

Viewpoint: Climate change-fighting agricultural tools are delivering enormous benefits — but anti-biotechnology activists continue to vilify them

Following the recent COP26 séance in Glasgow, climate change issues remain prominent for governments and the public. Agricultural practices have been identified as a significant source of greenhouse gases, and policy discussions have been underway to address concerns about the way that we grow the food we eat. Often, those issues have been viewed through a “sustainability” lens.

It's true that agriculture releases significant amounts of CO₂, but they can be modulated. A recent [article](#) in the journal *Sustainability* found that over the past 30 years, the province of Saskatchewan, Canada has managed to turn net carbon emissions into carbon sequestration. This signal achievement is attributable to two modalities: the cultivation of genetically engineered (GE) herbicide-resistant crops and the use of glyphosate, a widely used, highly effective herbicide. The authors concluded that nations that restrict the cultivation of similar land management systems that grow GE crops are losing an opportunity to contribute to agricultural sustainability.

Let us explain.

By transferring CO₂ from the atmosphere into organic carbon in the soil via the photosynthesis carried out by plants, carbon sequestration plays a role in reducing greenhouse gas (GHG) emissions. The degree of sequestration is highly dependent on the agricultural techniques employed. Before herbicide-tolerant GE crops were commercially available, most farms used tillage, the mechanical overturning of soil, to eliminate weeds from their fields. This gives rise to GHGs in two ways: It requires fossil fuels for the tractors that till the fields, and tilling the soil itself results in [the release of greenhouse gases](#). Although tillage is effective as a form of weed control, the less of it performed, the less carbon released from the soil, so it is desirable to keep tillage to a minimum, and that's where herbicide-tolerant crops come in: Cultivated fields can be treated with herbicides that kill the weeds but spare the crops.

Follow the latest news and policy debates on sustainable agriculture, biomedicine, and other ‘disruptive’ innovations. Subscribe to our newsletter.

[SIGN UP](#)

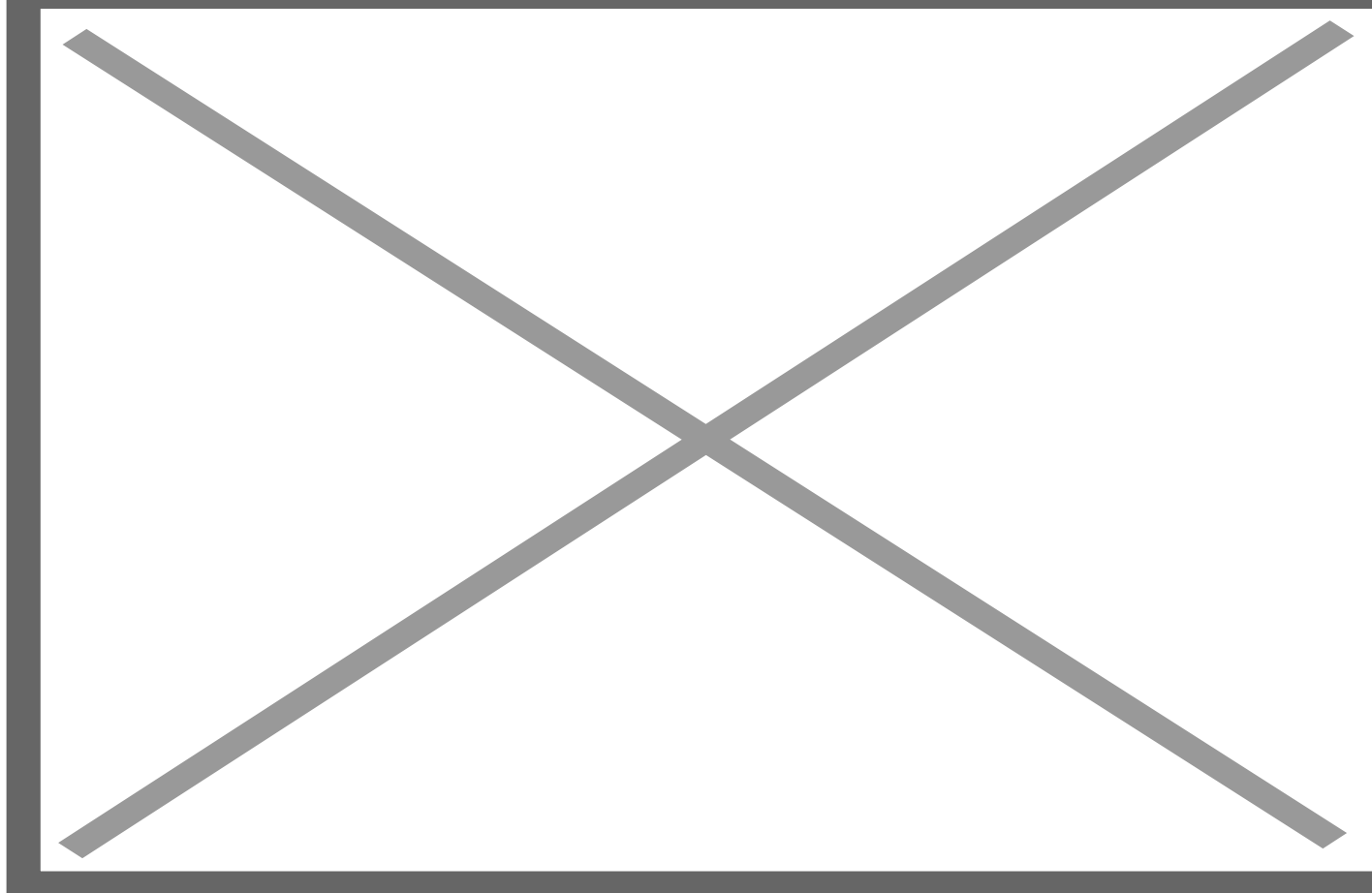
Across the Canadian prairies, farmers have over the years gradually shifted away from weed management practices such as fallowing land (that is, periodically leaving it uncultivated) and tillage. Using farm management practices that incorporate GE crops and killing weeds with safe herbicides such as glyphosate has reduced fossil fuel consumption by reducing the use of tractors to work the land. It was known previously that reduction of soil disturbance from tillage would also reduce greenhouse gas emissions, but the extent to which carbon sequestration and storage in untilled soil occurred had not previously been thoroughly investigated.

The study by Professor Stuart Smyth and his colleagues at the University of Saskatchewan cited above, which was conducted in the province of Saskatchewan, Canada, demonstrated yet another facet of

glyphosate's utility. It confirmed that "the correlation between genetically modified, herbicide-tolerant crops and glyphosate use is a driver of the increased soil carbon sequestration," and that, thereby, "[t]he removal of tillage and adoption of minimal soil disturbances has reduced the amount of carbon released from tillage and increased the sequestration of carbon through continuous crop production."

The study quantified "the transition from farmland being a net carbon emitter to being a net carbon sequesterer over the past 30 years," a hugely important result for policymakers devising strategies to reduce GHGs. It found that farming practices such as using GE crops and benign but effective herbicides such as glyphosate can offset a significant fraction of greenhouse gas emissions from agriculture and other commercial sectors. These technologies have been well received: Farmers perceive them as critical to their success in terms of both sequestering carbon as well as generating improved yields. The authors conclude that without glyphosate and herbicide-tolerant GE crops, there could be a significant decrease of carbon sequestration in Saskatchewan's soils due to increased tillage.

Image not found or type unknown



Credit: Natural England

The Smyth *et al* study shows that based on the carbon sequestration taking place in Saskatchewan alone, over the past quarter century, Canada has reduced emissions by 13% — 2% through reducing tillage, and another 11% by reducing summerfallow practices. For the average 1,000-hectare farm, this amount of

carbon sequestration represents an equivalent of removing 432 cars from the road per year. This is a helpful boost to Canada's attempts to reduce emissions 30% below 2005 levels by 2030.

Saskatchewan's experience has implications for other countries, particularly those where the growing of GM crops is prohibited. Without addressing their own greenhouse gas emissions from agriculture, many of them will find it difficult to achieve the goals set out by the Climate Summit. It appears that they have created unnecessary obstacles to achieving net zero carbon, not the least of which is antagonism toward, or even a ban on glyphosate, which acts by blocking an important step in plant but not animal metabolism, and has been judged by every national regulatory agency that has evaluated it to be safe for use. With a short half-life, it can be readily applied to fields with crops modified to tolerate the herbicide and can control weeds, improving crop yield. After hundreds of toxicity studies, glyphosate has been shown to be an order of magnitude less toxic than caffeine and even less toxic than table salt. In fact, glyphosate was recently shown to have [a lower chronic toxicity than more than 100 other herbicides on the market](#), which suggests that banning it would increase the risk of illness (including cancer) due to exposure to the use of more-toxic herbicides.

And yet, in spite of its benefits, the [vilification of this benign herbicide has been intense](#). Its primary manufacturer Monsanto/Bayer has for years been the target of a series of lawsuits, due in part to its "probably carcinogenic" classification by the International Agency for Research on Cancer (IARC), a component of the UN's World Health Organization. This conclusion resulted from the organization evaluating *hazard* (the possibility of harm under any circumstances) instead of *risk* (the probability of harm under conditions of use) but was, in any case, fraudulent. As the distinguished cancer epidemiologist Geoffrey Kabat [wrote](#) in an article called "Glyphosate-gate Scandal":

This ruling caused consternation in the scientific and agricultural communities. Glyphosate, which is manufactured by Monsanto and is the active ingredient in the company's popular product Roundup, is one of the most widely-used herbicides worldwide. It is cheap, effective, and has low toxicity. IARC's ruling is contrary to the assessment of every other agency that has evaluated the compound, including the U.S. Environmental Protection Agency, the European Food Safety Authority, and the World Health Organization, of which IARC is a part.

This complicated story offers an important overarching lesson: Technologies such as state-of-the-art genetic engineering and agricultural chemicals are important to achieving not only agronomic objectives but also environmental ones. In particular, if countries around the world wish to reduce their agricultural carbon footprint, they are essential.

Kathleen Hefferon, Ph.D., teaches microbiology at Cornell University. Find Kathleen on Twitter [@KHefferon](#)

Henry Miller, a physician and molecular biologist, is a senior fellow at the Pacific Research Institute. He was a Research Associate at the NIH and the founding director of the FDA's Office of Biotechnology. Find Henry on Twitter [@henryimiller](#)