



Glyphosate enables carbon sequestration

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The use of glyphosate and the introduction of glyphosate-tolerant crops spurred the development of no-till farming practices and the reduction in summerfallow. On a 2,470 acre (1000 ha) farm, the net increase in carbon sequestration due to these farming practices was equivalent to the emissions of 432 cars.

Over the last 30+ years, Prairie farmers have moved away from a cropping system that used intensive tillage and summerfallow to control weeds to a no-till system that reduced fuel consumption and greenhouse gas emissions, and improved soil quality. This has resulted in a net increase in carbon sequestration in agricultural Prairie soils.

A multi-year, Canadian Prairie-wide farm survey was set up to examine the relationship between genetically-modified, herbicide-tolerant crop adoption, glyphosate use, and the soil carbon sequestration due to changes in Saskatchewan crop farmers land management practices over the past 30 years.

An online survey of Saskatchewan crop farmers was conducted between November 2020 and April 2021. The survey covered two time periods, 1991–1994 and 2016–2019, to determine how their practices changed over the past 25 years. The survey covered all aspects of crop production from seeding to harvest including crop inputs such as chemicals and fertilizer, and equipment use. It also

asked farmers how herbicide-tolerant crops, GM crops, and glyphosate facilitated the adoption of conservation tillage and reduced summerfallow.

Carbon sequestration was estimated with a carbon accounting framework incorporating coefficients derived from the Century Model.

Farming practices would change without glyphosate

The survey found that farmers felt that glyphosate was the greatest reason they were able to reduce tillage and summerfallow, rated at 9 on a scale of 1-10, followed by herbicide-tolerant canola at 7.3.

Currently, herbicide-tolerant canola is grown on virtually all canola acres in western Canada. If herbicide-tolerant crops were removed from the market, farmers said 23% of their land would have to go back to summerfallow compared to 1% that is currently in summerfallow. In the absence of herbicide-tolerant crops, the survey found that the most common changes in farming practices would be a change in chemical use (30%), a decrease in yield and profitability (28%), a change in crop rotation (21%), an increase in tillage (20%), and reversion to summerfallow (11%).

Going further, if glyphosate use was discontinued in Saskatchewan, farmers reported having to increase tillage (54%), incur a decrease in yield and profitability (37%), change chemical use (23%), and revert to summerfallow (14%). Four percent said that they would not continue farming without glyphosate.

From net emitter to net sequesterer

From 1991-1994, the annual net change in soil organic carbon (SOC) from tillage was estimated at -0.02 Mg/ha/year. This accounted for a net change in SOC from tillage at -278,624 Mg/year on the 15.2 million Saskatchewan cropped acres, indicating that soils released more C from tillage than was sequestered. Annual net SOC gains from the removal of summerfallow from 1991-1994, was +0.03 Mg/ha/year, indicating a slight reduction in summerfallow acres during that time period.

By reducing tillage practices in the time period 2016-2019, annual net change in SOC was +0.12 Mg/ha/year. The annual net change in SOC from eliminating summerfallow was +0.42 Mg/ha/year, indicating that carbon was being sequestered in the soil.

Extrapolating those results to a 2,470 acre (1000) hectare farm, and to the province of Saskatchewan, the annual change in SOC for Saskatchewan from a decrease in tillage was +1,806,192 Mg/year, and an additional +6,402,075 Mg/year for a reduction in summerfallow practices.

Net SOC gains (Mg/year) from changes in tillage and summerfallow practices

	From Tillage Practices		From Summerfallow Practices	
	1991–1994	2016–2019	1991–1994	2016–2019
1000 Ha Farm	–18.3	119	33.4	421
Total Hectares in Survey Sample (9403 ha)	–172.3	1117	314	3960
Total Saskatchewan Crop Production (15.2 million ha)	–278,624	1,806,192	507,089	6,402,075

Source: Sutherland et al. 2021

The researchers put this in context by comparing emissions for an average Canadian vehicle to annual SOC gains from the reduction of tillage and summerfallow. The average Canadian vehicle emits about 1.25 Mg C annually. In the 1991–1994 time period, tillage practices on a 1000 ha farm released 15 times more C than the average car. By 2016–2019, the reduction of tillage sequestered the equivalent amount from 95 cars. Similarly, the reduction in tilled summerfallow in the 2016–2019 time period stored the equivalent emissions from 337 cars annually.

The survey results show how changes in farming practices that include genetically-modified, herbicide-tolerant crops and glyphosate have driven a significant increase in soil carbon sequestration. While the analysis did not measure total net emissions from dryland crop production, it highlights the important part that these farming practices play in including net C sinks in overall emission calculations.

The results also show how crucial glyphosate is to sustainable crop production, and how banning glyphosate use and herbicide-tolerant crops, as some countries are moving forward with, will impact agricultural sustainability.

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