TECHNICAL BULLETIN

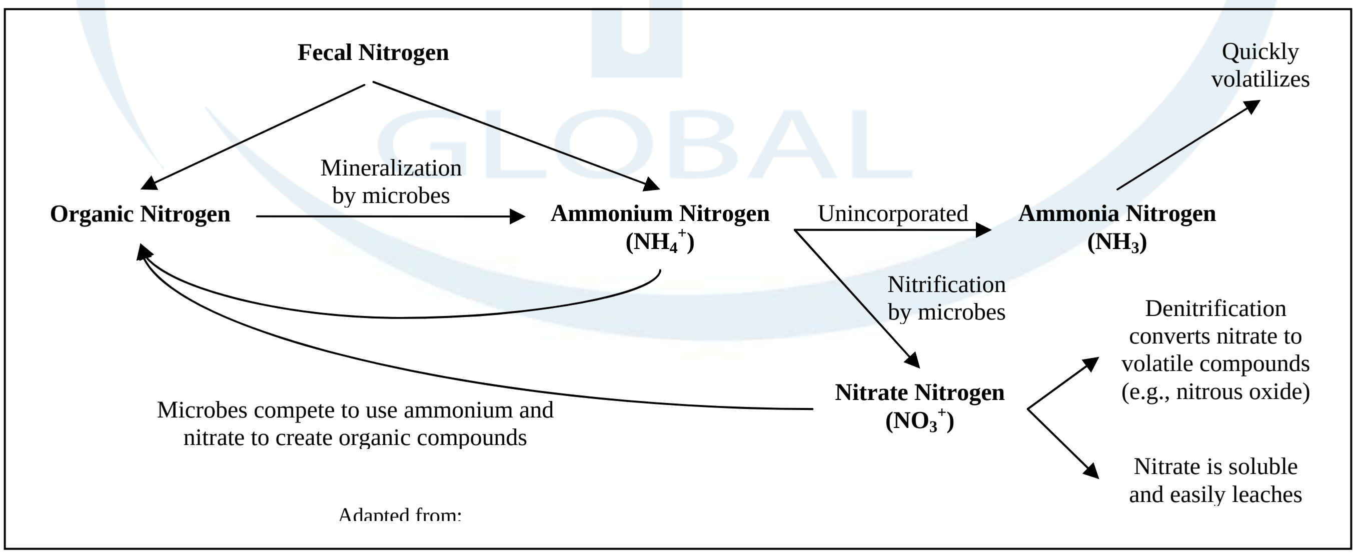
Issue 32

Improving the Value of Manure through the Utilization of Micro-Aid®

Introduction

Nitrogen (N) compounds are excreted from the body in the form of urea in the urine of livestock and uric acid in poultry, as well as in the forms of urea, ammonium (NH_4), and organic nitrogen in animal feces. Once excreted, urea can be volatilized into ammonia (NH_3) by the enzyme urease, which is produced by microorganisms in feces. Conversion of urea or uric acid to ammonia occurs rapidly, often within a few days; whereas, the breakdown of complex organic nitrogen forms found in feces occurs more slowly (within months or even years). From a fertilization perspective, it is desirable for animals to excrete more nitrogen via the feces in the form of organic nitrogen and less nitrogen via the urine in the readily-volatile urea form.

The figure below depicts the fate of organic nitrogen and ammonium nitrogen in undigested feces. The fate of these compounds within the nitrogen pathway is dependent upon factors such as pH, feces and urine composition, temperature, air velocity, surface area, and moisture. Ideally, microorganisms in the waste management system use ammonium nitrogen to synthesize organic nitrogen, which increases its fertilizing value and prevents the formation of volatile compounds (e.g., ammonia). Nitrification by microbes can also convert ammonium to nitrate nitrogen, which then has a few options as to its final outcome including formation of organic nitrogen, denitrification to volatile compounds, or leaching. Volatile compounds formed from the denitrification of nitrate nitrogen include nitrous oxide (N_2O), a greenhouse gas, and nitrogen gas (N_2), the form of nitrogen that naturally occurs in air. It is advantageous to try and reduce nitrogen loss (i.e., volatilization of ammonia, leaching, etc.) that frequently occurs during handling and storage.



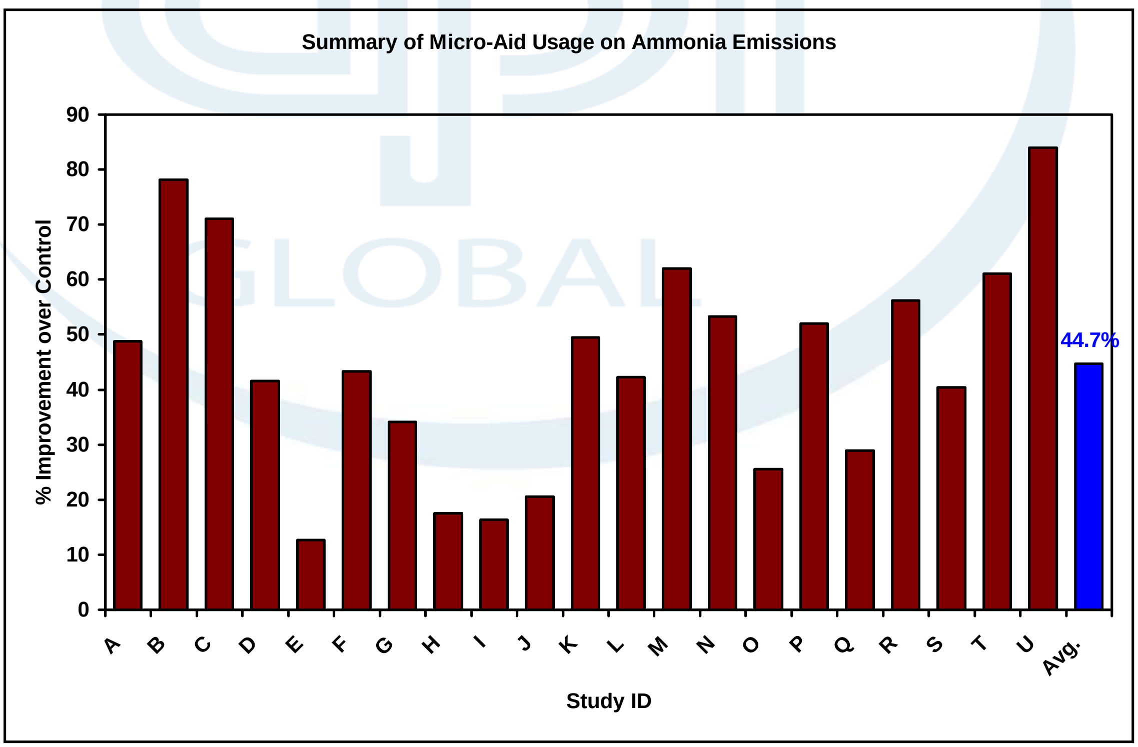
The amount of nitrogen available in manure the first year of application is referred to as plant available nitrogen and is a combination of all the ammonium nitrogen plus that portion of the organic nitrogen that will mineralize and become available to the crop during the growing season. To determine the plant available nitrogen, manure is analyzed for total nitrogen and ammonium nitrogen. From this information, organic nitrogen is then calculated by subtracting ammonium nitrogen from total nitrogen:

Total Nitrogen = Ammonium Nitrogen + Organic Nitrogen

Consequently, a decrease in the conversion of ammonium nitrogen to readily volatile ammonia will minimize the loss and help to increase the total nitrogen concentration in manure and its overall fertilizing value.
Ammonia emissions occur at several different stages of livestock production. These losses vary significantly among farms due to differences in methods of collection, storage, and manure treatment. Midwest Plan Service Publication, MWPS-18, suggests that nitrogen loss during storage is approximately 25%; however, actual values can vary plus or minus 10% depending upon genetics, dietary options, and variations in feed nutrient concentration, animal performance, and individual farm management. Ammonia losses also occur during land application with surface application experiencing the greatest losses. Reducing ammonia losses to improve nitrogen fertilizing value is an area of opportunity for Micro-Aid® to bring value.

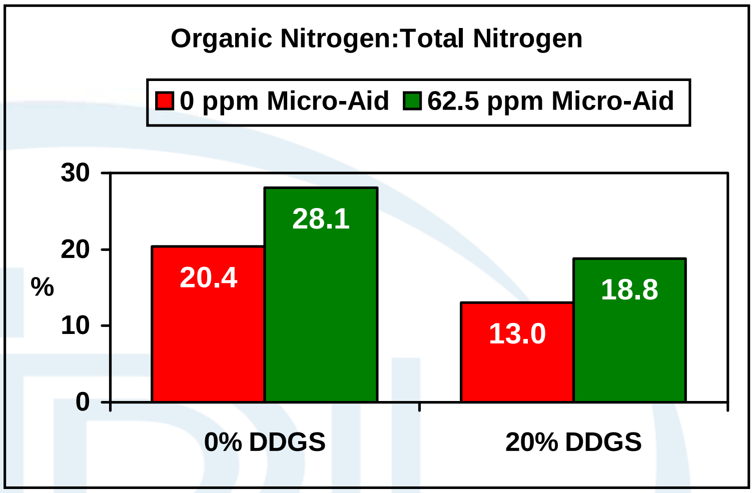
Micro-Aid®

Micro-Aid® is an all-natural, environmentally-safe feed additive that first begins to work enterically to help promote a healthy gastrointestinal tract environment. Furthermore, it is not absorbed by the intestinal tract; instead, Micro-Aid® passes through the animal and is excreted along with fecal matter into the waste management system. Once there, Micro-Aid® continues to work in a similar fashion as in the gut to enhance microbial populations, which in turn utilize undigested nutrients to

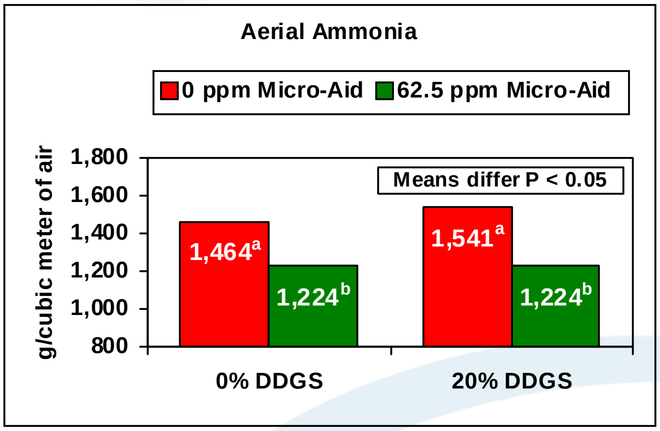


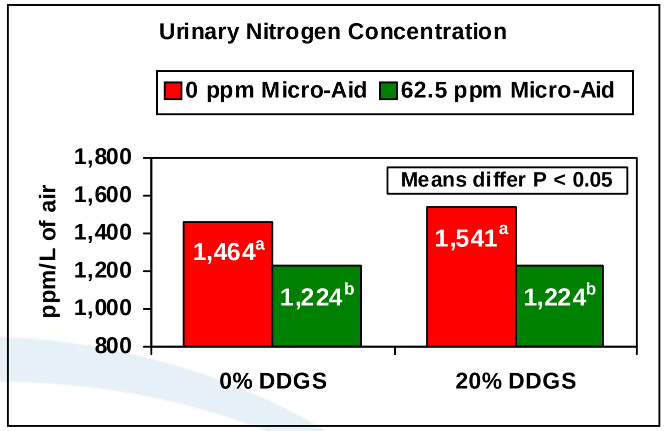
form organic nitrogen compounds while preventing the formation of noxious gases such as ammonia. This reduction in volatilization of ammonia that occurs due to Micro-Aid® positively impacts the total nitrogen concentration of manure.

In summarizing 21 experiments, the following figure reports that Micro-Aid® reduced ammonia emissions, on average, by 44.7%. This summary represents the benefits of Micro-Aid® in several species including poultry, swine, dairy, etc. Micro-Aid® is effective in reducing aerial ammonia and other noxious gases whether it is fed, added to pits and lagoons, or sprayed over litter or bedding.



It is worth noting that recent research evaluating the effects of Micro-Aid® reported that regardless of diet type fed (diets containing either 0 or 20% distillers dried grains with solubles, DDGS), Micro-Aid® increased organic nitrogen concentration from the slurry samples (i.e., feces and urine together). Slurry samples were collected and placed into an in-vitro storage area for 56 days in order to determine the nitrogen loss that could occur during storage, as well as any changes in nitrogen components. The graph indicates that there was an increase in the ratio of organic nitrogen to total nitrogen when Micro-Aid® was added to the diet, which is indicative of an increase in microbial conversion of nutrients to organic nitrogen. This improvement in nitrogen utilization is further supported by an approximate 20% reduction in volatilization of ammonia nitrogen that was measured in the in vitro model samples. Also of further interest is the fact that Micro-Aid® supplementation to diets containing either 0 or 20% DDGS reduced urinary nitrogen concentration by 8.3 or 9.6% when compared with the same diet without Micro-Aid®. As mentioned previously, it is desirable from a fertilization perspective to excrete less nitrogen compounds from the body in urine as readily-volatile urea. These results indicate that slurry from animals fed Micro-Aid® regardless of types of diets being fed, will have less nitrogen loss during storage.





Key Technical Points

- Plant available nitrogen is a combination of all the ammonium nitrogen plus that portion of the organic nitrogen that will mineralize and become available to the crop during the growing season; Nitrogen composition of manure is determined as:
- Total Nitrogen = Ammonium Nitrogen + Organic Nitrogen
- Consequently, a decrease in the conversion of ammonium nitrogen to readily volatile ammonia will minimize losses and help to increase the total nitrogen concentration in manure and its overall fertilizing value.
- Because Micro-Aid® is excreted along with fecal matter, it continues working within the waste management system to enhance microbial populations, which in turn utilize undigested nutrients and convert them to organic nitrogen compounds, preventing the formation of noxious gases such as ammonia.
- Micro-Aid® is effective in reducing ammonia emissions as a summary of 21 experiments reported that ammonia emissions were reduced, on average, by over 44%. This reduction in ammonia emissions would support an increase in the microbial conversion of ammonium nitrogen to organic nitrogen compounds.
- In vitro pit model research with slurry (i.e., feces + urine) of pigs fed Micro-Aid® and 0 or 20% DDGS reported an increase in the ratio of organic nitrogen to total nitrogen after 56 days; this increase in organic nitrogen is supported by an approximate 20% reduction in aerial ammonia and is indicative of a shift from ammonium nitrogen to organic nitrogen, which would increase total nitrogen concentration of the slurry.