Will CRISPR's promise force the organic industry to reconsider its opposition to gene-edited crops?

Opposition to genetically modified (GM) crops advanced by organic activist groups (and official organizations like the US National Organic Standards Board (NOSB) or the EU's European Court of Justice) is based on the claim that recombinant DNA technology introduces genes from one species into another. That's not natural, these critics contend.

By this definition, though, gene-editing techniques like CRISPR/Cas9 are natural: They're part of the immune system in many species of bacteria. Scientists are now using these tools to make specific changes (or edits) to the DNA of food crops and animals to boost their nutritional content or protect them from disease, without adding "foreign" genes to their genomes.

Therefore, CRISPR-enhanced plants and animals could be utilized by organic growers and ranchers, right? So far, the answer is no—but some dissension in the ranks is starting to appear. While the organic industry generally remains opposed to all forms of genetic engineering, the sustainability benefits of gene-editing techniques like CRISPR have convinced several high-profile organic farmers to come out in support of the technology. Their opposition to the prevailing wisdom espoused by the NOSB suggests that organic agriculture could slowly begin to abandon its hard-line prohibition on biotechnology.

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'Not needed or wanted in organic agriculture'

When CRISPR-Cas9 was introduced as a faster, easier way to edit genetic sequences (other techniques like TALENS and ZFN have been around but are more cumbersome), supporters of the technique in agriculture touted it as a way around organic farming's rules about "foreign-ness." And many NGOs took a "let's take a closer look" approach, not immediately condemning the technique.

However, things changed after the US Department of Agriculture (USDA) in 2018 declared that:

> USDA does not regulate or have any plans to regulate plants that could otherwise have been developed through traditional breeding techniques as long as they are not plant pests or developed using plant pests. This includes a set of new techniques that are increasingly being used by plant breeders to produce new plant varieties that are indistinguishable from those developed through traditional breeding methods. The newest of these methods, such as genome editing, expand traditional plant breeding tools because they can introduce new plant traits more quickly and precisely, potentially saving years or even decades in bringing needed new varieties to farmers.

Earlier this year, USDA Under Secretary of Agriculture Greg Ibach testified on Capitol Hill that organic growers could benefit from this development as well:

> I think there is the opportunity to open the discussion to consider whether it is appropriate for some of these new technologies, that include gene editing, to be eligible to be used to enhance organic production.

These two statements didn't sit well with pro-organic groups. The Cornucopia Institute, a Wisconsin-based organic advocacy outfit, has been organizing a petition drive among similar groups in opposition to allowing any type of genetic modification in food. On its website, the Institute stated:

> …organic seed promotes biodiversity, democratizes collective resources, celebrates seed quality over quantity, and preserves agrarian tradition. GMO seeds are not needed or wanted in organic agriculture. In a 2017 survey conducted by Natural Grocers, 70% of respondents said they buy organic to avoid GMOs. Although advocates of GMOs claim that these crops will help farmers respond more quickly to environmental and pest threats, it takes years of testing to ensure the crops will perform as expected.

They have some support. The Organic Consumers Association, a trade group representing thousands of organic food retailers, asked its members to sign a letter asking the National Organic Standards Board to reject "all forms of genetic engineering," and to "continually update the NOSB's definition of "excluded methods" to keep up with the new forms of genetic engineering."

The NOSB in October voted against adopting gene editing ("mutagenesis via intro methods"), and previous decisions (most recently April 2019) have specifically excluded CRISPR, ZFN, TALENS and other gene-editing technologies from the "organic" designation.

Opposition in the ranks

But the traditional arguments put forth by organic, anti-GM NGOs are falling flat among some organically inclined farmers and scientists. Klaas Martens, an organic farmer of 1,600 acres of grains and vegetables in New York (and a supplier of Dan Barber's Blue Hill restaurant and Row 7 seed company—who was the subject of a recent New York Times op-ed), told attendees of the 2018 CRISPRcon gene-editing convention that he wouldn't have a problem with using gene editing, as long as the crops mimicked naturally occurring varieties. He told the New Food Economy:

> If it's used in the same way that current products are, then I wouldn't have any interest." (comparing gene-edited crops to "Roundup-ready" crops, which are genetically spliced with plant and bacterial DNA to resist herbicides) "If it could be used in a way that enhanced the natural system, and mimicked it, then I would want to use it. But it would definitely have to be case by case.

Earlier, in 2017, Urs Niggli, director of the Research Institute of Organic Agriculture, told Greenpeace Magazine:

> New techniques are currently revolutionizing genetic research. They allow extremely precise changes to the genome…. This so-called genetic surgery changes the debate about the risks and chances of interventions in the genome.
>
> For farmers – including organic farmers – the new method offers many opportunities: plans could be bred that better adapt to difficult environmental conditions such as drought, ground wetness or salinization. The fine root architecture could be improved so that roots absorb more nutrients such as phosphorous or nitrogen from the soil. Tolerance of resistance to diseases and pests, as well as storage and quality of food and feed could also be improved.
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> Scientists believe that the small changes made by CRISPR/Cas to the plant's own genes, which are indistinguishable from a spontaneous or natural mutation, pose not risks. The situation is different when the method introduces foreign genes or when it causes entire populations … to be eradicated.

Tom Willey, an organic farmer in California, also supports the organic industry's adoption of gene editing, as part of the effort to restore biodiversity. He told University of California, Berkeley postdoctoral scholar Rebecca Mackelprang:

> I see circumstances under which it could be useful for short-cutting a process that for traditional breeding might take many plant generations.

Gene editing, then, could:

> Reach back into genomes of the wild ancestors of crop species to recapture genetic material—lost due to breeding for other traits, mainly higher yields. "In the light of the urgency posed by climate change, we might wisely employ CRISPR to accelerate such work.

While many organic advocates argue that adjusting to climate change, drought, salinity and pests can be done without GM (or synthetic chemicals), some organic farmers and industry participants obviously don't share this optimism. Currently, it costs more than $130 million and up to seven years to get a genetically engineered (or edited) crop approved for use in the United States (in Europe, it's now essentially impossible thanks to the Green party influence on the EU and EU regulators strict adherence to the "precautionary principle"). This means that small businesses and academics not attached to large universities or industrial labs are shut out. It also means a host of developed crops that could be used to handle tomorrow's challenges are waiting in the lab.

And that's a problem. CRISPR alone has resulted in the creation of a wide range of food that's more nutritious than conventionally (and organically) grown predecessors. These include soybean oil with less trans fat and and more oleic acids, a high-fiber wheat, a type of gluten-free wheat, as well as, as economist Steven Cerier wrote in a recent Genetic Literacy Project article:

> Rice, wheat, legumes and several vegetables that have up to 60% more protein than existing varieties. Significantly, the amount of protein is increased at the expense of starch and other carbohydrates, thus increasing the nutritional density of foods made from these crops.

In addition to better nutrition, CRISPR and other techniques can produce these foods with fewer inputs (fertilizer, pesticides, even just plain raw land and water) than conventional and organic foods. CRISPR and other editing techniques are being used to produce crops that are more tolerant to drought, heat, and other symptoms of climate change. Relying solely on organic techniques has not resulted in any of these innovations.

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