INFOSHEET #16

NUTRIENT MANAGEMENT IN GROWING CROPS

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

environmental farm plan
sustainably farmed

Based on Environmental Farm Plan Workbook, 4th ed. 2013

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

For managing nutrients in growing crops that are located in a Source Water Protection Zone, the risk management measures needed to address the risk will be determined through the Source Water Protection process in your particular area. The measures may be the same as or more than required by EFP due to the proximity to a municipal drinking water supply. For more information, contact your local municipality or check their website under Source Water Protection Planning.

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 Best (4).
- **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.

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

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RIGHT SOURCE

16–1. 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 time**
- **Right rate**
- **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, nutrient availability, and equipment required for application.

See OMAFRA's crop recommendation publications and:

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

Table 9–17. 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
Anhydrous ammonia	liquid[2]	82	2.9
Phosphate Materials		**% Phosphate (P_2O_5)**	
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		**% Potash (K_2O)**	
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.

RIGHT RATE

16–2. Method of determining amount of nitrogen to apply

BACKGROUND

Routine nitrogen testing is not done on soil samples because the nitrate-nitrogen contents vary greatly from week to week in the soil due to variables such as weather and soil temperature.

Nitrate-nitrogen samples are taken at a greater depth (30 cm) than standard soil tests (15 cm). Since the nitrate is present in the moisture content in the sample, care must be taken to prevent changes in the moisture content of the sample.

Determining the right amount of nitrogen to apply will pay off both economically and environmentally. Use OMAFRA'S NMAN software tool (AgriSuite)

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

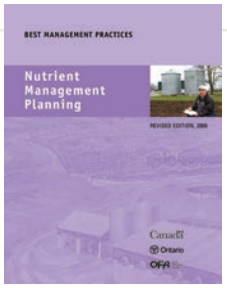
Use the Corn N Calculator to determine the N requirement for your expected yield:

- 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 the NMAN computer software to perform a nitrogen balance as part of your Nutrient Management Plan/Strategy:

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



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

16–3. Method of determining amount of phosphorus, potassium or other nutrient

BACKGROUND

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

The phosphorus and potassium rates recommendations in the OMAFRA guides, based on soil test results, are sufficient for yield levels well above those commonly obtained in Ontario.

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 OMAFRA-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.

Table 1–25. Phosphate and Potash Recommendations for Corn Based on OMAFRA-Accredited Soil Tests

Sodium Bicarbonate Phosphorus Soil Test (ppm)	Rating[1]	Phosphate (P_2O_5)[2] Required kg/ha	Ammonium Acetate Potassium Soil Test (ppm)	Rating	Potash (K_2O)[2] 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[3]	0	251+	NR[3]	0

100 kg/ha = 90 lb/acre

OMAFRA fertilizer recommendations are based on Ontario field trial research.

16–4. Adjustment to amount of fertilizer needed when using legumes or cover crops

BACKGROUND

Legumes can 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 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?

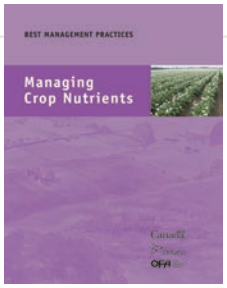
OPTION 1 – ACTION

Determine the legume percentage in the forage stand or cover crop, and adjust your nitrogen fertilizer according to the tables in various OMAFRA 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 vigorous stand of legume cover crop can provide 45 kg/ha of nitrogen to the next crop. Reduce the allowance if the stand is thin, or if the top growth is less than 45 cm (18 in.).

A soil nitrate test properly taken and properly handled just before the side-dress nitrogen application in corn can help determine the nitrogen contribution from a previous legume crop. Remember that 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 help give a more accurate report.



For more "right rate" tips, see pages 80–84 in Managing Crop Nutrients, **a BMP publication.**

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

16–5. 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 these provide, 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 utilized by the growing crop. The soil nutrients that move out of the plant's root zone are not only lost, but may reach the ground water aquifer and cause contamination.

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
- you can 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 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.

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

16–6. Nutrient loading during the 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, and 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 will use the residual soil fertility:

- use soil tests to determine the amount of fertilizer to be applied to any given crop.

OPTION 2 – ACTION

Only apply nutrients to balance with crop removal over the rotation.

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

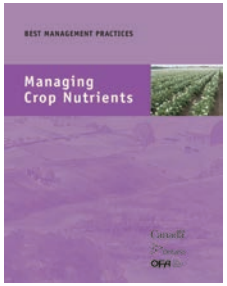
See also OMAFRA publications:

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

RIGHT TIME

16–7. Timing of nitrogen application

BACKGROUND	WHAT CAN YOU DO?
Nitrogen is the nutrient at greatest risk of loss by volatilization 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. The side-dress application of nitrogen allows you to assess the condition of the crop, and adjust your nitrogen application to compensate for any potential reductions in yield.	**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.** **OPTION 3 – ACTION** **Incorporate nitrogen in the soil less than two weeks prior to planting:** • reduces potential losses due to leaching in the soil and to the atmosphere by volatilization.



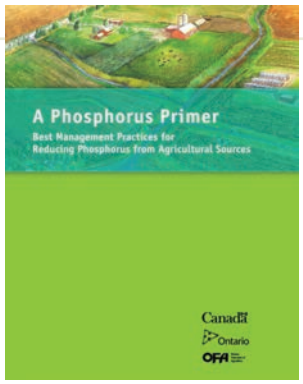
For many more application and timing tips, see pages 78–103 in this BMP publication.

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

16–8. Timing of phosphorus application

BACKGROUND	WHAT CAN YOU DO?
In soil, phosphorus is released by the breakdown of organic matter and diffusion in the water film surrounding soil particles 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.	**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/manure in the spring and incorporate.**

Up to 30% of the phosphorus in spring-applied manure may be taken up by plants in the year of application. The remainder has a residual effect.



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

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

RIGHT PLACE

16–9. Application distance from surface water

BACKGROUND

Phosphorus in surface water continues to be a serious issue despite concerted 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.

Generally speaking, increasing the application distance will reduce the likelihood that nutrients in runoff will reach surface water.

For more "right place" tips, see BMP Managing Crop Nutrients, **pages 92–103.**

WHAT CAN YOU DO?

OPTION 1 – ACTION

For all fertilizer that is surface-applied:

Maintain a 13 m (43 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

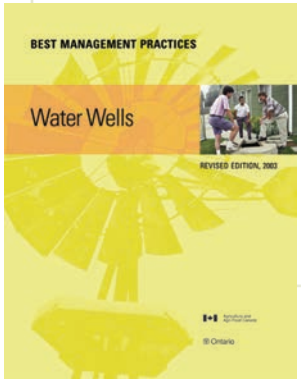
For all fertilizer materials that are surface-applied to land covered in a living crop or land covered with at least 30% residue:

Maintain a 3 m (10 ft) spreading setback.

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

16–10. Application distance from well

BACKGROUND



To learn more about potential risks to your well water quality and how to minimize them, see this BMP publication.

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

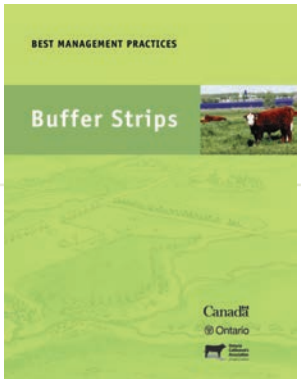
Proper well construction and maintenance also safeguard ground water quality from potential contaminants.

WHAT CAN YOU DO?

OPTION 1 – ACTION

Maintain fertilizer-spreading setbacks from water wells:

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



Buffer strips alongside water bodies trap nutrients and runoff and keep them out of surface water. To learn how they work and design options, see this BMP publication.

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

16–11. Application system – inorganic sources

BACKGROUND	WHAT CAN YOU DO?
Fertilizers that are 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.	**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:** • avoid broadcasting fertilizers on floodplains, steeply sloping fields, or near watercourses or wells.

SOIL TESTING

16–12. Timing and number of soil samples

BACKGROUND	WHAT CAN YOU DO?
Soil testing is the only way to determine whether the soil in your fields is deficient, adequate or excessive in fertility. Tests must be taken periodically (every two to five years) to track any changes in soil fertility. Composite soil samples should represent the natural varability in the field.	**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.

See OMAFRA factsheet:

- Soil Sampling and Analysis for Managing Crop Nutrients, **Order no. 06-031**

16–13. Record-keeping

BACKGROUND	WHAT CAN YOU DO?
A proper nutrient management program will gradually build your soils from low to moderate soil test levels, and maintain them there. Excessive soil test levels, or rapidly increasing or decreasing levels, indicate either a problem with your program, or a problem with your testing procedure. Failing to maintain up-to-date records means that you have no idea whether or not your fertilizer management program is meeting its goals.	**OPTION 1 – ACTION** **Set up and maintain a system to record all the results of the soil tests:** • include date, crop rotation, each crop's history, yield, field identification, nutrient test results and name of lab • maintain a schedule for routinely sampling the fields • record soil test values for each field on a graph to make trends over time immediately apparent.

OMAFRA's Field Pocket Guide **can help you keep track of individual soil fertility levels.**

NUTRIENT RETENTION WITHIN FIELD

16–14. Potential for nutrient losses through leaching or runoff

BACKGROUND	WHAT CAN YOU DO?
The risk of nutrient movement off a field due to erosion or leaching is balanced by 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. Obviously, this is not a viable agricultural system for everyone. Any practice that increases the amount of groundcover or root mass will help you lower the risk of nutrient loss from a field.	**OPTION 1 – ACTION** **Utilize cover crops whenever the field would otherwise be bare; at least three or more years in six.** **Increase the proportion of sod crops in the rotation:** • add some solid seeded crops into your rotation • use soil testing regularly to optimize the amount of fertilizer applied to any given crop.

The risk of nutrient movement off a field can be reduced through the use of cover crops.

FOR MORE INFORMATION

Ontario Ministry of Agriculture, Food and Rural Affairs

Many sources of supplementary information are available from the Ministry of Agriculture, Food and Rural Affairs. Below are some suggestions to get you started. Most can be found online at **www.ontario.ca/omafra** or ordered through ServiceOntario.

Agronomy Guide for Field Crops, Publication 811

Field Pocket Guide – A Practical Tool to Record Crop Management Activities, Publication 820

Ontario Field Vegetable Guide, Publication 839 (replaces Vegetable Production Recommendations, Publication 363)

Soil Fertility Handbook, Publication 611

Soil Sampling and Analysis for Managing Crop Nutrients, Order no. 06-031

NMAN Software (v3.2) – a software tool to assist farmers in predicting nutrient generation from livestock and determining landbase requirements for agronomic use of nutrients, including manure, washwaters and NASM. (Version 3.2, released in Dec. 2012, replaces all previous versions.)

Nutrient Management Act, 2002, Ontario Regulation 267/03 as amended – www.e-laws.gov.on.ca/html/regs/english/elaws_regs_030267_e.htm

See also Best Management Practices publications to better understand on-farm environmental issues and discover a range of proven practical options to address them. They are available at no charge to Ontario farmers. To order, see ServiceOntario information.

Inquiries to the Ontario Ministry of Agriculture, Food and Rural Affairs

Agricultural Information Contact Centre

Ph: 1-877-424-1300

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