

MEASURE AND MANAGE

Urea Loss from Broadcast Applications on Winter Wheat 2005

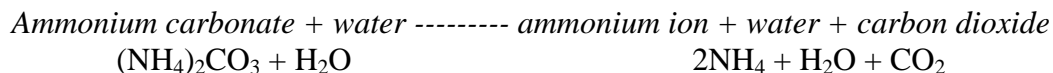
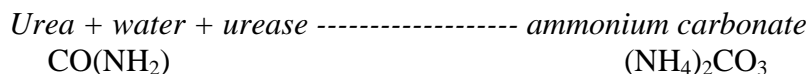
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The major loss of urea Nitrogen on winter wheat from broadcast applications is by volatilization. Volatilization is the loss of gaseous NH_3 to the air. The main factor in creating ammonia loss from urea is hydrolysis. When urea is not incorporated it is subject to loss, a rain of at least a quarter of inch within 1 to 2 days after application is needed to move the urea into the top half inch of soil to stop ammonia loss.

Volatilization losses of urea are influenced by soil temperature, soil texture, soil pH, moisture / humidity and residue cover of the soil surface. The worst case scenario for loss is applying to soil with pH.7.5, wet soil surface, high humidity and high trash cover (>30%).

The loss of urea by hydrolysis begins with the breakdown of the urea molecule. The urease enzyme present in crop residues begins to cleave the ammonia from the carbon dioxide in the urea. The following reaction depicts the sequence of the breakdown.

Urea Breakdown



The volatilization loss occurs with lack of moisture and Ammonia is formed rather than Ammonium. Any reaction is driven faster to the right by higher temperatures.

The loss of urea is also related to CEC and soil pH. At the site of the urea granule in particular the center of the granule the pH rises rapidly. During hydrolysis ammonia is released causing the pH to rise. The higher the pH rises the more ammonia is released. The potential ammonia loss can be faster in a sandy low CEC soil because it has low buffering capacity. Sandy soil (low CEC) can not stop the rapid rise in pH the way a high CEC soil with higher buffering capacity can. However soils that have a higher pH to begin with >7.5 will promote more ammonia loss as they encourage the reaction to evolve ammonia. A high pH sandy soil (low CEC) will have a faster loss of

unincorporated urea relative to a clay soil. The rate of loss may be quicker but the amount may be only slightly greater. The following tables are only of one soil type.

Dave Franzen Soil Science Specialist at NDSU Extension Service has published the following tables the entire document can retrieved at www.ag.ndsu.nodak.edu/aginfo/procrop/fer/ureavo05.htm

Percent of surface added urea volatilized as ammonia as influenced by soil temperature and days urea was left on the soil surface (from Overdahl et.al 1987)

% of added N volatilized

Temperature (F)	45	60	75	90
Days				
0	0	0	0	0
2	0	0	1	2
4	2	2	4	5
6	5	6	7	10
8	5	7	12	19
10	6	10	14	20

Volatilization losses are small <6% within a 10 day period when soil temperatures are <60F. However the losses are greater when pH is factored in

Percent of surface applied urea volatilized as ammonia as influenced by soil pH and days urea is left on the surface (from Overdahl et.al 1987)(surface applied soil temperatures > 75F).

Soil pH % of added N volatilized

pH	5.5	6.0	6.5	7.0	7.5
Days					
0	0	0	0	0	0
2	0	0	0	1	5
4	2	5	10	18	20
6	5	7	11	23	30
8	9	12	18	30	33
10	10	13	22	40	44

When the soil pH is 6.0 and urea is left on the surface for 8 days the loss can be 12% when soil pH is 7.5 the potential loss is 33%

The spring of 2005 in Ontario allowed for applications of N in early April. The weather has remained relatively dry up to April 20th when a half inch rained was received, If we use the previous tables for a 6 day application on dry soil with a pH of 7.5 which represents the majority of wheat fields the estimated loss can be as much as 30% an

average application of 90 lbs of N from urea would mean a potential loss of 27 lbs of N. Keep in mind that soil temperature are in the 60 F range so the loss is probably less. At the same time we have good conditions for mineralization of soil Nitrogen. The net effect is probably zero. Reviewing N rates and yield from various N projects on Wheat suggests 65 to 80 lbs of N produced maximum yields of winter wheat last year. Further factors are % trash cover, height and density of wheat canopy. Each field will be unique, making blanket statements about urea loss and future use not warranted.