

4R NUTRIENT STEWARDSHIP

NERP

BLAIRMORE RING

15

# CANADIAN FERTILIZER INNOVATIONS

Revolutionizing agricultural advancement

SIZE GUIDE NUMBERS  
CODES OF PRACTICE

4R RESEARCH NETWORK

GREENER D

4R SUSTAINABILITY

NO-TILL

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## Introduction

It's no secret that the world can only progress as quickly as our agricultural and fertilizer practices improve.

Since the development of the first chemically defined fertilizer by Sir John Bennet Lawes at Rothamsted in 1843, agriculture has gone through a productivity revolution. The development of the Haber-Bosch process of ammonia synthesis (1908) and the modernization of agriculture during the Green Revolution between the 1930s and 1960s lifted millions out of poverty and famine. The increased availability of mineral potash (particularly from Canada in the early 20th century) resulted in the development of formulated, chemically defined fertilizers with the three major macro-nutrients: nitrogen, potassium, and phosphorus (NPK).

This widespread availability and use of chemical fertilizers was arguably the industrial revolution's single most important innovation for feeding the growing population.

Today, the fertilizer industry is still recognized as an indispensable component in meeting the world's current and future food needs. In 2017, Canada's agriculture industry was recognized by the federal Advisory Council on Economic Growth as one with the power to raise the country to an economic leadership position on a global scale. With this support from the government, agriculture will again lead the way for growth in our country and throughout the world.

Beginning long before the Green Revolution, the fertilizer industry has been working to shape agricultural advancement by improving the way farmers deliver essential nutrients to crops. As the backbone of agriculture, the innovations of the Canadian fertilizer industry continue to support this global development led by farming and agri-food.

Published in conjunction with Global Fertilizer Day on Oct. 13 – which marks the anniversary of Fritz Haber's discovery of the Haber-Bosch process – this booklet celebrates 15 Canadian fertilizer innovations that have helped to revolutionize agriculture and shape the world of today.





# NERP

Based on the principles of 4R Nutrient Stewardship, the Nitrous Oxide Emission Reduction Protocol (NERP) is another science-based system developed in Alberta, Canada to reduce on-farm greenhouse gas emissions.

Through careful selection of nitrogen fertilizer source, rate, timing and placement practices, the nitrous oxide emissions per unit of crop produced can be substantially reduced, in some cases by up to half. The practices that reduce nitrous oxide emissions also tend to increase nitrogen use efficiency and the economic return on fertilizer dollars.

NERP is quickly gaining recognition from decision makers who see the system as an innovative best practice for meeting mandatory emissions reductions targets. In Canada, the provinces of Ontario and Quebec have chosen NERP as a candidate for their provincial emission reduction protocols.

# 4R Nutrient Stewardship

4R Nutrient Stewardship (Right Source @ Right Rate, Right Time, Right Place®) is a science-based nutrient management system that is universally adaptable yet locally-focused, allowing farmers to tailor fertilizer needs to their specific fields.

By applying the right source of fertilizer at the right rate, the right time and in the right place, farmers can ensure nutrients from fertilizer – Nitrogen, Phosphate, Potassium and Sulphur – are taken up efficiently by their crops and not lost to water or air.

Developed in Canada, this innovative nutrient management system allows farmers to increase crop production on existing farmland while minimizing unwanted environmental impacts – creating a truly sustainable way to feed the world.

4R Nutrient Stewardship has been recognized by decision makers in Canada and around the world as a best practice system for nutrient management and environmental protection.



## Breton Plots

In 1929, the Breton Soil Fertility Plots were some of the first sites where intensive fertilizer comparative research was conducted.

Founded by two researchers – Dr. Frank A. Wyatt and Dr. John D. Newton – from the Soils Department at the University of Alberta, the plots were located in an area made up of Grey Luvisolic soils, more commonly known as Grey Wooded soils.

These soils, found in forested areas around Canada, were largely unprofitable to farmers until research at the Breton plots on cultivation methods, crop varieties, rotation and fertilizer use changed the way they were used.

This preliminary research on otherwise unusable soil has led the way for modern agriculture and fertilizer use.

## Blairmore Ring

In Saskatchewan, locked beneath 1,000 metres of ground, is the world's largest reserve of potash. Valuable to farmers because of its high content of potassium – a nutrient necessary for plant growth – the mining and manufacturing of potash is one of Canada's most prosperous industries.

However, until the innovation of the Blairmore Ring, potash in Canada was almost entirely inaccessible. This modernization overcame the biggest challenge facing the potash industry: located between 400 and 600 metres below the surface, just above the reserves, is a section of wet, sandy earth called the Blairmore Formation.

This wet earth would inevitably fall into and block potash mine shafts from being excavated further. The solution, crafted by potash engineers, was to freeze the Blairmore Formation, wrap the interior of the mine shaft in concrete, and reinforce the concrete with a series of iron rings known as Blairmore rings.

This innovation has contributed to the growth of the fertilizer and agriculture industries within Canada and throughout the world, as Saskatchewan provides 45 per cent of global potash supply.



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*I'm the world's biggest fan of fertilizer. I'm endlessly fascinated by the stuff. It's a magical material that can transform the lives of the poor by helping them grow bigger harvests and adapt to the impacts of climate change.*

Bill Gates 1 September 2015

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## Size Guide Numbers

An increase in bulk blending in Canada resulted in the need to pay close attention to producing quality fertilizer blends.

The fertilizer manufacturer and/or seller of the materials used in the blends and the retailers share a large responsibility for producing quality blends:

- Manufacturers supply properly sized fertilizer of guaranteed nutrient content
- Retailers ensure maintained blending equipment, good operating procedures, and determine if the fertilizer received is suitable for blending

Retailers that practice a “total quality approach” to fertilizer blending will consider, in addition to the guaranteed analysis of the blend, the effect of particle size and distribution on their ability to produce top quality blends. The aim is to supply and apply fertilizer products at the correct rate and uniformly to increase productivity and crop quality at minimum loss or risk to the environment.

To address this, the size guide number, or SGN, is a measure of fertilizer quality developed by Fertilizer Canada. The SGN system is based on the concept that only two measures are sufficient to describe the particle size distribution of a fertilizer material. They are the SGN and the Uniformity Index (UI), which are calculated from granulometric data.

## Elephant Brand Fertilizer

Elephant Brand, as one of the first fertilizer companies in Canada, was a true innovator of the industry and blazed the trail for modern agriculture as we know it.

Many of the staple fertilizers farmers rely on today were introduced to Canadians by Elephant Brand. Beginning in 1931, Elephant Brand was the first to produce Ammonium Sulphate and Ammonium Phosphate. Then, in 1941, they were the first in North America to produce Anhydrous Ammonia from natural gas.

By 1945, Elephant Brand had made another breakthrough and was the first company in the world to prill agriculture grade Ammonium Nitrate.

Though the history of Elephant Brand is filled with similar innovations, one of the most significant to the agriculture industry was the building of the original bulk blending plants at retail outlets in the Canadian Prairies in 1968. These facilities allowed for the creation of more efficient, blended fertilizers that farmers use to this day to fill their crops’ specific nutrient needs.





## CFPF

Hosted annually since 2006, the Canadian Fertilizer Products Forum (CFPF) was created in joint partnership with the Canadian Food Inspection Agency (CFIA), to provide the framework for consultation, resulting in strengthened coordination among federal departments and agencies, increased transparency, and improved stakeholder engagement in the regulatory process. The Forum aims to deliver high quality, safe products to market, offering a broad range of solutions to nurture plants and the soil.

The mission of the CFPF is to:

- improve the efficiency of the Canadian regulatory system and policies for fertilizers and supplements to encourage innovation, economic and environmental sustainability and international leadership;
- enhance the reputation of the industry and public confidence in its products via communications to a broad range of stakeholders; and
- plan for the future by analyzing emerging opportunities, new technologies and strategies on how agricultural producers can remain competitive.

The Forum has been recognized by the federal government as an innovative process that benefits the entire fertilizer industry.

## Codes of Practice

The Canadian fertilizer industry is a world leader in safety and security. Developed to create standardized procedures, Fertilizer Canada's Agricultural Ammonium Nitrate Code of Practice and Anhydrous Ammonia Code of Practice continue to be the gold standard for the industry. These Codes of Practice are mandatory for members of Fertilizer Canada.

The innovative Codes the Canadian fertilizer industry has implemented have demonstrated a stringent commitment to furthering safety and security. All anhydrous ammonia and ammonium nitrate sites managed by Fertilizer Canada members reach mandatory code compliance requirements by meeting or exceeding safety standards. In fact, 100 per cent of the 385 anhydrous ammonia sites in Canada are certified under the Anhydrous Ammonia Code of Practice verified by a third-party audit.

It is through the framework of these Codes that the Canadian fertilizer industry will continue to lead the way in safety and security. Using the existing Codes as a stepping stone, Fertilizer Canada is currently developing a Calcium Ammonium Nitrate Security Code of Practice, which will further safety standards for the industry.





## Greener World

Healthy grass is crucial to our environment. It reduces pollution, absorbs greenhouse gasses, and produces an abundant supply of clean oxygen. Proper fertilizer use is the best way to feed healthy lawns and reap the benefits.

Fertilizer Canada has created an innovative urban fertilizer campaign called Greener World, which aims to educate communities about the benefits and proper use of fertilizer.

By adapting the principles of 4R Nutrient Stewardship, fertilizer can be optimized for use in urban settings, such as on lawns or in community parks. Our Greener World campaign provides information on using the right source of fertilizer at the right rate, time and in the right place to grow lush grass while protecting bodies of water.

## 4R Research Network

The 4R Research Network is composed of 10 leading Canadian researchers who will qualify economic, social and environmental benefits resulting from advanced fertilizer management systems under 4R Nutrient Stewardship. The project emphasizes collaboration with university researchers, professional advisors, provincial agriculture departments, and Agriculture and Agri-Food Canada researchers.

Research covers many areas of environmental focus including reducing greenhouse gas and ammonia emissions, losses of phosphorus to surface waters, and nitrate leaching in groundwater. Activities, including field trials, cover key field crops across Canada and were selected to overcome gaps in adoption, such as: lack of best management practices (BMPs), evaluation of multiple nutrient loss pathways of nitrogen and phosphorus, evaluation of BMPs under the diverse soils, weather, cropping systems in Canada, and decision-making tools for tailoring BMPs to local needs and conditions.

This innovative network enables a strong transfer of knowledge from researchers to the farm level, bringing together science and agriculture extension to continue to grow the industry in Canada.



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*The fertilizer industry is not only vital to our economy but to our survival. Without nutrients for our crops, we cannot eat*

*– Hon. Lawrence MacAulay,  
Minister of Agriculture and Agri-Food Canada*

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## Use of Sulphur to Increase Yields in Canola

Canola, itself a Canadian innovation, has a higher sulphur requirement than almost any other major crop.

Increasing the amounts of sulphur in the soil through the use of ammonium sulphate fertilizer has transformed the Canadian canola industry, increasing yields and protecting against nutrient depletion.

Canola, originally bred at the University of Manitoba and named by condensing the word “Canada” and the suffix “ola” used for other oil-producing plants such as Mazola, plays a major role in the Canadian economy: of the 15.6 million tonnes grown in 2014, 45 per cent was exported to offshore markets.

## 4R Solution

Fertilizer Canada believes that smallholder farmers have the potential to play a key role in the mission of feeding the world. By implementing the latest in sustainable agriculture practices, these farmers can boost crop yields and profitability – contributing more agri-food products to the global market.

Through a Memorandum of Understanding with the Canadian Cooperative Association, Fertilizer Canada has committed to increasing food security for smallholder farmers in developing countries. Pending federal government approval, the 4R Solution project will promote 4R Nutrient Stewardship in five developing countries, including: Colombia, Ethiopia, Ghana, Senegal and one in Southeast Asia.

This innovative proposal focuses on educating smallholder farmers on the most efficient and climate-smart uses of fertilizer products on-farm and also on gaining increased integration of these best management practices into official agricultural policies and programs. The project aims to improve farm productivity and the profitability of 120,000 smallholder farmers, 40 per cent of whom are women.







## Use of Unit Trains for Potash Export

The Canadian fertilizer industry produces upwards of 15 million tonnes of potash fertilizer every year. In order to get this massive volume of fertilizer to markets in Canada and across the world, the potash fertilizer industry relies heavily on the rail system.

In fact, 95 per cent of potash fertilizer in Canada is transported by rail. The use of unit trains to bring potash to ports for offshore export has been an important innovation in shaping our country's history.



## Non-Fertilizer Uses for Potash

Potash is rich in potassium, a nutrient found in every cell of plants and animals. Because of this, it is valuable as a fertilizer for farmers wishing to increase crop yields and replenish nutrient levels in soil.

However, potash has a number of other uses as well. With 95 per cent of the world's potash reserves being found in Canada, our nation has had a key role in the innovation of these products:

- Animal feed: Potash is added as a supplement to increase the nutrients found in feed, which in turn promotes healthy animals.
- Glass: Granular potash (potassium carbonate) can be used as a flux to lower the temperature at which glass melts. Aided by the excellent clarity it lends, this method is often used in the production of eyeglasses, glassware, televisions and computer monitors.
- De-icer: Potash is a major ingredient in many de-icer products that are used to clear snow and ice from roadways and other surfaces. An added advantage of using potash over other de-icing products is the fertilizing properties it can provide to grass and other plants near treated surfaces.

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*In fact, Africa's smallholders are more than capable of feeding the continent — so long as they boost their yields by using the latest agronomic practices in combination with appropriately adapted seeds and fertilizer.*

— Kofi Annan, "Food and the Transformation of Africa; Getting Smallholders Connected", Foreign Affairs February 2016

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## Water Recycling in Solution Mining

Mining and processing potash and phosphate fertilizers can be a water intensive process. Water is used at several points during the creation of these fertilizers, including in solution mining to reach deposits at depths greater than 1,000 metres.

Solution mining is the safest and most effective way to mine potash and phosphate fertilizers that would otherwise be inaccessible. Warm water is pumped to the mineral formations, which dissolve. Then, the mineral-laden water is pumped to a facility where the potash is removed using evaporators.

Canadian fertilizer companies who utilize solution mining have committed to innovating this system by recycling up to 90 per cent of the water used in their facilities. This has contributed to a reduction of up to 15 per cent of groundwater withdrawals by these companies since 2005.



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*The challenge for your industry is to be at the head of this green revolution as you were at the head of the last one. Just as you have helped turn farming from a subsistence business into a flourishing industry that feeds the world, I now call on you to work with farmers, environmentalists and governments to help fine-tune agriculture into a business that feeds the world without harming the natural world.*

– Hon. George Webster,  
Former P.E.I. Minister of Environment, Energy and Forestry

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Fertilizer Canada represents manufacturers and wholesale and retail distributors of nitrogen, phosphate, potash and sulphur fertilizers. The fertilizer industry plays an essential role in Canada's economy, contributing over \$12 billion annually and 12,000 jobs. The association is committed to supporting the fertilizer industry with innovative research and programming while advocating sustainability, stewardship, safety and security through standards and Codes of Practice.

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