Beneficial Crop Management Practices to Mitigate Greenhouse Gases

Crop production is an integral part of dairy farming as it provides feed for animals and an avenue for manure disposal. Crop production is a major source of greenhouse gas emission, mostly in the form of nitrous oxide (N_2O) gas emitted from soils. Nitrogen inputs used in crop production are the major contributors of agricultural N_2O emissions. Production of N_2O in soils mainly occurs due to two microbial processes: nitrification and denitrification and are regulated by several soil factors. The Dairy Livestock and Crop Systems Project identified several beneficial soil and crop management practices with large potential to reduce GHG emissions.

Spring manure application is one of the promising management practices to mitigate GHG emissions. Compared to fall manure application, spring manure application reduces up to 10% of total N_2O emissions from cropping systems. Fall application of nitrogen results in high available nitrogen at the time of winter and spring thaws. This in turn can result in nitrogen loss through leaching and enhanced N_2O emissions. In contrast, when nitrogen is applied in the spring soil conditions tend to be less favourable for leaching and N_2O production. Nitrogen leaching can result in indirect N_2O emissions due to processes that take place in groundwater or surface water but are linked to field practices.

Reducing tillage in the Prairies has potential to reduce GHG emissions. Studies conducted in Prairies reported lower N_2O emissions from no-till plots compared to conventional tillage. No-till also reduces GHG emissions from western Canadian croplands by increased storage of soil carbon. Reduced tillage also provides the system with other benefits such as improving soil quality, promoting biodiversity in and around soil, reducing soil erosion and avoiding soil compaction.

Optimizing nitrogen application based on soil test and yield target has the potential to reduce N_2O emissions by about 10%. Yield target helps determine the crop nitrogen requirement and soil tests give a better understanding of soil available nitrogen for plant growth. Estimating the nitrogen fertilizer requirement using yield target and soil test results help add the right amount of nitrogen for plant growth and yield expectations.

Increasing the proportion of perennials in rotation, in sub-humid soils demonstrated 2 times larger carbon sequestration compared to annual cropping with the same nitrogen input. Though annual crops have higher carbon sequestration rates during the growing seasons, the total sequestered carbon over a year is higher with perennials due to their longer growing season. Also, compared to annuals, the extensive root mass of perennial crops, particularly in deep soils, help store more soil organic matter in deeper depths.

Some variation in greenhouse gas emissions from soil and cropping systems from year to year will be unavoidable, but there are clear benefits of soil testing to match crop nutrient needs to inputs; implementing reduced tillage systems; and increasing perennial use in crop rotations; and potentially spring manure application.

This project is funded by Agriculture and Agri-Food Canada under the Agricultural Greenhouse Gases Program.

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada