environmental farm plan
sustainably farmed

INFOSHEET #16

NUTRIENT MANAGEMENT IN GROWING CROPS

How to address concerns identified in Environmental Farm Plan Worksheet #16

Based on Environmental Farm Plan Workbook, 5th ed. 2025

This infosheet outlines options to address concerns identified in your Environmental Farm Plan (EFP) as they relate to nutrient management in growing crops.

When managing nutrients in a Source Water Protection Zone, you may need to take measures to reduce risk. **The Farm Source Water Protection Plan framework** and workbook can help you work through the Source Water Protection framework and its application on your farm.

For help with technical terms, please see the full glossary in your EFP Workbook.

All options in this infosheet are classed as **Actions** or **Compensating Factors**.

- **Actions** address the identified concern, and will change the EFP rating to (3) or (4) Best.
- **Compensating Factors** are alternatives that will adequately address the concern, but will not change the rating in the EFP worksheet.

In most cases, you'll need more information before choosing and implementing options. Sources for more information are noted at the end of this infosheet.

Sustainable Canadian Agricultural Partnership
OSCIA
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16-1. Nutrient management planning

BACKGROUND

Managing and tracking on-farm nutrient use is important for achieving good yields and avoiding over-application. All farms should consider developing a plan to manage the nutrients on their farm as a best management practice. Having a plan to manage your nutrients will help reduce fertilizer input costs. A nutrient management plan is a living document that you update periodically and considers all nutrients applied on the farm.

Without a plan, farmers may unintentionally apply nutrients at excessive rates, leading to contamination of surface and/or groundwater, as well as an accumulation of nutrients in the soil.

Evaluate nutrient balances on a yearly crop basis or over an entire rotation. Use as a record-keeping tool as well.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Develop a nutrient management plan for your farm with a 4R certified crop advisor (CCA) or 4R certified agricultural retailer.

OPTION 2 – ACTION

Hire a certified person or take the training yourself to use AgriSuite to create a nutrient management plan for your farm.

This BMP publication is an essential companion for anyone completing a nutrient management plan. Learn how to inventory nutrient sources, interpret results, plan application, keep records, monitor, and adjust.

16–2. Choice of fertilizer materials

BACKGROUND

Smart nutrient management embodies the 4-R principle: the right nutrients, in the right amounts, at the right times, in the right place.

Determining the right nutrients – in form and ratio of nutrients – is the first step.

Follow the 4-Rs for nutrient management in growing crops:

- **Right nutrients**
- **Right rate**
- **Right time**
- **Right place**

The 4-Rs will get the best results at the least cost.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Determine the crop's specific nutrient needs.

Know what and how much nutrients are available in various types of fertilizers.

Select the fertilizer materials that best meet crop needs – considering cost, crop safety, nutrient availability, potential for environmental loss, and equipment required for application.

Consider using enhanced efficiency fertilizer (e.g., Environmentally Smart Nitrogen [ESN]).

Read OMAFA's crop recommendation publications:

- **Soil Fertility Handbook, Publication 611**
- **Agronomy Guide for Field Crops, Publication 811**

Fertilizer Materials – Primary Nutrients			
Nitrogen Materials	**Form**	**% Nitrogen (N)**	**Salt Index[1]**
Ammonium nitrate	dry	30 to 34	15.3
Calcium ammonium nitrate	dry	27	15.3
Urea	dry	45 to 46	8.1
Ammonium sulfate	dry	21	16.3
Urea-ammonium nitrate	liquid	28	11.3
Anhydous ammonia	liquid[2]	82	2.9
Phosphate Materials	**Form**	**% Phosphate (P_2O_5)**	**Salt Index[1]**
Single superphosphate	dry	20	2.0
Triple superphosphate	dry	44 to 46	1.1
Monoammonium phosphate	dry	48 to 52	2.0
Diammonium phosphate (18-46-0)	dry	46	2.3
Ammonium polyphosphate (10-34-0)	liquid	34	2.3
Potash Materials	**Form**	**% Potash (K_2O)**	**Salt Index[1]**
Muriate of potash	dry	60 to 62	9.7
Sulfate of potash	dry	50	4.3
Sulfate of potash magnesia (11% Mg)	dry	22	9.9
Potassium nitrate (13-0-44)	dry	44	6.1

[1] Expressed per unit (100 lb) of nutrient
[2] Liquid under pressure

Determining your crop's specific nutrient needs and desired balance will help you source the best fertilizer materials for the job.

16–3. Method of determining nitrogen application rate for crop

BACKGROUND

Nitrate nitrogen contents vary greatly from week to week in the soil due to variables such as weather and soil temperature. Pre-side-dress nitrate test (PSNT) can help measure soil nitrate and fine-tune additional commercial N needs for corn.

A soil nitrate test properly taken and handled just before the side-dress nitrogen application in corn can help determine the nitrogen contribution from soil. Remember the amount of soil nitrate can vary greatly within a field, so use the test results as a guideline only. A sufficient number of samples will give a more accurate report.

Determining the right amount of nitrogen to apply will pay off both economically and environmentally.

Use OMAFA's AgriSuite, a suite of free web-based decision support tools to help you determine the best way to store, treat and use materials – such as manure – on your farm.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Collect soil samples and submit them to an accredited soil testing lab for nitrate-nitrogen soil test:

- follow recommended procedures for sampling and handling the soil samples to ensure good results

OPTION 2 – ACTION

Use the Corn N Calculator to determine the N requirement for your expected yield:

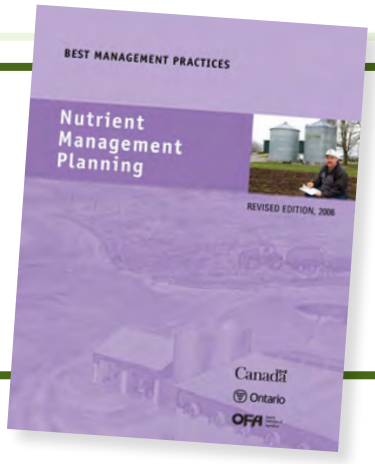
- it will estimate (based on information you provide) the amount of nitrogen to be added, either by side dressing or broadcast, to reach your expected corn yield

OPTION 3 – ACTION

Use AgriSuite to perform a nitrogen balance as part of your Nutrient Management Plan/Strategy:

- estimate your nitrogen requirements from the information provided in your Plan/Strategy – e.g., previous crop, previous nutrient applications, etc.

The Nutrient Management Planning BMP book explains the process step-by-step, showing how to inventory nutrient sources, interpret results, plan application, keep records, monitor, and adjust.



16–4. Method of determining amount of phosphorus, potassium or other nutrient

BACKGROUND

A soil test is useful to determine each individual field fertilizer application rate. Ontario research has determined the recommended fertilizer rate-to-yield results.

The phosphorus and potassium rates recommendations in the OMAFA guides, based on soil test results, are sufficient for yield levels well above those commonly obtained in Ontario. Where soil fertility levels are low (less than 12 ppm), estimating nutrients removed by a crop(s) at harvest between soil tests may help fine-tune application rates.

Adding more fertilizer than necessary will not increase crop yields but will lower profitability and increase the risk of environmental contamination. In some cases, excess fertilizer can decrease crop yield or quality.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Use the fertilizer recommendations from an OMAFA-accredited soil testing laboratory, or from the various production recommendations:

- note that a soil test estimates the amount of phosphorus and potassium available to the crop
- use soil test results to determine how much additional materials are required to produce an optimum yield for a particular crop

Phosphate and Potash Recommendations for Corn Based on OMAFA-Accredited Soil Tests

Sodium Bicarbonate Phosphorus Soil Test (ppm)	Rating	Phosphate (P_2O_5) Required kg/ha	Ammonium Acetate Potassium Soil Test (ppm)	Rating	Potash (K_2O) Required kg/ha
0-3	HR	110	0-15	HR	170
4-5		100	16-30		160
6-7		90	31-45		140
8-9		70	46-60		110
10-12	MR	50	61-80	MR	80
13-15		20	81-100		50
16-20		20	101-120		30
21-30	LR	20	121-150	LR	0
31-60	RR	0	151-250	RR	0
61+	NR	0	251+	NR	0

100 kg/ha = 90 lb/acre

HR: High Response MR: Medium Response LR: Low Response NR: No Response RR: Rare Response

OMAFA fertilizer recommendations are based on Ontario field trial research.

16–5. Adjustment to amount of fertilizer needed when using legumes or cover crops

BACKGROUND

Legumes supply nitrogen for their own growth needs as well as supply nitrogen for the following crop. Purchasing nitrogen fertilizer and not accounting for this legume source of nitrogen not only lowers profitability, but also increases the risk of environmental nitrate loss.

By using legumes to their full nutrient advantage, you can save money on fertilizer. When these crops are plowed down or killed off with herbicide, a significant amount of nitrogen is available for the next crop planted.

These crops also improve soil structure and moisture-holding capacity by adding to the supply of organic matter.

WHAT CAN YOU DO?

OPTION 1 – ACTION

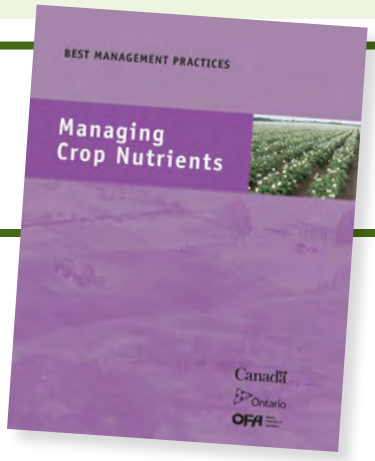
Determine the legume percentage in the forage stand or cover crop and adjust your nitrogen fertilizer according to the tables in various OMAFA publications with production recommendations.

A full stand of perennial legumes such as alfalfa, trefoil or clover, when left in the field for more than a year, should consist of more than 12 plants per square foot. A 50% stand of six plants per square foot would receive the same nitrogen allowance as the full stand, which will provide 110 kg/ha of nitrogen to the next crop.

A full stand of legume cover crop, that is planted and terminated in the same year, can provide 45 kg/ha of nitrogen to the next crop (up to 82 kg/ha if the next crop is corn). Reduce the allowance if the stand is thin, or if the top growth is less than 45 cm (18 in.).

A full stand of legume can supply 45 kg /ha of nitrogen to the following crop.

For more “right rate” tips, refer to Managing Crop Nutrients BMP.



16-6. Adjustment to amount of fertilizer needed when applying manure, compost, digestate or biosolids

BACKGROUND

Manure, compost or biosolids (including treated municipal biosolids) can supply large amounts of nutrients for crop production. By accounting for the nutrients, you can reduce the amount of inorganic fertilizers you need to apply and save money.

The addition of these materials also improves soil structure and moisture-holding capacity by increasing the soil organic matter.

Adjusting the amount of fertilizer needed when applying manure, compost, digestate or biosolids reduces input costs and decreases the risk of applying excess nutrients that can not be used by the growing crop. The soil nutrients that move with runoff water, soil sediment or move below the plant's root zone can lead to contamination of water courses or ground water.

Manure or biosolids can supply large amounts of nutrients for crop production, improve soil structure and reduce fertilizer costs.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Reduce the amount of fertilizer applied to the crop by the amount of available nutrient added by manure or biosolids:

- obtain a lab nutrient analysis for the manure and biosolids applied to your fields
- use manure analysis from the previous year (if available) as a guide to the nutrient content of the manure currently applied unless your management has changed – liquid manure analysis, in particular, will be fairly constant from year to year
- determine the available nutrients you are applying with manure, compost or biosolids per acre, and reduce your commercial fertilizer rates accordingly
- apply manure to crops with a high nutrient demand, or crops on fields with low soil test values, rather than to the fields conveniently close to the barn
- calibrate your spreader so you know how much material per acre is going on your fields

OPTION 2 – ACTION

Apply nutrients according to formal nutrient management plan.

Refer to Cover Crops and Manure Application for adding additional organic matter.

16-7. Nutrient balancing during rotation

BACKGROUND

As the total nutrient application to any given field increases, the risk of environmental contamination from excess nutrients also increases.

This is particularly true when nutrients are repeatedly applied in excess of crop uptake or the same crop is grown continuously.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Alternate the crops that use high rates of fertilizer with crops that use lower rates of fertilizer, or use cover crops that will take up the residual soil fertility.

OPTION 2 – ACTION

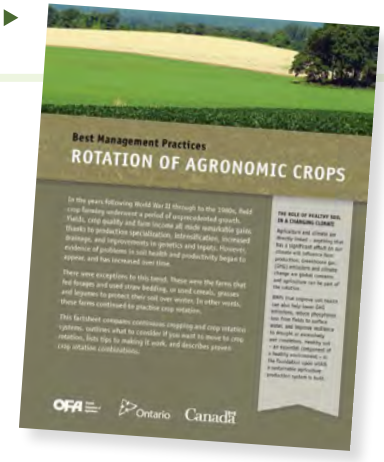
Use soil tests to determine the amount of nutrients available in the soil. Only apply nutrients to balance with crop removal over the rotation.

Review these OMAFA publications:

Soil Fertility Handbook, Publication 611

Agronomy Guide for Field Crops, Publication 811

Rotation of Agronomic Crops ▶



Where soybeans follow corn in the rotation, the corn will respond to the applied fertilizer, while the soybeans can use the available residual fertilizer from the corn crop.

16–8. Timing of nitrogen application

BACKGROUND

Nitrogen is the nutrient at greatest risk of loss by volatilization, denitrification or leaching from a cropping system. Applying nitrogen when the crop is less able to use it wastes your time and money and can result in detrimental impacts to the environment.

Nitrogen inhibitors used when nitrogen is applied ahead or at planting will help to slow the release of nitrogen and can help reduce N losses.

Side dress applications of nitrogen permits you to apply nitrogen when crop needs are highest. It also allows you to assess the conditions of the crop and adjust or use variable rate technology to compensate for field conditions and weather.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Side-dress most of the fertilizer nitrogen applied to corn and row crops with high nitrogen requirements:

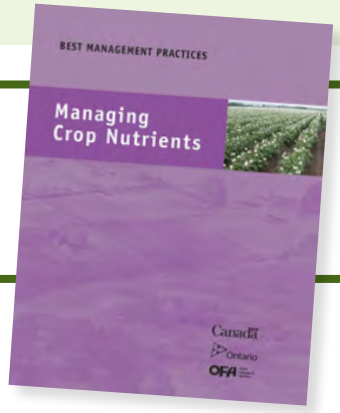
- apply a small amount of nitrogen as a starter at seeding time and side-dress the balance
- adjust side-dress rates for crop conditions

OPTION 2 – ACTION

Top-dress nitrogen on cereals and pure grasses just before they begin to grow quickly and can utilize readily available nitrogen.

Top-dress nitrogen on cereals and grasses just before they begin to grow quickly and can use readily available nitrogen. Applying nitrogen when the crop needs it will increase nitrogen use and reduce the potential for loss and environmental risk.

For many more application and timing tips, review this Managing Crop Nutrients BMP publication.



16–9. Timing of phosphorus application

BACKGROUND

In soil, phosphorus is released by the breakdown of organic matter and diffusion in the water film surrounding soil particles which makes it available to plant roots. Therefore, soil moisture is critical for plants to uptake phosphorus. Increasing soil temperature increases the release of the phosphorus.

Natural movement in the soil is limited to only a few millimetres a year, so the source must be placed very close to where the roots can take it up.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Band application of phosphorus at or near time of planting:

- makes it more available to plants before it becomes attached to soil particles

OPTION 2 – ACTION

Broadcast phosphorus in the spring or after wheat harvest in late summer, and incorporate as quickly as possible.

OPTION 3 – ACTION

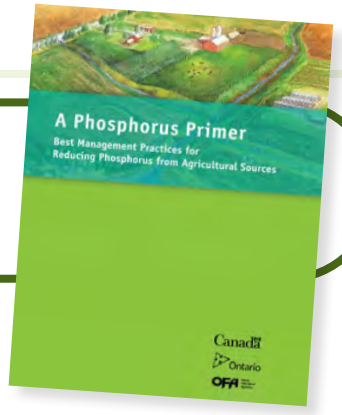
Broadcast phosphorous into growing crop.

A significant amount of the phosphorus in spring-applied manure may be taken up by plants in the year of application. The remainder has a residual effect.

Refer to:

Soil Fertility Handbook, Publication 611

Agronomy Guide for Field Crops, Publication 811



A Phosphorus Primer explains how P can be lost and sets out BMPs to keep it in its place.

16–10. Application system – commercial fertilizer

BACKGROUND

Fertilizers left on the soil surface are subject to losses to the air by volatilization (especially urea nitrogen), or to surface water through runoff.

Incorporating the fertilizer as soon as possible will minimize these losses, increase the cost-effectiveness of the fertilizer and decrease the environmental risk.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Incorporate nutrients where possible:

- incorporate broadcast fertilizers as soon as possible after application and within 24 hours
- in reduced tillage systems, band as many nutrients as possible
- band starter fertilizers during planting
- side-dress nitrogen between the rows of corn and other row crops

OPTION 2 – ACTION

Where possible, limit broadcast applications of fertilizer to level fields with greater than 30% crop residue coverage:

- avoid broadcasting fertilizers on floodplains, steeply sloping fields, or near watercourses or wells

OPTION 3 – ACTION

Broadcast into growing crops.

16-11. Application distance from surface water or tile inlets (catch basin or Hickenbottom)

BACKGROUND

Phosphorus in surface water continues to be a serious issue despite efforts to manage its movement. Erosion of agricultural soils by water and the resulting nutrient-rich runoff need to be reduced for both environmental and economic reasons.

Increasing the application distance away from the surface water or tile inlet will reduce the likelihood that nutrients in runoff will reach surface water.

For more "right place" tips, refer to the Managing Crop Nutrients BMP.

WHAT CAN YOU DO?

OPTION 1 – ACTION

For all fertilizer that is surface-applied:

- maintain a 10 m (30 ft.) spreading setback from any surface water

OPTION 2 – ACTION

For all fertilizer that is injected, banded below the soil surface, or surface-applied and incorporated within 24 hours:

- maintain a 3 m (10 ft.) spreading setback from surface water

OPTION 3 – ACTION

For all fertilizer materials that are surface-applied to land covered in a growing crop or land covered with at least 30% residue:

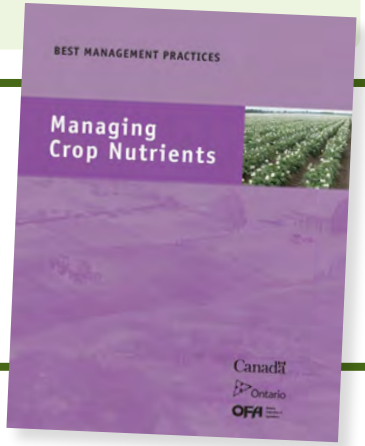
- maintain a 3 m (10 ft.) spreading setback

OPTION 4 – ACTION

In addition to Option 2 and 3, maintain a grassed buffer beside the surface water or tile inlet.

Fertilizer materials that are injected into the soil should be set back from surface water at least 3 m (10 ft.).

Buffer strips alongside water bodies trap nutrients and runoff and keep them out of surface water. To learn how they work and design options, refer to Managing Crop Nutrients BMP.



16-12. Application distance from well

BACKGROUND

If commercial fertilizer is applied closer than the required minimum distance from a well this is a contravention of provincial legislation. Application setbacks help protect ground water quality and your family's health.

Proper construction and maintenance of wells also safeguards ground water quality from potential contaminants.

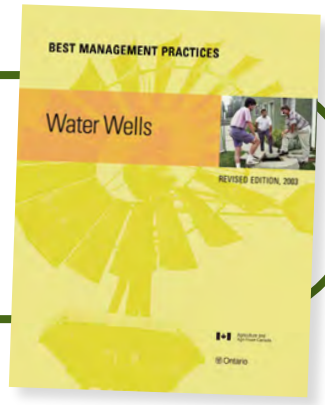
WHAT CAN YOU DO?

OPTION 1 – ACTION

Maintain fertilizer-spreading setbacks from water wells:

- more than 3 m (10 ft.) from a drilled or dug well
- more than 100 m (330 ft.) from a municipal well

To learn more about potential risks to your well water quality and how to minimize them, refer to the Water Wells BMP.



Know the location of wells near fields and maintain application setbacks.

16–13. Timing and number of soil samples

BACKGROUND

Soil testing is the only way to determine whether the soil in your fields is deficient, adequate or excessive in phosphorous or potassium.

Tests must be taken periodically (every two to five years) ideally at the same place in the rotation and at the same time of year, to track any changes in soil fertility. Composite soil samples should represent the natural variability in the field.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Every two to three years, collect a composite soil sample for every 25 acres or less:

- collect at least 2 cores per acre and no fewer than 20 cores
- take samples at the same point in the rotation and at the same time of year

OPTION 2 – ACTION

Every four to five years, collect a composite soil sample from a sample size of less than 25 acres:

- soil-test at the same stage of the rotation
- collect at least 1–2 cores per acre and no fewer than 20 cores

A satisfactory composite sample contains 2 cores per acre but no fewer than 20 cores to represent the variability in the field.

Read OMAFA factsheet:

Soil sampling and analysis for managing crop nutrients

16-14. Number and location of soil samples

BACKGROUND

GPS technology and geo-referencing sampling locations make soil sampling for P and K more accurate and provide the potential for variable rate application based on soil test results.

Common practices for identifying the variability that exists in soil are:

- **Grid or point sampling** – using mapping software, a grid is superimposed over the field to serve as a guide for sampling locations. The grid is of uniform size for the field but may vary in size from 0.4 ha (1 acre) per point to 4 ha (10 acres) per point. A GPS location is logged by the software at a point representative of that grid area. Soil cores are taken at that point, which are combined and sent to the soil lab.
- **Zone sampling** – using mapping software, management zones are defined that align with distinct areas showing differences in soil properties and/or management. Measurements from sources such as yield or elevation data, soil type maps, topography, or drainage may be used to identify these zones. Soil cores are taken throughout each zone, which are separately packaged and sent to the soil lab.
- **Sensor-based sampling** – use data from sensors measuring things like elevation, slope, radiation, electrical conductivity, or topsoil depth in conjunction with software programs to analyze and create high-definition maps identifying variability throughout a field. Standard soil cores and soil lab analysis are included to feed into the software programs. These can be used to help fine-tune phosphorus and potassium application.

Each of these technologies require soil cores taken to 15 cm (6”) depth for measuring P and K, and from areas representative of the soil around them. Maximum area for any type of soil sampling operation must be 10 ha (25 acres) or less.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Identify areas of variability on your own farm and sample separately:

- high and low yielding areas
- tops of knolls, side slopes, field hollows
- areas of erosion

Results from these samples can direct your P and K fertility program.

OPTION 2 – ACTION

Work with a trusted partner (Certified Crop Advisor, agronomist, or service provider) to use higher-definition sampling methods:

- grid, point or zone sampling
- sensor-based sampling

Results from these samples can direct your P and K fertility program. Use variable rate technology for improved application.

NUTRIENT RETENTION WITHIN FIELD

16-15. Potential for nutrient losses through leaching or runoff

BACKGROUND

The risk of nutrient movement off a field due to erosion or leaching is reduced by increasing the amount of groundcover and root mass available to absorb the nutrients. The lowest risk of nutrient movement off a field will occur when there is a permanent sod with a dense root network receiving little or no fertilizer. This is not a viable agricultural system for everyone.

Any practice that increases the amount of groundcover or root mass will help lower the risk of nutrient loss from a field.

The risk of nutrient movement off a field can be reduced using cover crops.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Use cover crops, especially cover crops that provide winter cover, whenever the field would otherwise be bare to at least 3 years in 6.

Increase the proportion of solid seeded crops (e.g., forages, winter cereals, canola) into the rotation.

Use soil testing regularly to optimize the amount of fertilizer applied to any given crop.

OPTION 2 – ACTION

Increase cover crop use to more than 3 years in 6.

Refer to Winter Cover Crops for more information on providing winter cover to reduce runoff.

FOR MORE INFORMATION

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND AGRIBUSINESS (OMAFA)

- Agricultural Information Contact Centre (AICC)
  Toll free: 1-877-424-1300 | e-mail: ag.info.omafa@ontario.ca

  Find most of the resources listed below at www.ontario.ca

Publications

- Agronomy Guide for Field Crops, Publication 811
- Guide to Vegetable Production in Ontario, Publication 839
- Soil Fertility Handbook, Publication 611

Factsheets

- Soil sampling and analysis for managing crop nutrients
- Interpreting your soil test results

Best Management Practices Series

- A Phosphorus Primer
- Field Crop Production
- Managing Crop Nutrients
- Manure Management
- Nutrient Management Planning
- Soil Management
- Adding Organic Amendments
- Cold and Wet Soils
- Low Fertility
- pH Extremes

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND AGRIBUSINESS (OMAFA), *continued*

AgriSuite

- Nutrient Management Strategy & Plan Tool
- Manure Storage Sizing Tool
- Phosphorus Loss Assessment Tool
- Fertilizer Tool
- Field Management Tool

Ontario Crop Protection Hub

FERTILIZER CANADA

- The 4Rs: Right Source, Right Rate, Right Time, Right Place

UNIVERSITY OF GUELPH, RIDGETOWN CAMPUS

- Nutrient Management Training and Certification
  - Nutrient Management Strategy/Plan Preparation Workbook

LEGISLATION/ACTS

- Nutrient Management Act, 2002
- Ontario Regulation 267/03
- Fertilizer Act, 1985
- Clean Water Act, 2006