

# Greenhouse Gas Emissions and Alberta's Cropping Industry



Bulletin #5

## Why are Greenhouse Gas Emissions Important?

Over the last century, modern industry and lifestyles have rapidly increased greenhouse gas (GHG) concentrations in the Earth's atmosphere. Scientists studying this issue have concluded that these increasing concentrations are contributing to Climate Change. Climate Change is direct result of severe weather events, more forest fires, and reduced availability of quality water resources.

Canada and roughly 180 other countries adopted an international agreement in 1997 called the Kyoto Protocol which committed them to reduce GHG emissions that contribute to climate change. Recent negotiations for global GHG reductions occurred in 2009 in Copenhagen, Denmark. Canada pledged to take action and reduce GHG emissions to 17 percent below 2005 levels by 2020.

In order to achieve significant reductions, all GHG emitters will need to do their part. The cropping industry has a key role to play in these efforts and has the opportunity to contribute to emissions reductions in response to demands for action. By showing leadership and taking initiative, Canadian farmers can remain competitive and efficient, and may be able to capture emerging market opportunities. Following conservation practices that reduce emissions will also help producers meet other environmental objectives such as improved soil and water quality.





## Emissions from AB's Cropping Industry

It is difficult to estimate GHG emissions from cropping practices because of differences in soil moisture, soil temperature, land management practices (such as surface residue, tillage, nutrient management), cropping systems, geographic location (south vs. north, lower slope vs. upper slope) and soil properties.

The main gases emitted by the cropping industry are nitrous oxide ( $\text{NO}_2$ ) and carbon dioxide ( $\text{CO}_2$ ). The majority of  $\text{NO}_2$  emissions are from nitrogen fertilizer but  $\text{NO}_2$  is also emitted from manure, soil nitrogen (especially in fallow years), legumes, plant residues and compost.  $\text{CO}_2$  emissions from Alberta's cropping industry result primarily from decomposition of soil organic matter (carbon) and the burning of fossil fuels. Additionally, methane ( $\text{CH}_4$ ) is emitted from the handling, storage and application of manure.

## Reducing Emissions - Cropping Industry

Emissions from the cropping industry can be reduced through the use of beneficial management practices (BMPs) for fertilizer use, cropping cover and rotation.  $\text{CO}_2$  emissions from agricultural soils have in fact declined in both Alberta and Canada due to the increase in no-tillage acres and reduced summer fallow acres.  $\text{CO}_2$  emissions are expected to continue declining due to an increase in conservation farming management practices, leading to both improved soil quality and a reduction of  $\text{CO}_2$  emissions.

Alberta's cropping industry is in a unique position because of its ability to 'capture' atmospheric carbon in growing crops and then store a portion of that carbon in soil organic matter. Through photosynthesis,  $\text{CO}_2$  is removed from the atmosphere by plants and stored in the soil, through roots and residue input. This process is known as carbon sequestration or carbon storage. Agricultural soils can be a source (emitting  $\text{CO}_2$ ) or a sink (storing  $\text{CO}_2$ ) of carbon, depending on the management of that soil. As the Canadian Prairies occupy over 54 million acres

of Canada's farmland, agriculture can make a significant contribution to the reduction of Canada's GHG emissions.

Generally speaking, management practices that lead to increased yields will also increase carbon storage in soil. Therefore, continued use of current recommended practices such as no till, minimum till reduced summer fallow and proper straw management is preferable. Enhancing carbon storage in agricultural soils can also improve soil and water quality, decrease nutrient loss and soil erosion, and increase water conservation and crop production.

Recently, the Government of Alberta passed legislation that created a market for agriculture producers to sell carbon. Although Alberta is the first province in Canada to do so, other provincial governments and the federal government have indicated that they are developing offset systems that will be complimentary to Alberta's.

Many of the nutrient management BMPs can reduce GHGs associated with cropping. For more information, please see *Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta*.





## Nutrient Management

The production and transportation of commercial fertilizer are energy-intensive and as a result are associated with GHG emissions. Organic fertilizers including manure can also be significant sources of GHGs. Fertilizer applied to fields in excess of plant needs is also associated with GHGs, particularly N<sub>2</sub>O and CH<sub>4</sub>. Producing high yields from less fertilizer is therefore a desirable way to reduce input costs, GHG emissions, and other negative environmental impacts.

Nutrient management planning can have a significant effect on GHG emissions resulting from the application of organic and commercial fertilizers.

- Matching fertilizer applications to plant needs is crucial. Soil testing provides an inventory of nutrients available to plants and should be the basis for the application of additional nutrients.
- The rate of fertilizer application will be determined by soil test results, crop requirements, fertilizer nutrient content, and yield goals. Organic fertilizer should be tested to determine the appropriate quantity required for application.
- Application timing is also important. Fertilizer should be applied just prior to the time of maximum uptake by the crop. Apply nitrogen fertilizer in spring just before or during seeding, and where possible avoid application in late summer, fall or winter.
- The application method can also affect nutrient use efficiency. Manure should be incorporated (solid) or injected (liquid) and commercial fertilizer should be banded to the side of the seed row rather than broadcasted.
- Other strategies to reduce GHG emissions from fertilizer include the use of proper crop rotations (legume-cereals), improved fertilizer formulations such as coated nitrogen fertilizers, site-specific nutrient application to improve fertilizer use efficiency, split applications of nitrogen, appropriate fertilizer placement, and reduced tillage intensity.

## Cropping Practices

Crop Rotation – regularly alternating the sequence and type of the crops grown can increase the level of soil organic matter, help reduce disease, insects, pests and weeds, and can lower production risk by diversifying operations. For instance, weed control can be improved by alternating long-season crops with short-season crops and applying pre-seeding and in-crop herbicides earlier or later in spring.

Continuous Cropping – growing crops every year with no fallow (unplanted) years can reduce the loss of soil carbon and associated GHG emissions.

Reduced Tillage – no-till or zero tillage is the most extreme reduced-tillage system and involves the complete elimination of tillage other than for seeding. Direct seeding is minimal tillage with exceptions for seeding, weeding, harrowing to address soil crusting and excessive crop residue, and fall-fertilizer injection. Reduced tillage lowers CO<sub>2</sub> emitted from soil due to soil disturbance as well as from the amount of fossil fuels used for farm operations. Reduced soil disturbance also improves moisture-holding capacity, maintains standing stubble to trap snow, reduces the establishment of weed seeds, and may improve yield and fertilizer-use efficiency. Both reduced-tillage systems also involve leaving crop residue on the field to prevent erosion and conserve moisture.

Cover Cropping – reduced tillage and direct seeding are often sufficient to control wind and water erosion however, cover crops may be used for additional soil protection. Cover crops are typically planted later in the growing season after crops that leave minimal residue. They are normally inexpensive to seed, killed by freezing over the winter and competitive with weeds in the fall but not with the following crop. Cover crops can improve carbon sequestration by enhancing soil structure and adding organic matter to the soil.

Crop Residue Management – the elimination of residue burning and increased use of methods like chipping, composting, chopping or cultivating to manage leftover plant materials on fields will reduce CO<sub>2</sub> emissions.



Retaining crop residue can also have other benefits like reduced soil erosion, improved water efficiency (increased snow catch and water infiltration, and reduced evaporation), increased carbon concentration (organic matter) in topsoil, improved soil structure and plant-nutrient cycling, and reduction of some weed species.

Other practices that reduce CO<sub>2</sub> emissions and increase soil carbon include field shelterbelts, rotational grazing, and perennial forage crops. These practices can also be used to conserve soil moisture, improve yield potential, reduce erosion and reduce fuel costs. Using higher yielding crops or varieties and maximizing nutrient application can also increase soil carbon.

For more information contact Agriculture and Rural Development directly at (780) 310-FARM (3276) or Toll Free at 1 (866) 882-7677.

This document last updated: January, 2011

## Summary

All industries, including the cropping industry, will need to reduce GHG emissions. Increased adoption of BMPs for cropping and nutrient management could help to significantly reduce the cropping industry's emissions and contribute to efforts to slow global warming. Adoption of BMPs may also have other environmental benefits, such as soil and water conservation, and may improve producers' production efficiencies. Additionally, there may be opportunities to sell carbon-sequestration credits in the expanding carbon market.

## Sources

- Agriculture and Agri-Food Canada. 2008. Better Farming Better Air; A scientific analysis of farming practice and greenhouse gases in Canada. <http://publications.gc.ca/site/eng/327611/publication.html>
- Alberta Agriculture and Rural Development. 2004. Beneficial Management Practices: Environmental Manual for Crop Producers in Alberta. [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex9330](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9330)