Greenhouse Gas Emissions
Alberta's Cropping Industry

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Greenhouse Gases - Things You Need To Know

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. The majority of scientists studying this issue believe that these increasing concentrations are contributing to global warming. Rapid global warming could result in such problems as more severe weather events, more forest fires, and damage to water resources.

Canada has committed to reduce the nation's GHG emissions to 6% below 1990 levels by 2008 to 2012. Canada's emissions have continued to grow since 1990, making our target more distant. The national and provincial processes to address Canada's commitment have indicated that all sectors of industry will be involved in reducing emissions. In addition, recent surveys show the majority of consumers in Canada and abroad believe action has to be taken now on GHG emissions.

The cropping industry also has an immediate economic stake in reducing its emissions because these emissions represent a loss of costly nutrients and other inputs. Following conservation practices that reduce emissions will also help producers meet other environmental objectives such as improved soil and water quality.

Emissions From Alberta's Cropping Industry

It is difficult to estimate GHG emissions from cropping practices because of differences in: soil moisture, soil temperature, land management practices (e.g. surface residue, tillage, nutrient management), cropping systems, geographic location (e.g. south vs north, lower slope vs. upper slope) and soil properties. This makes it difficult to estimate total GHG emissions for the sector.

Photo courtesy of Ducks Unlimited Camrose, Alberta

The main gases emitted by the cropping industry are nitrous oxide (N_2O) and carbon dioxide (CO_2). The majority of N_2O emissions are from nitrogen fertilizer, with 42% of Alberta's total agricultural emissions resulting from the use of nitrogen fertilizer in crop production. Nitrous oxide is also emitted from manure, soil nitrogen (especially in fallow years), legumes, plant residues and compost. Current methods used to estimate national N_2O emissions from agricultural soils are about plus or minus 40% accurate.

Whatever form of nitrogen added to or existing in soil, it is susceptible to N_2O loss through a process called denitrification. This is the conversion or reduction of nitrate (NO_3^-) to N_2O and dinitrogen gas (N_2) in waterlogged conditions.

The loss of N_2O represents a loss of costly nitrogen inputs; therefore it makes environmental and economic sense for

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producers to increase their nitrogen use efficiency. If Alberta producers implement N_2O emission reduction strategies, the amount of gaseous nitrogen losses can easily be reduced by 10 to 20%. Utilizing all of the tools available can cut emissions in the future.

Carbon dioxide emissions from agricultural soils have declined in both Alberta and Canada due to the increase in no-tillage acres and reduced summer fallow acres. Carbon dioxide emissions are expected to continue to decline due to an increase in conservation farming management practices, leading to improved soil quality and reduction of CO_2 emissions.

Reducing Emissions from Fertilizers

By using a number of currently available management practices and technologies, nitrogen use efficiency can be improved and reduce the amount of N_2O emissions. Matching fertilizer applications to plant needs is important. Optimizing timing of nitrogen application is key with the goal of applying nitrogen just prior to the time of maximum uptake by the crop.

If soil conditions are conducive to N_2O loss, changing from fall nitrogen application to a spring application will reduce N_2O emissions in Alberta cropping systems between 30 and 50%. Changing application methods from broadcasting to banding will reduce N_2O emissions up to 20%. Applying anhydrous ammonia in the fall leads to relatively high N_2O emissions in the spring. This particular practice could be switched to spring applications for reduced potential losses of N_2O.

Promoting balanced nutrient fertilization, where nutrient additions match removals, is also important. For example, Alberta Agriculture research results indicated that farmers using either sulphur or copper fertilizer in soils deficient in these nutrients increased crop yields and improved crop nitrogen uptake efficiency. Therefore, the risk of nitrogen loss from the system is reduced.

Other strategies to further reduce losses of N_2O may include the use of proper crop rotations, 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.

Reducing Emissions from Cropping Practices

Carbon dioxide emissions from Alberta's cropping industry result primarily from decomposition of soil organic matter (carbon) and the burning of fossil fuels. Using management practices that slow the rate of decomposition of organic matter (such as reduced tillage), CO_2 emissions will be reduced and soil quality improved.

Increasing the acreage of minimum tillage reduces CO_2 emissions from soil. It is estimated that changing from conventional tillage to minimum tillage increases carbon sequestration in soil between 0.08 and 0.54 tonnes per hectare per year. Reduced tillage systems, which lower fuel usage and costs, also reduces CO_2 emissions.

Reducing the number of fallow years reduces CO_2 emissions by approximately 0.17 tonnes CO_2 per hectare per year. Proper residue management, including the elimination of residue burning, also results in reduced CO_2 emissions.

Opportunity For Cropping Industry To Increase Soil Carbon

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, 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 CO_2) or a sink (storing CO_2) of carbon, depending on the management of that soil.

Broadly speaking, any management practice that leads to yield increases will increase carbon storage in soil. Future actions should therefore include continued use of current recommended practices such as minimum tillage, reduced summer fallow and proper straw management.

Conservation farming practices, such as direct seeding to conserve moisture, that improve yield potential, reduce erosion and reduce fuel costs, also increase soil carbon. Other practices that reduce CO_2 emissions and increase soil carbon include field shelterbelts, rotational grazing, perennial forage crops and reduced tillage. Using higher yielding crops or varieties and maximizing nutrient application can also increase soil carbon. Improving water management through reduced tillage, residue management or irrigation improves crop growth and increases soil carbon.

Opportunities For Nitrous Oxide Reduction

Nitrous oxide has a global warming potential approximately 310 times higher than CO_2, over a period of 100 years. The key to reducing N_2O emissions from the cropping industry is to continue recommended nitrogen fertilizer management strategies in Alberta such as spring banding. Simultaneously, more research and extension should be done on proper crop rotations (legume-cereals) to reduce nitrogen fertilizer input, precision farming to manage variation of soil fertility, and use of slow release fertilizers in areas where N_2O loss is high. Manure application should be based on crop requirement and kept away from the recharge area of a water shed.

Summary

Governments and consumers are expecting all industries, including the cropping industry, to reduce GHG emissions. Increased adoption of conservation farming practices, best management practices and improved fertilizer use could significantly reduce the cropping industry's emissions. As well, promising methods to reduce emissions could be developed through more research. Reducing emissions can improve the industry's production efficiencies, conserve soil and water resources, and contribute to efforts to slow global warming.

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