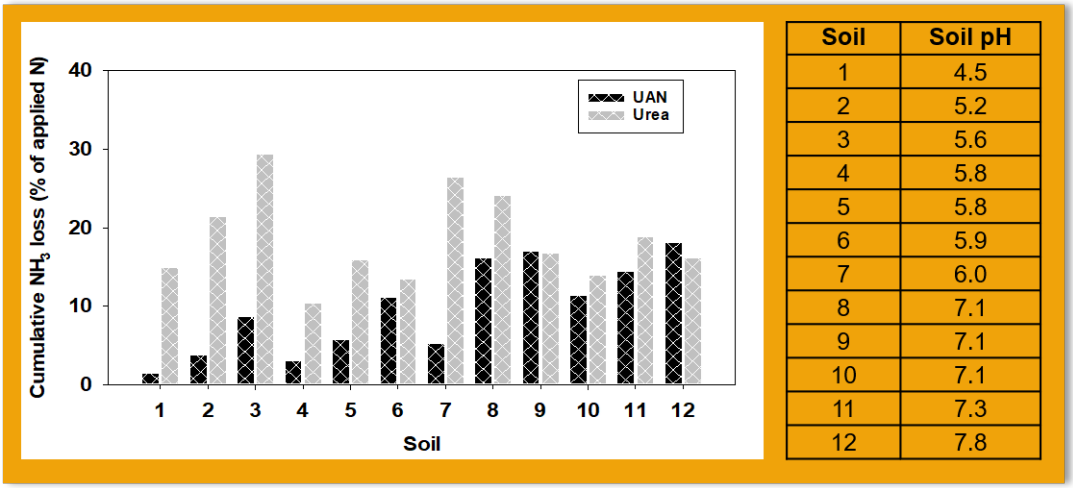
AMMONIA VOLATILIZATION FROM UNINCORPORATED, SURFACE-APPLIED UAN ON ALKALINE SOILS (PH >7)

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Under normal conditions, ammonia volatilization from surface application of urea ammonium nitrate (UAN) tends to be lower than surface application of urea. It's important that farmers are well acquainted with situations when surface-broadcast of UAN results in above average ammonia loss, and in some instances greater losses than urea. This fact sheet provides information on situations where ammonia loss from unincorporated, surface-applied UAN exceeds traditional losses.

In Tennessee, the primary nitrogen (N) sources used are urea and UAN. Other sources of N fertilizers such as anhydrous ammonia is used in some counties in Central and West Tennessee. It is known that ammonia volatilization from applied N fertilizers may occur from (1) unincorporated, surface-applied urea-based fertilizer; (2) anhydrous ammonia due to poor equipment calibration; and (3) unincorporated, surface-applied ammonium-based fertilizer on alkaline soils. N loss from these fertilizers are governed by a complex interaction of prevailing environmental conditions, soil properties and management practices. Soil properties determine ammonia loss potential while the extent of the loss is dictated by environmental conditions and management practices.

Soil pH and prevailing critical relative humidity are partly responsible for the higher than usual ammonia loss from UAN. In a lab study conducted at the West Tennessee AgResearch and Education Center on 12 soils with different soil pH, ammonia volatilization losses from UAN in soils 8, 9, 10, 11 and 12 were higher than those under the other soils (see figure below). The pH of these soils was greater than 7.



Soil	Soil pH
1	4.5
2	5.2
3	5.6
4	5.8
5	5.8
6	5.9
7	6.0
8	7.1
9	7.1
10	7.1
11	7.3
12	7.8

Figure 1. *Cumulative ammonia loss 16 days after fertilizer application from surface applied urea ammonium nitrate and urea onto 12 soils. Soil pH of each soil is shown at the right side of graph*

UAN is made up of urea, ammonium and nitrate, while urea-N fertilizer is composed of 100 percent urea. Hence, the initial concentration of ammonium in UAN is high. In alkaline soils, the high pH favors the conversion of ammonium to ammonia. This explains why in soils with pH greater than 7, the ammonia loss from UAN is very high regardless of the buffering capacity of the soil. The initial pH plays a major role in ammonia loss from surface applied UAN. Also, the urea hydrolysis is limited in UAN so very little ammonia is formed from the urea portion of UAN compared to 100 percent urea. In contrast, the amount of ammonia loss from urea is dependent not only on the initial soil pH, but also on the buffering capacity of the soil. Applied urea undergoes hydrolysis to produce ammonium and bicarbonate, which results in an increased soil pH around the immediate environment of urea granules. In poorly buffered soils, the increase in soil pH may substantially drive ammonia volatilization from urea. However, in well buffered soil, the increase in pH may not drive ammonia loss from urea.

Field studies in Georgia have reported that UAN lost a similar or higher amount of ammonia than urea, which was attributed to the influence of critical relative humidity (CRH). The low CRH (18-20 percent) of UAN than urea (72-80 percent) meant that UAN absorbed moisture from its surroundings more rapidly than urea, which would only absorb moisture when its relative humidity is around 80 percent.

Tennessee producers have multiple options to successfully minimize ammonia loss when applying UAN in fields with pH greater than 7. Surface-applied UAN should be treated with a proven N stabilizer for optimal yields when soils pH is above 7. Information on N stabilizers evaluated under growing conditions are available at https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2024/03/W1221.pdf and https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/10/PB1888.pdf.

Further Reading

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Adotey, N., McClure, A.T., Yin, X., and J. McNeal. 2021. Enhanced efficiency nitrogen fertilizer as a tool to control nitrogen loss in row crop production. UT Extension Publication, PB 1888

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