NSCEB
National Security Commission on Emerging Biotechnology

Building the Future with Biotech

How Biotech is Shaping the Agricultural Landscape

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Farmers have been changing plants and animals for over 10,000 years, selecting those with desired traits to breed the next generation. Around the same time, people began using microorganisms to process foods. These early forms of agricultural biotechnology resulted in improved crops and livestock and in products like yogurt, bread, and beer.[1]

Today, scientists are using modern biotechnology tools, like gene editing, to make precise genetic changes and more quickly develop plants, animals, and microbes with desired traits. The responsible application of emerging biotechnology can increase resiliency and sustainability in agriculture, and further progress will require a collaborative approach involving scientists, policymakers, and the public. This paper explores three examples that represent the broader benefits of leveraging emerging biotechnology in agriculture. The National Security Commission on Emerging Biotechnology is currently developing policy recommendations that will lower barriers to entry for products like these, and potentially allow more researchers to leverage biotechnology for agricultural applications that can support U.S. farmers and increase food security.

Photo by Terry Isbell, USDA ARS

Improved cover crops for fuel and feed: A cover crop is planted between growing seasons to help reduce erosion, among other advantages. Cover crops typically do not generate income for farmers, so adoption remains relatively low. Scientists are using gene editing and breeding to adapt a weedy plant called pennycress into an effective cover crop that produces valuable oil for renewable fuel and protein for animal feed. Farmers could grow this new cover crop between other crop seasons, providing economic benefits and supporting resilient supply chains.[2]

Photo by T.A. Olson, USDA ARS

Helping cattle to better tolerate heat: At temperatures above 80°F, cattle can become heat stressed, leading to decreased production of meat and milk. Scientists have turned to gene editing to develop cattle that are better able to regulate their body temperature during hot conditions. These cattle have shorter hair and metabolic changes that help them stay cooler and maintain high-quality meat and milk production.[3] Gene editing is also being used to develop livestock with improved disease resistance and reduced environmental impacts, among other benefits.[4]

Photo by Peggy Greb, USDA ARS

Reducing the need for fertilizer: Nitrogen fertilizers are used to boost crop yields and reduce the amount of land needed to produce food, feed, fuel, and fiber. However, fertilizer can be costly, is susceptible to supply chain disruptions, and can contribute to nutrient runoff.[5] Scientists are using genome editing to change genes within certain soil microorganisms to enhance their ability to take nitrogen directly from the air and make that nitrogen available to crops. These microbes can help reduce nitrogen losses, improve yields, and increase farmers' profits.[6]

Sources

1 Mannaa et al. "Evolution of Food Fermentation Processes"
2 Winthrop et al. "From Farm to Flight"
3 Sosa et al. "Effects of the SLICK1 Mutation in PRLR"
4 Wray-Cahen et al. "Advancing Genome Editing"
5 Department of Agriculture. "Global Fertilizer Market Challenged"
6 Bloch et al. "Harnessing Atmospheric Nitrogen"

For any questions about this white paper, or related work at the National Security Commission on Emerging Biotechnology, please contact us at ideas@biotech.senate.gov. Staff at the National Security Commission on Emerging Biotechnology authored this paper with input from the expert Commissioners. The content and recommendations of this white paper do not necessarily represent positions officially adopted by the Commission.