Organic GMOs Could Be The Future of Food — If We Let Them

Genetic modification is the essence of life, not a perversion destroying our food systems.

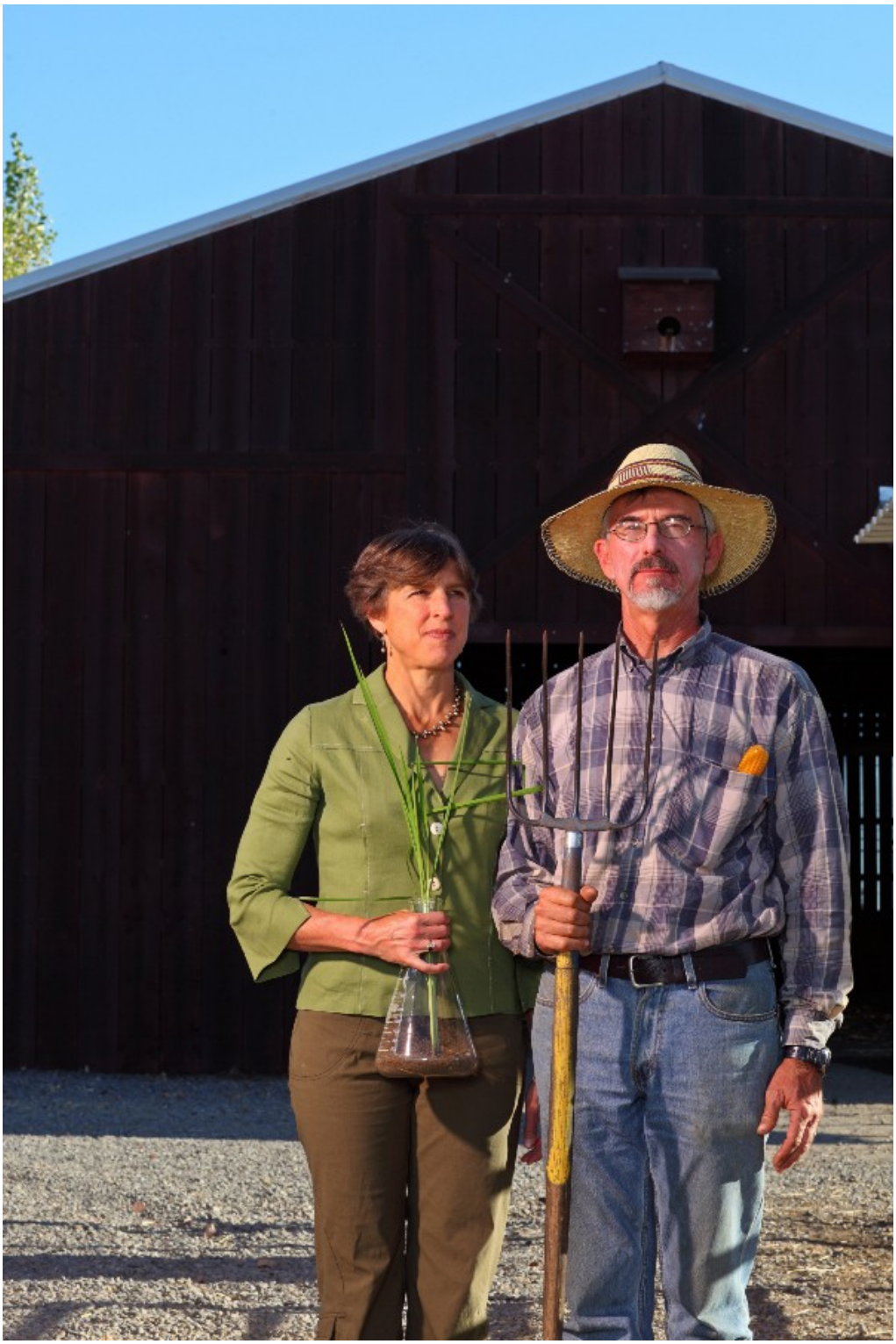
Rice plants used for genetics research by scientist Pamela Ronald.

Two years ago, I traveled to Woodland, California, to meet scientists who were developing tastier and more nutritious fruits and vegetables. On the way to the research center, my taxi driver asked what had brought me to town. "Well," I started, "I'm a journalist and I'm here to visit Monsanto." "Monsanto? They do all that unnatural GMO stuff, right?" "They do make a lot of GMOs," I replied, "but the scientists I'm visiting do not use genetic engineering." Instead, they perform marker-assisted breeding. They chip off tiny bits of seeds and young plants and analyze their genes in search of desirable traits. Then they use that information to decide which seeds to plant and, later, cross-pollinate and which ones to reject, speeding up the traditional plant breeding process. "And that's not GMO?" my driver asked. "Since they are just reading the DNA, not changing it, it's technically not a form of genetic engineering," I answered.

I was about to go on, but I caught myself. In part because I worried that I was on the verge of subjecting another human to an unexpected seminar on plant genetics. But, more fundamentally, because I realized that what I had just said was wrong. Of course the breeders at Monsanto were changing the plants' DNA. That is what breeders everywhere have done for centuries, regardless of their tools. That is what the pioneers of agriculture started doing at least 10,000 years ago. That is what sex itself does: it shakes up DNA. In that moment, I realized just how meaningless the term GMO is, and how obfuscating it is, too.

Traditional breeding changes the DNA of plants through generations of matchmaking and artificial selection in the

field. Genetic engineering directly alters plant genomes in the lab, deleting or rearranging native genes, or adding genes from different species. The staunchest and most common objection to GMOs is that the kind of genetic mixing-n-matching scientists perform in labs is unnatural and therefore wrong. Biologists now know, however, that DNA is inherently promiscuous and has traveled between species and across kingdoms since the beginning of life itself: from bacteria to plants, fungi to animals, reptiles to mammals. Given this context, genetic engineering is an extension of a process that DNA invented billion of years before humans evolved. What's more, it is a powerful tool that can help us farm responsibly and sustainably by minimizing damage to the environment and prioritizing the health of both people and animals—the precise goals of organic farming. Type the terms 'GMO' and 'organic' into Google and you'll get a barrage of links framing the two as diametrically opposed. The truth is that, when well-designed and used responsibly, the products of genetic engineering are often perfectly aligned with the goals of organic farming.



Scientist Pamela Ronald and her husband, Raoul Adamchak in Davis, California.

One testament to this compatibility is the marriage of Pamela Ronald, a plant geneticist, and Raoul Adamchak, an

organic farmer, who live and work in Davis, California. I visited the couple last fall. Ronald was in her office at UC Davis, sitting at a desk beside two computer monitors and shelves lined with trinkets from Asia—a decorative fan, a figurine with red and gold robes. As we chatted, Ronald made a pot of green tea and shared slides from a recent talk, her elastic voice leaping with excitement. She showed me a four-month time lapse of two experimental rice fields in the Philippines. At first, both grew equally well. Then the fields were completely inundated with water for 17 days, simulating the kind of flood conditions that routinely devastate rice crops in Asia. The conventionally bred rice on the right never fully recovered, whereas the field on the left immediately recuperated and thrived, yielding three times as much grain. Ronald and her colleagues at the International Rice Research Institute developed the flood-tolerant "scuba" rice using marker-assisted breeding. Last year, nearly four million farmers grew it. "That's the power of genetics," she said.

After meeting Ronald, I walked a short distance to Adamchak's certified organic farm, which is co-run by students. They grow a wide variety of fruits and vegetables —cabbage, cauliflower, kale, tomatoes, eggplants, peppers, melons, and okra—and sell them to the college dining services and a local farmers market. Adamchak, who both moves and talks at a leisurely pace, walked me through the modest seven acres, explaining the importance of crop rotation, cover crops, and biodiversity, all of which help to combat pests and weeds and return nutrients to the soil without manmade chemicals. He started to run the farm in

1996, the same year that he married Ronald. That was also one of the first years that U.S. farmers grew GMOs. Initially, Adamchak told me, no one found it odd that an organic farmer and geneticist would get hitched. But over the next four years attitudes shifted dramatically. "I started to notice that the level of animosity toward genetically engineered crops was increasing and the level of misinformation was increasing," Adamchak says. "That was one of the reasons that motivated us to write our book."

In *Tomorrow's Table: Organic Farming, Genetics, and the Future of Food*, Ronald and Adamchak argue that genetic engineering can help "develop biologically-oriented, sophisticated, and elegant approaches to address agricultural problems" and that "to maximize the benefit of GE [genetically engineered] plants, they would best be integrated into an organic farming system." Organic farming strives to keep crop yields high without ruining the environment or sacrificing the health of people and animals. To accomplish this, it shuns many of conventional farming's practices—synthetic chemicals and fertilizers, heavy tilling, monoculture—in favor of ecologically sound strategies, such as planting a high diversity of crops and rotating them frequently so pests do not have a chance to establish themselves. In sum, Adamchak writes, organic farming is "better farming through biology." And that is exactly what genetic engineering enables, too.

Bt crops, which produce highly specific toxins to kill insect pests, are a good example. Bt crops are one of the most commonly grown varieties of GMO worldwide, and they have been a major agronomic and ecological success: they

have increased yields while simultaneously reducing the use of broad-spectrum insecticides that kill benign and beneficial insects and linger on the corn and soybeans eventually mixed into processed foods. And they have helped delay the inevitable emergence of insect pest resistance for longer than their chemical spray predecessors. (Bt crops, by the way, produce the same kind of bacteria-derived toxins that organic farmers have been using for decades.) Some of these benefits have been particularly pronounced for impoverished farmers in India and China, in addition to the large-scale industrial farmers that are usually associated with GMOs.

None of this is to say that all GMOs are a panacea, or that Monsanto and the other profit-driven GMO producers value the environment and public health above all else. To the contrary, some GMOs have made it all too easy for farmers to misuse them in ways that harm the environment. Consider the other commonly farmed GMO: Roundup-Ready crops, which withstand the herbicide Roundup (glyphosate). To their credit, they have promoted the use of the relatively mild glyphosate over more toxic alternatives such as atrazine, and decreased the use of tilling, which helps prevent soil erosion. But they have also made it extremely tempting for farmers to douse weeds with huge quantities of a single herbicide, placing massive evolutionary pressure on the weeds to develop extreme resistance. In a pernicious cycle, the typical response from farmers and biotech companies is to soak resistant weeds in even more glyphosate or throw alternative chemicals into the mix as a so-called “solution.” Excessive Roundup use has also contributed to the decline of the Monarch butterfly, by

devastating native populations of the only plant its larvae eat—milkweed.

Some people see the environmental failure of Roundup-Ready crops as proof that genetic engineering is an innately detrimental technology—that it cannot help but ruin the "natural order" of things. That's a mistake. A balance of risks and benefits is not specific to genetic engineering; it will accompany any technology or strategy we use. Likewise, there is no such thing as a "natural" form of farming. All agriculture—including organic farming—is, by definition, a deliberate and dramatic modification of nature. An official U.S. Department of Agriculture (USDA) 'organic' label at the supermarket does not denote an "all-natural food." (Unless you are scavenging food from the wild, that phrase is meaningless.) Rather, such labels indicate foods grown on farms that meet the agency's standards for organic farming. When the USDA first drafted the National Organic Program standards in 1997, it permitted the use of GMOs on organic farms. In response, the organic food industry sent the USDA 200,000 angry letters, e-mails, and faxes. "At the time, the perception was that genetic engineering was not part of a natural process," Adamchak recalls. In 2000, the USDA banned GMOs from certified organic acres. Although nothing physically prevents the union of organic farming and intelligent, environmentally friendly GMOs, it is illegal.

Yet the supposed "unnaturalness" of GMOs was never a valid reason to reject them, as the recent research on gene-swapping in nature makes clearer than ever. Even when permeable species boundaries are not crossed, genomes are in flux. That is the essence of evolution, and evolution never

stops. I fully realize that the ostensible perversion of GMOs is not the only objection to them. I have written previously, for example, about the troubling consolidation of seed stock and patents at a handful of giant biotech companies. Still, the idea that GMOs are unnatural and anti-organic is the most immediate and intractable objection to them. Not only is it a major obstacle to intelligent discussion about the real risks of the technology—herbicide overuse, corporate control of the food system, the spread of GMO pollen—it also divorces GMOs from sustainable agriculture in the public's mind, when the two can and should work together.

For another perspective, I called up Mark Rasmussen, director of the Leopold Center for Sustainable Agriculture at Iowa State University, which seeks to reduce the "negative environmental and social impacts of farming." I asked him whether there is a space for GMOs in the kind of farming he promotes. "Yes and no," he said. "I think there's no uniform answer with regard to GMOs. We tend to lump them all together. Each needs to be considered on its own individual merits."

He's right. Not only does the wider GMO debate often conflate harmful and beneficial GMO crops, it also tends to ignore the true diversity of cases to consider. There are already many examples of what we might call "organic GMOs": those that promote the same values as organic farming by reducing the use of synthetic chemicals, delivering more nutrition, and even restoring ecosystems. In the late 1990s, GMO papaya saved Hawaii's entire papaya industry from viral eradication. To continue growing organic papaya, farmers planted the vulnerable trees within protective fences of the GMO variety. Researchers are creating similarly virus-resistant cassava, a staple food for millions in Africa. Others have engineered pest-immune eggplant and bananas that defeat a lethal bacterial disease —which means using fewer chemicals to fight those diseases. Genetic engineering is also the most promising way to rescue orange trees from greening disease and resurrect the once abundant American chestnut, a keystone forest species. And teams of international scientists are developing GMO rice and wheat that are much more efficient at photosynthesis and at using the nitrogen they acquire from the dirt and air, increasing yields by 50 percent and reducing the need for polluting synthetic fertilizers. "If I saw something like that come along, I would certainly pay attention to it," Rasmussen says. "It gets to the whole concept in sustainable agriculture of using biological systems to our advantage."

With each passing decade, we will have a larger and more sophisticated repertoire of genetic engineering tools. Scientists recently developed a breakthrough technique

known as CRISPR, which allows them to add, remove, and swap genes with much greater speed and precision than ever before. Chinese scientists have already used CRISPR systems to engineer wheat that is immune to a deadly fungus, which would translate to far less toxic fungicide in the field. Instead of introducing foreign DNA into wheat, they deleted a deleterious native gene, as well as its backup copies (in traditional breeding, it is exceedingly difficult to knock out all the copies at once). Meanwhile, scientists and biotech companies have been pursuing new applications of a technique known as RNA interference, which modifies crops to produce genetic snippets that protect them against insect pests and viruses. If these same genetic sequences were mixed into sprays, farmers could use them only when needed, minimizing the risk to beneficial insects.

Similar inventions are undoubtedly on their way. The question in front of us is how best to keep ourselves nourished and healthy, while also preserving the environment for those who come after us—the same challenge we have faced for so long. GMOs—whether a weedy grass transformed into plump-kerneled wheat through artificial selection, or a modern wheat altered with CRISPR—have been a critical part of our solutions right from the start. The reality is that human civilization was built on the systematic modification of other species. As a nation, we must challenge each other to accept that the central objection to GMOs depends on an imaginary perversion. To do otherwise, to brush off the GMO debate as low stakes or pander to those who want to label and restrict

something they cannot define, is to perpetuate a misunderstanding of enormous consequence.

I recently moved to Portland, Oregon, a beautiful city that I already love, but also one that is full of what some locals half-affectionately call "woo." Many people here believe in the existence of mystical energies, practice homeopathy, and take a strong stance against GMOs, even if they can't be bothered to check every menu item for their presence, or don't realize that 70 percent of processed foods contain GMO corn or soy. The other week, at a party, the conversation meandered from home-brewing to cider to recently released varieties of apples. "Of course I'm not going to try any GMOs," one of the party-goers said. "They're just not natural." The impulse to speak sat like a trapped bird in my mouth. Was I really going to say something and ruin a potential new friendship? Did it really matter that much?

I considered, and opened my mouth.

This fall, Medium is exploring the future of food and what it means for us all. To get the latest and build on the conversation, you can follow Future of Food.

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