Synthetic nitrogen in forage production

Dustin Sawyer and **Scott Fleming** for *Progressive Forage*

AT A GLANCE

Nitrogen applications in forage production should be considered in the light of three areas of concern: economics, environmental stewardship and animal health.

The article "Avoiding excessive nitrate concentrations in 2021" in the February issue of *Progressive Forage* introduced carbon, hydrogen, oxygen and nitrogen (CHON) and its importance to all living things, and spoke to the role humans play in managing nitrogen – the only CHON element that can be managed. While that article focused on the impact of nitrates on animal health and the management of manure applications, this one will aim at a better understanding of synthetic nitrogen sources, when they should be used and the best ways to apply them.

Nitrogen applications in forage production should be considered in the light of three areas of concern: economics, environmental stewardship and animal health, and there is a growing conservation movement that helps with this. Known as the 4R Nutrient Stewardship, this ideology helps to put more structure to the management process by breaking it into four decision points: right source, right rate, right time, right place. In order for the crop to get the most use from the fertilizer, it helps if the fertilizer is where the plant needs it, when the plant needs it and in a form the plant can use.

Fertilizer efficiency

Protein is the final destination for nitrogen in the plant, and it's a complicated pathway to get there. It would be great if all the applied fertilizer was taken up and converted to protein. This would be 100% nutrient-use efficiency – and will unfortunately never happen. There are robbers and thieves along the pathway that sneak a little nitrate here and a little ammonium there, whittling away at the efficiency, but the 4R strategy helps to minimize how much those thieves can take.

Applying fertilizer at the right time is the easiest of the 4Rs to conceptualize. The amount of a given nutrient a plant needs changes as the plant progresses through its life cycle. This variable uptake rate is known as the uptake curve of the plant, and it forms the basis of the "right time" management decision. The nitrogen uptake curve for corn can be found through a basic internet search and shows that uptake is relatively slow until around V6, is in high gear by V10 and, not surprisingly, slows back down around VT. To get the most of the applied nitrogen into the plant as possible,

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the nitrogen should be applied as close as possible to the maximum uptake time, V10 through VT.

Keeping in mind nitrogen is part of CHON and all living things need it, the plants have some competition, and the nitrogen that's hanging out in the soil waiting for the plant to find it can easily end up elsewhere. Water can leach nitrate from the soil, the air can volatilize ammonia, and microbes can tie nitrogen up. Fall applications of nitrogen are going to be much less effective than spring applications, which are less effective than in-season applications.

A matter of source

These potential losses of nitrogen can also be managed through another of the 4Rs: using the right source. Manure is a primary source of nitrogen in many forage production systems, but it doesn't completely remove the need for synthetic sources. There are three main sources of synthetic nitrogen: anhydrous ammonia, liquid urea ammonium nitrate (UAN) and urea. Each of these has its advantages and disadvantages but, when viewed in the light of applying at the right time, liquid UAN stands out. The ability to band or side-dress in season means the nitrogen can be applied as close to the time of peak need as possible, and it can be placed near the roots (the right place). When considering urea or anhydrous ammonia, a nitrification inhibitor is strongly recommended. By inhibiting the conversion of the nitrogen into nitrate, the "time" of the application is essentially delayed. That means while the fertilizer is technically in place prior to peak need, it is unavailable to the soil system until sometime in the future. During this time, the plant doesn't yet need the nitrogen – and because it's generally unavailable, the thieves will be less likely to steal it.

What to keep in mind

The ultimate goal in forage production is to get the crop to take up a lot of nitrate (as in grow big) but then convert that nitrate to protein so the harvested material is low in nitrate. This sounds simple, but most of the process is out of our control because water, sunlight and temperature are the three most important factors driving this conversion. If the growing season is cool, or there just aren't a lot of clear and sunny days, the plants will still take up the nitrate, but it will not convert it. Nitrate will accumulate. It's also important to keep in mind chopped forage is a mix of all of the plants in the stand – weeds included.

After the publication of my last article on nitrates, an intrepid reader pointed out to me the importance of weed control and its impact on the overall nitrate content of the harvested material. Some weeds are prone to nitrate accumulation and, if left out of control, they can make significant contributions to the nitrate concentration of the harvested forage. In the end, it all comes down to testing. Nitrogen can be managed to a point, but a forage test is the only way to know for certain whether the management practices worked and whether the forage is safe to feed.

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