Nitrogen Management for Potatoes: General Fertilizer Recommendations

GHG Taking Charge Team Factsheet

Why do we need good nitrogen management?

Sound nitrogen management for potatoes makes good economic sense. Optimal nitrogen fertilization is essential for achieving commercial tuber yield and size requirements and results in maximum economic return. Excessive nitrogen inputs can reduce tuber specific gravity and can delay maturity, making vines difficult to kill.

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 potatoes

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 determined 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 variety selection and planting date, and also by soil and climatic conditions.

The nitrogen supply for a potato 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 fertilizer nitrogen rate for a potato 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 potatoes

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

How much fertilizer nitrogen to apply?

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

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

where R is the crop N requirement based on potato variety and planting date, M_{AMM} is a credit for ammonium in manure or compost, M_{ORG} is a credit for organic nitrogen in manure or compost, C is a credit for the crop grown in the previous year, and S is a credit based on soil organic matter content.

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

Cautionary note: According to CHC On-Farm Food Safety Guidelines, the time between application of liquid or solid manure and potato harvest should be a minimum of four months.

Step 1: Calculate crop N requirement (R)

Choose the base value for calculating crop nitrogen requirement from Table 1. These values represent our best guess as to the maximum fertilizer N application rate which may be required for these varieties. The base value is the same for irrigated and non-irrigated crops.

A shorter crop growth period results in a lower crop demand for N. The base value is decreased by 10% for seed crops or for crops that will be harvested early. The base value is also decreased for planting dates after May 25 by 11 kg N/ha (10 lb N/ac) for each week that planting is delayed.

Step 2: Credit for manure ammonium (M_{AMM})

Manure or compost contains nitrogen in ammonium (NH_4) and organic forms. Compost may contain nitrogen in nitrate (NO_3) form, however no credit is given for this.

Nitrogen in ammonium form is readily available to the potato 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 or compost is estimated from Table 3 based on the method of application and time until incorporation. These are average values which are sensitive to climatic conditions.

Step 3: Credit for manure organic nitrogen (M_{ORG})

Organic nitrogen in manure or compost is not readily available to the potato 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 or compost is estimated from Table 4 based on the time of application and the carbon to nitrogen (C:N) ratio of the manure or compost.

Step 4: Credit for previous crop (C)

The previous crop grown can affect the availability of nitrogen for the potato crop. Legume crops have the ability to fix nitrogen from the atmosphere in their root systems. Plant available nitrogen is released to the potato 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 potato crop.

Step 5: 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 or compost 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 1. Base values for different potato varieties

Variety	Base value kg N/ha (lb N/ac)
Russet Burbank	208 (185)
Shepody	180 (160)
Russet Norkotah*	200 (180)
Superior	190 (170)
Snowden	200 (180)
Goldrush	190 (170)
Early table	135 (120)
Other mid-season	160-180 (140-160)
Other late season	180-200 (160-180)
Other low N requirement	135-160 (120-140)

*For standard clone, reduce value for new clonal selections

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 potato crop.

When to apply the fertilizer nitrogen?

Most or all fertilizer nitrogen can be banded at planting. Banded fertilizer nitrogen is used more efficiently than broadcast fertilizer nitrogen. Split fertilizer N application can improve the efficiency of crop nitrogen use in sandy soils that are susceptible to leaching. Split nitrogen application has not been found to improve tuber yield in medium-textured soils, and may reduce yield potential in years with dry soil conditions early in the growing season.

Soil and plant nitrogen tests for potatoes

You can improve your fertilizer nitrogen management through weekly petiole nitrate testing starting as early as

Table 2. Manure or compost analysis calculation table.

Enter values from your manure or compost 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)

Potato General Nitrogen Recommendation Worksheet

Step 1: Crop N requirement (R)

Enter base value (in kg N/ha) from **Table 1** based on potato variety __________ (a)
Enter 1.0 for full season crops or 0.9 for early harvested or seed crops __________ (b)
Enter 0 if planted on or before May 25; 11 if planted May 26 to June 1;
22 if planted June 2 to June 8; 33 if planted June 9 or later __________ (c)

R in kg N/ha = [__________ (a) x __________ (b) - __________ (c)] .... __________ **(1)**

Step 2: Credit manure or compost ammonium nitrogen (M_{AMM}) in kg N/ha

Enter manure or compost 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 2**) __________ (c)
Enter manure ammonium availability coefficient (from **Table 3**) __________ (d)

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

Step 3: Credit manure or compost organic nitrogen (M_{ORG}) in kg N/ha

Enter (a) and (b) from Step 2: __________ (a) __________ (b)
Enter manure organic N concentration in ppm (line 104 from **Table 2**)__________ (c)
Enter manure organic N availability coefficient (from **Table 4**) __________ (d)

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

Step 4: 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 5: Credit soil organic matter content (S)

Soil organic matter greater than or equal to 3.5%	15
Soil organic matter less than 3.5%	0

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

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 or compost ammonium nitrogen availability coefficients

	Liquid /semi-solid manure		Solid manure or compost	
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

40 days after planting and continuing until the crop approaches maturity.

Good agronomy is an important part of good nitrogen management. It is recommended that you do an annual soil test for phosphorus and potassium. Soil pH should be maintained between 5.2 and 6.2, depending on potato variety. Practices which maintain and increase soil organic matter content are critical for maintaining optimal soil physical properties. Poor soil physical properties, for example low soil water holding capacity, can reduce crop yield potential. It is also important to achieve optimum plant and stem populations for the market targeted, scout fields to ensure adequate control of pests and diseases and regularly monitor tuber health and quality in order to take appropriate and timely management decisions that will make the difference between a normal and an above average yielding crop.

Contacts:

For further information on these general fertilizer nitrogen recommendations, or on the PSNT or the SNT, contact the Soil and Feed Testing Laboratory, P.E.I. Dept. of Agriculture, Fisheries and Aquaculture (902) 368-5628 or Nutrient Management Specialists at (902) 894-0392 or (902) 368-6366 with the Prince Edward Island Department of Agriculture, Fisheries, and Aquaculture.

Table 4. Manure or compost organic nitrogen availability coefficients

Manure Type	Spring applied	Fall applied
Poultry manure:	0.30	0.30
Compost or other livestock manure:		
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

This factsheet was prepared by Bernie Zebarth (Agriculture and Agri-Food Canada), Charles Karemangingo, Daniel Savoie, Peter Scott (New Brunswick Department of Agriculture and Aquaculture) and Gilles Moreau (McCain Foods (Canada)), January, 2007.

Greenhouse Gas Mitigation Program for Canadian Agriculture
Programme d'atténuation des gaz à effet de serre pour l'agriculture canadienne

Canadian Cattlemen's Association

Canadian Pork Council / Conseil canadien du porc

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