Nitrogen Fertilization of Perennial Grass

Wise use of perennial grasses on dairy farms can reduce whole farm nutrient management problems. Dry matter yield in grasses responds primarily to nitrogen (N) fertilizer application. The rapidly increasing cost of commercial N fertilizer makes it imperative to optimize N use efficiency. This information sheet shows research results from N rate studies with perennial grasses and addresses grass fertilization guidelines. Grass Information Sheet #16 addresses manure applications.

It is very difficult to diagnose nutrient deficiencies in cool-season grasses, with the exception of N. Dead or dying leaves with yellow or brown lesions could be caused by many factors, most often due to disease or drought. Fertilization management (except for N) must be based on soil test results.

Other Soil Fertility Factors

Regular soil testing should be used to determine the optimal quantity of P and K application, reducing the risk of excess application. Cool-season grasses perform optimally at a soil pH between 6 and 7. Limestone should be applied well in advance of seeding and worked in if needed.

Nitrogen Sources

Common N fertilizer sources are urea (46% N) and ammonium sulfate (21% N). Ammonium nitrate (33.5% N) is now available in a slightly diluted form. Surface application of urea is subject to volatilization losses. The risk of volatilization can be reduced if urea is applied less than 2 days prior to a 0.3-0.4" rainfall event. If no rainfall occurs within 5 days, N losses will be substantial. Animals, particularly horses, should not be placed on fertilized pastures until after a rainfall event.

Yield Response

The N rate for maximum yield response can be very high for grasses, often exceeding 400 lbs/acre, but this is not a meaningful value. Also the economic N rate (ENR; Table 1) often exceeds 300 lbs N/acre. Very high N application rates result in low N recovery (Fig. 1), and hence large N losses to the environment. Nitrogen recovery was higher for 3-cut management at low N fertilization rates, and higher for 4-cut management at high N fertilization rates (Fig. 1).

Table 1. Economic N rate (ENR; lbs actual N/acre) for 3 vs. 4 cuts/season. Averages of 2 grass species, 3 years, and 4 replicates. Ammonium nitrate was the N fertilizer source used.

3 Cuts	ENR	4 Cuts	ENR
Site	lbs/a	Site	lbs/a
Aurora,NY	313	Aurora, NY	318
Ithaca, NY	230	Ithaca, NY	308
Freeville, NY	320	Freeville, NY	330

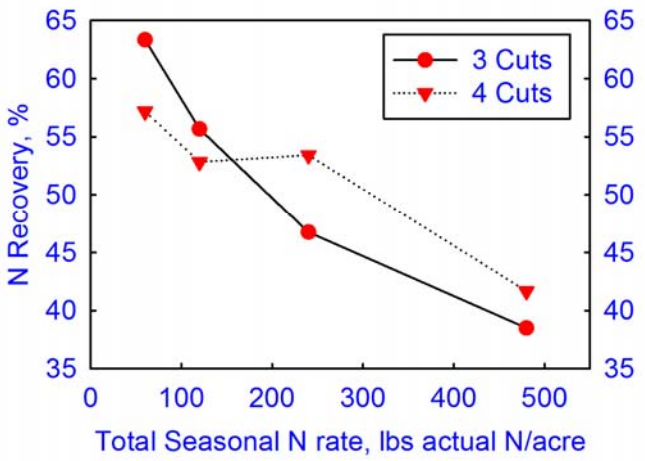

Figure 1. Nitrogen recovery (in the forage) for 3 vs. 4 cuts/season. Averages of 2 grass species, 3 sites, 3 years, and 4 replicates. Ammonium nitrate was the N fertilizer source used.

N Application and Crude Protein Content

Application of N at spring greenup results in a consistent increase in forage crude protein (CP) content, at least up to 120 lbs N/acre (Fig. 2). At a 100 lbs N/acre rate, forage CP will increase approximately 6% units compared

to no N application, if harvested at 50-55% NDF. If harvested at a more mature growth stage in early June, a 100 lbs N/acre rate will increase CP approximately 4% units.

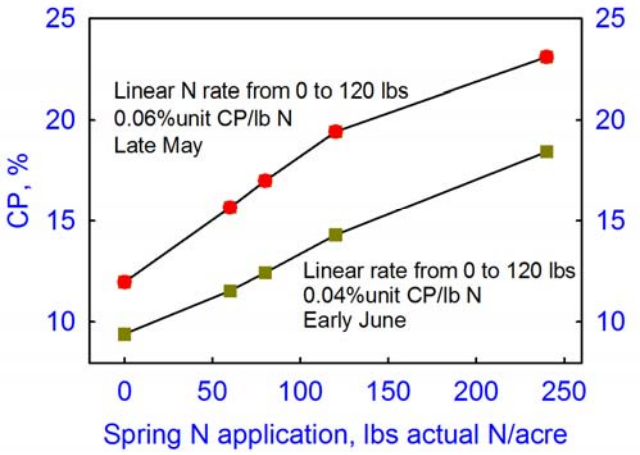

Figure 2. Crude protein (CP) for late May vs. early June spring harvest. Averages of 2 grass species, 3 sites, 3 years, and 4 replicates.

Timing of N Application

For a three harvest system, split application of N at spring greenup and after 1st cut resulted in higher yields than a single N application at greenup (Table 2). There was no yield advantage in a three-way split of N application over the season. Nitrogen recovery was not significantly affected by split application.

Table 2. Application of 200 lbs N/acre at spring greenup and after 1st or 2nd cuts. Averages of 3 grass species, 2 sites, 3 years, and 4 replicates. Ammonium nitrate was the N fertilizer source used.

Split application	Yield	N recovery
Greenup/cut 1/cut 2	tons/a	%
100 + 50 + 50	3.6	51
100 + 100 + 0	3.6	55
200 + 0 + 0	3.2	53

Nitrates in Forage

In reality, some of the N taken up by grasses is stored as non-protein N. The higher the N fertilization rate, the greater the risk of nitrate-N concentrations (exceeding 1000 ppm). Such high nitrate levels may affect animal health. Whether or not nitrates accumulate depends on both the weather and the amount of available N for plant uptake. Exceeding 100 lbs N/acre in the spring will greatly increase the risk of nitrate-N exceeding 1000 ppm in spring-harvested grass forage. Spring growth is the most likely to contain excess nitrates. Species with higher N uptake potential (reed canarygrass, orchardgrass) will have more potential for nitrate accumulation than species with lower N uptake potential (timothy).

Summary

Cool-season grasses require significant N fertilizer for high yields. Nitrogen is recommended under the assumption of adequate moisture availability. Drought will drastically reduce yield response to N. Up to 225 lbs N/acre can be applied with minimum risk to both the environment and animal health. Split application of N at spring greenup and after 1st cut will maximize yield response.

Additional Resources

- 2011 Cornell Guide for Integrated Field Crops Management. Electronically accessible at: http://ipmguidelines.org/Fieldcrops/.
- Cherney, D.J.R. and J.H. Cherney. 2006. Split application of nitrogen on temperate perennial grasses in the Northeast USA. Online. Forage and Grazinglands doi: 10.1094/FG-2006-1211-01-RS.
- Klausner, S.D., J.H. Cherney, R.F. Lucey, and W.S. Reid. 1998. Nitrogen Fertilization of Grasses. Research Series No. R98-1. Dept. of Crop & Soil Sci. Cornell Univ.

Disclaimer

For more information

Cornell University Cooperative Extension

Grass Management Manual
http://forages.org

Jerry Cherney, Quirine Ketterings, Debbie J.R. Cherney

2011