Manure nitrogen rates for corn production

Interpretation of University of Minnesota nitrogen guidelines

Minn. R. ch. 7020 (feedlot rules) limits the total amount of plant available nitrogen (N) applied to cropland when manure is utilized as a nutrient. In general, the feedlot rules require adherence to the University of Minnesota Extension Service recommendations. This document will outline how recent changes to the University nitrogen recommendations for corn production will be implemented within the framework of the feedlot rules.

This document does not address recommendations for corn production on irrigated sandy soils, which are discussed in the Minnesota Pollution Control Agency (MPCA) factsheet titled Manure management for corn on irrigated sandy soils.

Choosing the appropriate nitrogen recommendation

The current University guidelines include multiple nitrogen recommendations that utilize ratios of the cost of fertilizer relative to the value of corn. For each ratio, the University guidelines provide a number termed the "maximum return to N value" (MRTN). N application rates that exceed the MRTN, increase the likelihood of N leaching/loss. Therefore, the MPCA expects N application rates to be consistent with the appropriate MRTN values. The maximum MRTN values are:

- 195 lbs N/acre for corn following corn
- 150 lbs N/acre for corn following soybeans

Farmers should also be aware some fields can achieve highly productive and profitable yields by applying N at rates below the maximum MRTN or by using best management practices (BMPs) for improved N utilization. Some items to consider to maximize N utilization include:

- *Soils and drainage.* Fields with low organic matter (3% or less) or poor drainage have less response to N.
- *Regional differences.* Yields in northern Minnesota might be lowered by a shorter growing season, while farms in southeast Minnesota with loess soils may be able to maximize yield with lower rates of N.
- *Application timing.* The time of year N is applied (ie. spring or fall) can influence N utilization.

The University of Minnesota has produced a number of documents that outline BMPs for improved N utilization, including some with a regional focus. Links to these BMP documents can be found on the Minnesota Department of Agriculture's Nitrogen Fertilizer BMPs webpage.

Recommendations for low productivity soils

For corn grown on non-irrigated loamy fine sands with less than 3% organic matter, the University recommends N application at 100 lbs N/acre for corn following corn or 70 lbs N/acre for corn following soybeans.

Rotations that include alfalfa

When alfalfa is grown one or two years prior to the current corn crop, the N recommendations include consideration of a number of factors when selecting the appropriate amount of N to apply. Given the complexity of the recommendations, the MPCA expects N rate decisions to comply with the recommendations as given but should not exceed the values in Table 1.

Table 1. Maximum N application for first- and second-year corn following alfalfa

Alfalfa age	First-year corn following alfalfa	Second-year corn following alfalfa
1 year	80 lbs N/acre	120 lbs N/acre
2 years or more	40 lbs N/acre	80 lbs N/acre

Accounting for all sources of nitrogen

In determining the proper rate, farmers must account for all sources of N including, but not limited to:

- Any commercial fertilizer or manure applications for the current crop
  - Including the use of starter fertilizer
- Previous crops can provide a source of N for the current corn crop. The credits in Table 2 below must be subtracted from the corn/corn MRTN to account for N contributions from previous crops.

Table 2. Nitrogen credits for different previous crops.

Previous crop	N credit
Red clover*, alsike clover, birdsfoot trefoil, grass/legume hay, grass pasture, or fallow	75 lbs N/acre
Edible bean or field pea	20 lbs N/acre

*A credit of 35 lbs N/acre should also be given when red clover is grown two years before the corn crop

- Nitrates and/or N fertilizer in irrigation water
- N credits from manure application to the previous crop (2nd year manure credit)
  - 25% of N from manure applied for the previous crop is available to the current crop (15% for swine)

The total amount of N applied from all sources should be consistent with the MRTN.

Examples of N recommendation calculations

Example 1: 200 bu corn following edible bean crop:

- 180 lbs N/acre – 20 lbs N/acre (credit from table 2) = 160 lbs N/acre

Example 2: 200 bu corn following soybean crop with 5 gal of 10-34-0 starter applied at planting:

- 150 lbs N/acre – 6 lbs N/acre (N available in starter) = 144 lbs N/acre

Example 3: 210 bu corn following corn crop with 5 gal of 10-34-0 starter applied at planting:

- 180 lbs N/acre – 6 lbs N/acre (N available in starter) = 174 lbs N/acre
  - If swine manure was applied to the previous corn crop, a manure credit is also applicable: 174 lbs N/acre - 35 lbs N/acre manure credit = 139 lbs N/acre

To learn more, consult the University of Minnesota calculating manure application rates webpage.

Deviations from the MRTN

The feedlot rule allows for deviations in excess of the MRTN in very limited situations. The allowable deviations are not intended for application of N at rates greater than the MRTN as a standard practice (ie. planned rate); however, the following are situations when a deviation may be warranted:

- N deficiencies are measured/observed during the growing season and N can be side-dressed.
- The results of a soil nitrate test suggests additional N is recommended.
- Recommendations from a land grant college in a contiguous state with similar soils and climatic conditions suggest a higher rate of N application.

Note: The supplemental N worksheet, referenced in the University publication, is not sufficient to justify additional N.

If you believe a deviation above the MRTN (up to 20%) is warranted, you need to document your justification for the additional N application as part of the required land application of manure records.

More information

For more information, consult the University of Minnesota "Fertilizing corn in Minnesota" resources at: extension.umn.edu/crop-specific-needs/fertilizing-corn-minnesota

For more information on manure application rates, see the University of Minnesota resources at: extension.umn.edu/manure-land-application/manure-application-rates

For additional nutrient planning resources, visit the MPCA feedlot program land application page at: www.pca.state.mn.us/water/land-application-manure