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Crop biotechnology contributes to climate change mitigation

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This literature analysis concludes that GM crops provide benefits that contribute to climate change mitigation and adaptation. The analysis also shows that innovative crop biotechnology products are capable of making important sustainability contributions, including to reduce GHG emissions, increase carbon sequestration, improve food security, and mitigate climate change.

Researchers have considered the impact of genetically modified (GM) crop technologies on the economic and ecological footprint of farming since they were first commercialized in the mid-1990s. Peer-reviewed research over almost 25 years shows that commercial GM crops in adopting countries have contributed to higher yields and reduced chemical inputs. The result is that GM crops produced higher global farm incomes and have delivered substantial environmental benefits through changes in management practices and reductions in chemical use.

The objective of this research project was to assess how strong the linkages are between GM crop technologies and climate change mitigation. This helps regulators, scientists, and risk assessment experts make decisions about contributions of GM crop technologies to mitigating and adapting to climate change and achieving the United Nations Sustainable Development Goals (SDGs).

The project used a standardized evaluation methodology to provide a detailed and structured review of the literature. Although there are a range of agricultural technologies and products that contribute to climate change mitigation, this project focused specifically on the linkages between crop biotechnology and climate change mitigation both internationally and more regionally including research in the Canadian provinces of Alberta, Manitoba and Saskatchewan. In the project, over 90 peer-reviewed articles were used to assess the impacts of agricultural biotechnology and GM crops on changes in key research areas including land conservation, carbon sequestration, chemical use and toxicity, GHG emissions, land use and soil health.

In the literature analysis, the differences in outcomes in GM regulatory regimes for crop approval, commercial adoption and the ability of countries to use these technologies as part of their climate change strategies were also reviewed. One recent assessment of the global impacts from GM crops showed that an additional 3.4% more land would have been required to produce the equivalent yields without GM crops. This study also concluded that regulatory bans on the commercialization and adoption of GM crops restricted the benefits to one-third of their full potential that could have resulted from GM crop production.

The review also showed that as of 2019, GM crop varieties compared to equivalent non-GM varieties did not show any elevated risk in all risk assessments completed in 72 countries. The ability to meet global food security, sustainability and climate change mitigation could be more challenging with limited adoption of GM crop technology.

Product-based regulatory systems superior to precaution-based systems

The analysis also showed that commercialization of GM crop varieties over the past 30 years in countries with product-based regulatory systems, such as Argentina, Australia, Brazil, Canada, and the USA, provided the efficiency, repeatability, and timeliness required to further incentive R&D investments. These countries with product-based regulatory systems will continue to attract greater levels of both R&D investments and expert scientists to work on innovative crop technologies.

However, in other markets with process-based regulatory systems, such as the European Union, a lack of trialing and evaluation has impaired full adoption and reduced R&D investment into variety development. These countries will experience a double loss in terms of both financial and human capital.

This makes the global response to climate change and international commitments to improve sustainability variable and challenging across jurisdictions. Countries with regulatory systems that can respond to the evidence of technologies that contribute to sustainability and benefit from using new innovative gene-edited crop varieties as they are commercialized will be able to reduce GHG emissions, increase carbon sequestration, improve food security, and mitigate climate change.

Those countries with precaution-based regulatory systems that have so far rejected or seriously impeded the full commercialization of GM crops will not realize the benefits and will be contributing to greater food insecurity, the continuation of unsustainable agricultural practices, higher GHG emission levels and reduced carbon sequestration. Regulators may need to shift their precaution-based regulatory evaluation system reviews to respond to evidence of technologies that do contribute to sustainability to meet climate change mitigation and Sustainable Development Goals.

Overall, the analysis concludes that GM crops provide benefits that contribute to climate change mitigation and adaptation. From a GM crops technology perspective, the review shows that innovative products are capable of making important sustainability contributions, including to reduce GHG emissions, increase carbon sequestration, improve food security, and mitigate climate change. Innovation in agriculture technologies and crop biotechnology, along with effective regulations are key to ensuring yields and nutrition are maintained under climate change and mitigation efforts.

In the future, more research is needed to fully understand the complex interactions between variable cropping systems, local and global ecosystems and climate, as well as economic and social systems. Greater collaboration among various disciplines including economists, plant and soil scientists, climatologists and other social scientists may be required to bring differing measurement and modeling together to fully assess impacts.

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