Nitrogen Management for Corn: General Fertilizer Recommendations

GHG Taking Charge Team Factsheet

Why do we need good nitrogen management?

Sound nitrogen management for corn makes good economic sense. Optimal nitrogen fertilization is essential for achieving a successful, high yielding corn crop. Inadequate nitrogen inputs result in loss of silage or grain yield. Excessive nitrogen inputs reduce profitability and can delay maturity for grain corn. Applying the optimal fertilizer nitrogen rate achieves good crop yield and results in maximum economic return.

Good nitrogen management also makes good environmental sense. Excess fertilizer nitrogen application increases environmental losses of nitrogen, including nitrate leaching to groundwater and emissions of nitrous oxide, a greenhouse gas. Good nitrogen management represents an effective and practical means for producers to reduce greenhouse gas emissions.

Optimizing nitrogen management for corn

Our goal in optimizing crop nitrogen management is to match the nitrogen supply to the crop nitrogen demand. The amount of nitrogen required by the crop is dictated by the level of crop growth – the greater the growth, the higher the crop demand for nitrogen. Crop growth is influenced by management practices such as hybrid selection and planting date, and also by soil and climatic conditions.

The nitrogen supply for a corn crop comes from fertilizer, but also from manure and mineralization.

Mineralization is the release of plant available nitrogen from soil organic matter and crop residues as a result of soil microbial activity. The optimal amount of nitrogen inputs for a crop varies from field-to-field and from year-to-year due to variation in both crop nitrogen demand and soil nitrogen supply.

General nitrogen recommendations for corn

This factsheet provides general fertilizer nitrogen recommendations for grain and silage corn. These recommendations require a soil test for organic matter content and a manure analysis. If no manure analysis is available, typical values for different types of manure can be used.

If you require assistance in estimating your general fertilizer nitrogen recommendation for corn from this factsheet, or if you need to obtain typical values for manure, contact your local Crop Development Officer or Nutrient Management Specialist with the New Brunswick Department of Agriculture, Fisheries, and Aquaculture or your agri-environmental club coordinator.

How much fertilizer nitrogen to apply?

The general recommendation for fertilizer nitrogen rate (F_N) in kg N/ha is estimated by:

$$\mathbf{F_N = 150 - M_{AMM} - M_{ORG} - C - S - YP}$$

where M_{AMM} is a credit for manure ammonium, M_{ORG} is a credit for organic nitrogen in manure, C is a credit for the crop grown in the previous year, S is a credit based on soil organic matter content, and YP is a reduction in the recommendation for fields with reduced yield potential.

This factsheet provides a series of six steps to calculate the fertilizer nitrogen recommendation using the General Nitrogen Recommendation Worksheet on page 3. Complete Table 1 to calculate the information you need from your manure analysis before you begin. The worksheet considers manure applied in the spring before planting, and manure applied in the previous fall. Complete steps 1 and 2 for each manure application.

Step 1: Credit for manure ammonium (M_{AMM})

Manure contains nitrogen in ammonium (NH_4) and organic forms. Nitrogen in ammonium form is readily available to the corn crop. The amount of ammonium in manure varies with animal species, animal diet and manure storage conditions and therefore a manure analysis is recommended. Nitrogen loss through ammonia volatilization can occur very rapidly following field application of manure. Ammonia loss occurs most rapidly when manure is applied and not incorporated in dry, warm conditions. Ammonia losses are reduced if application is followed by rainfall or cool, damp weather. The availability of the ammonium in the manure is estimated from Table 2 based on the method of application and time until incorporation. These are average values which are sensitive to climatic conditions.

Table 1. Manure analysis calculation table.

Enter values from your manure analysis on an "as received" basis:

NH4-N (ppm) = _____ (101)

Nitrogen (%) = _____ (102)

Carbon (%) = _____ (103)

Calculate the following:

Organic N (ppm) = [(line 102) x 10,000] - (line 101) = _____ (104)

C:N ratio = (line 103) ÷ (line 102) = _____ (105)

Step 2: Credit for manure organic nitrogen (M_{ORG})

Organic nitrogen in manure is not readily available to the corn crop. Some of the organic nitrogen is converted to plant available forms of nitrogen through mineralization. The amount of organic nitrogen which becomes plant available depends on the animal type and on the amount and type of bedding. The availability of organic nitrogen in manure is estimated from Table 3 based on the time of manure application and the carbon to nitrogen (C:N) ratio of the manure.

Step 3: Credit for previous crop (C)

The previous crop grown can affect the availability of nitrogen for the corn crop. Legume crops have the ability to fix nitrogen from the atmosphere in their root systems. Plant available nitrogen is released to the corn crop through the decomposition of crop residues. The credit varies with the proportion of legume, legume species and age of stand in the previous cropping year. Incorporation of annual ryegrass may reduce plant available soil nitrogen supply to the corn crop.

Step 4: Credit for soil organic matter content (S).

The contribution of nitrogen from soil organic matter can be substantial. It will depend on soil and climatic conditions, past manure applications, and previous crop rotations. Currently the amount of soil nitrogen mineralization which will occur during the growing season cannot be predicted accurately. Soils with high organic matter content generally have higher soil nitrogen mineralization than soils with low soil organic matter content.

Table 2. Manure ammonium nitrogen availability coefficients

	Liquid /semi-solid manure		Solid manure	
Application	Spring / Summer	Fall	Spring / Summer	Fall
Injected	1.00	0.80	1.00	0.90
Incorporated 1 day	0.75	0.60	0.85	0.77
Incorporated 2 days	0.70	0.56	0.75	0.68
Incorporated 3 days	0.65	0.52	0.65	0.59
Incorporated 4 days	0.60	0.48	0.60	0.54
Incorporated 5 days	0.55	0.44	0.55	0.50
Not incorporated- bare soils	0.34	0.27	0.50	0.45
Not incorporated- pretilled soils	0.70	0.56	0.70	0.63
Not incorporated- crop residues	0.50	0.40	0.70	0.63
Not incorporated- standing crops	0.70	0.56	0.60	0.54
Not incorporated- late fall	---	0.60	---	0.68

General Nitrogen Recommendation Worksheet

Base value 150 (1)

Step 1: Credit manure ammonium nitrogen (M_{AMM}) in kg N/ha

Enter manure application rate:

in gallons/acre	_____ (a)	and (b) = 89,000
OR in m^3/ha	_____ (a)	and (b) = 1,000
OR in tons/acre	_____ (a)	and (b) = 445
OR in tonnes/ha	_____ (a)	and (b) = 1,000

Enter manure ammonium concentration in ppm (line 101 from **Table 1**) _____ (c)

Enter manure ammonium availability coefficient (from **Table 2**) _____ (d)

M_{AMM} in kg N/ha = _____ (a) x _____ (c) x _____ (d) ÷ _____ (b) = ... _____ **(2)**

Step 2: Credit manure organic nitrogen (M_{ORG}) in kg N/ha

Enter (a) and (b) from Step 1: _____ (a) _____ (b)

Enter manure organic N concentration in ppm (line 104 from **Table 1**)_____ (c)

Enter manure organic N availability coefficient (from **Table 3**) _____ (d)

M_{ORG} in kg N/ha = _____ (a) x _____ (c) x _____ (d) ÷ _____ (b) = ... _____ **(3)**

Step 3: Credit crop grown in the previous year (C)

	Alfalfa	Red clover (2nd yr)	Red Clover (seeding yr)	Soybean	Annual ryegrass
Less than 1/3 stand:	0	0	0	0	0
Between 1/3 and 2/3 stand:	40	20	10	0	0
More than 2/3 Stand:	80	40	20	10	-15

C in kg N/ha = (enter appropriate value from above) = ... _____ **(4)**

Step 4: Credit soil organic matter content (S)

Soil organic matter greater than or equal to 3.5%	15
Soil organic matter between 2.5% and 3.5%	0
Soil organic matter less than 2.5%	-15

S in kg N/ha = (enter appropriate value from above) = ... _____ **(5)**

Step 5: Fertilizer N rate reduction for fields with reduced yield potential (YP)

Field with high yield potential	0
Field with reduced yield potential (choose a value between 10 and 50 in discussion with your local Crop Development Officer, Nutrient Management Specialist or club coordinator)	_____

YP in kg N/ha = (enter appropriate value from above) = ... _____ **(6)**

Step 6: Calculate general fertilizer nitrogen recommendation (F_N) in kg N/ha

(Multiply F_N by 0.89 to get fertilizer nitrogen recommendation in units of lb N/ac)

F_N in kg N/ha = **(1) - (2) - (3) - (4) - (5) - (6) =** .....

Table 3. Manure organic nitrogen availability coefficients

Manure Type	Spring applied	Fall applied
Poultry:	0.30	0.30
Other livestock:		
C:N < 15	0.20	0.30
C:N 15 to 25 (high in bedding)	0.10	0.10
C:N > 25 (very high in bedding)	-0.20	0.10

Step 5: Fertilizer N rate reduction for fields with reduced yield potential (YP)

The yield potential of a field can be reduced by poor drainage, soil compaction, poor soil conditions, late planting, poor crop stand or other factors. Fields with lower corn yield potential have a lower requirement for fertilizer nitrogen. It is important to identify factors which may be limiting crop yield.

Step 6: Calculate general fertilizer nitrogen recommendation.

The fertilizer nitrogen recommendation is in units of kg N/ha. This is the total amount of fertilizer nitrogen required by the corn crop, including nitrogen applied in starter fertilizer. If recommendation is zero, no fertilizer N is required.

When to apply the fertilizer nitrogen?

The corn crop uses very little nitrogen before the corn six-leaf stage. Application of fertilizer nitrogen before this time increases the risk of nitrogen loss by leaching and denitrification. The following is recommended for the timing of fertilizer nitrogen application for corn:

- Apply no more than 50 kg N/ha with the planter (no more than 25 kg N/ha if a urea-based fertilizer is banded)
- Apply the remainder of fertilizer nitrogen at approximately the corn six-leaf stage (crop about 8 to 10" high). If possible, band or incorporate fertilizer applied at this time

Soil and plant nitrogen tests for corn

This factsheet can be used to choose a general fertilizer nitrogen recommendation for corn. You can improve your general fertilizer nitrogen recommendations through use of the Pre-sidedress Soil Nitrate Test (PSNT) and the Stalk Nitrate Test (SNT).

The PSNT uses a soil sample taken at the corn six-leaf stage to predict plant available soil nitrogen supply. The SNT at harvest can be used as a “report card” to assess nitrogen management of the corn crop in that year.

Good agronomy is an important part of good nitrogen management. It is also recommended that you do an annual soil test for phosphorus and potassium and soil pH (soil acidity). Soil pH should be maintained between 6.0 and 6.5. It is also important to use adapted corn hybrids, establish a uniform crop stand and plant in soil conditions that will allow for maximum germination (soil temperature at 10 ^{o}C or higher). It is important to identify the factors limiting yield in fields with poor crop performance.

Contacts:

For further information on these general fertilizer nitrogen recommendations, or on the PSNT or the SNT, contact your local Crop Development Officer (1-888-NBAGRIC or 1-888-622-4742) or Nutrient Management Specialist (1-506-453-2109) with the New Brunswick Department of Agriculture, Fisheries, and Aquaculture, or contact your agri-environmental club coordinator.

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Greenhouse Gas Mitigation Program for Canadian Agriculture
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Canadian Cattlemen's Association

Canadian Pork Council / Conseil canadien du porc

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