Do you really understand modern farming? Scientist examines 10 truths of GMOs and organics

In my quest to learn about genetically modified foods and our food supply, many things have surprised me. Some of them may seem apparent and obvious, but as a city-dweller, I was unaware of numerous aspects of our food. I find comfort in the fact that many individuals that I share these gems with are equally surprised, leading me to believe that you may find some items as interesting as I do.

1) **The vast majority of fruits and vegetables are not transgenics.** I had heard so much about tomatoes with fish genes and strawberries that would never freeze that I just assumed that these genetically engineered items were in the market. Every time I picked up a fruit in the supermarket that was particularly large, I thought to myself "huh… that's got to be a GMO". You know those grapes the size of tennis balls that squirt juice everywhere when you bite into them? Every time I ate one, I'd close my eyes and thank the mysterious GMO gods for that sweet delicious nectar. Little did I know that none of these fruits was a GMO. They were genetically modified in the sense that they had been bred and selected to have optimal sweetness and size through cross-breeding. But they weren't transgenic organisms. There are only a handful of transgenic food crops, such as corn, soy and papaya. The short list can be found in this database (note that you have to select the type of approval to determine if the GMO has been commercialized or not).

2) **Organic food production uses pesticides**. I had always believed that by definition, organic food production did not use pesticides. Not only that, but some of the pesticides used are more toxic than those applied in conventional farming. The difference is that the pesticides used in organic farming are not synthetic, yet they are not necessarily better. Here is a myth-busting blog in Scientific American about this. And here's a list of pesticides approved for use in organic farming.

3) **Many plant traits are developed using mutagenesis. And can be labeled "organic"**. Mutagenesis is the use of radioactivity or chemicals to create random mutations in plants and selecting those with the desired trait. More than 2000 foods have been created by mutagenesis, including the durum wheat used to make fine Italian pasta. This article from the New York Times lists wheat, barley and even ruby red grapefruits as crops generated through mutagenesis. Imagine that!! The delicious, organic grapefruit from my farmers' market was developed using radiation to randomly create mutations, and somehow that's less scary than a GMO. Why the organic food movement isn't fighting to label the mutant ruby reds seems hypocritical. The fact that GMOs are excluded from the USDA's organic label, yet crops derived through mutagenesis can be happily certified as "organic" is astounding.

4) **There's lot of peer reviewed research on GMOs, both publically and privately funded. I mean a LOT**. Searching for the term MON810 in PubMed (a database hosted by the NIH), finds over 150 hits. That's 150+ studies that have looked into some aspect, such as identification or safety, on a single seed/trait (MON810 is Monsanto's Bt corn). Because it's a database search, let's assume that some of them are only loosely related to MON810. But even if 50 percent are discarded, that still leaves us with 70+ studies on a single trait/seed. In a Q&A at GMO-Skeptiforum, the founders of Biofortified.org

mentioned that the most common misconception about GMOs is that there are few independent studies. In an attempt to address this misconception, Biofortified created a new database that provides links to papers that have examined genetically engineered crops, and allows users to search based on many different characteristics including the source of funding. It is worth stressing that the sparsity of credible studies suggesting that GMOs pose a potential health risk does not mean that we should stop studying them, both in terms of technical methods in their generation, as well as safety.

5) **Types of traits used to generate GMOs are selected to improve farming conditions.** There aren't many GM crops in which the trait introduced was selected because it would make me want to buy it in the grocery store. There are several crops in the pipeline designed for me, such as non-browning apples. But at the moment, most crops are designed to help consumers indirectly by benefitting farmers, such as Bt crops that cut down on the amount of pesticides sprayed to fight worms, or glyphosate-resistant crops, which help farmers reduce the use of toxic chemicals to fight weeds. We, the consumers, see the benefits of these traits because reduced farming costs equate to savings at the grocery store. But we don't see signs at the grocery store stating, "Buy this peanut butter! Its peanuts are modified to be allergen-free, just for ***you***!" Those products are in the pipeline, though.

6) **The amount of misinformation and the distrust surrounding GMOs is staggering. And depressing.** It ranges from the subtle, in which statements are taken out of context or the complete findings of a paper are not discussed, to outright lies. I expected that there would be misinformation, but I was pretty naïve and didn't think it would be THAT bad. But it's downright awful. For example, the Institute for Responsible Technology's website —a one person NGO founded by anti-GMO activist Jeffrey Smith— states: "The only published human feeding experiment revealed that the genetic material inserted into GM soy transfers into bacteria living inside our intestines and continues to function." Smith completely misrepresents the paper's findings, which conclude: "it is highly unlikely that the gene transfer events seen in this study would alter gastrointestinal function or pose a risk to human health". GMO critics often peddle white lies as well as downright deceptive (and dangerous) statements such as claiming that GM insulin poses a health risk (Professor Kevin Folta reviewed this topic here).

I still have a tough time understanding why certain organizations would use such deceptive means to attack a technology. I think Dr Neil DeGrasse Tyson said it best in his recent Facebook post on the topic of GMOs:

> "If your objection to GMOs is the morality of selling non-perennial seed stocks, then focus on that. If your objection to GMOs is the monopolistic conduct of agribusiness, then focus on that. But to paint the entire concept of GMO with these particular issues is to blind yourself to the underlying truth of what humans have been doing—and will continue to do—to nature so that it best serves our survival. That's what all organisms do when they can, or would do, if they could. Those that didn't, have gone extinct. In life, be cautious of how broad is the brush with which you paint the views of those you don't agree with."

I was surprised at how many people distrust GMOs because of their belief that Monsanto is an 'evil' company. That's not a good reason for distrusting a technology with broad applications. It's like saying

that you don't trust computers because of Microsoft. But conventional and even organic food growers buy Monsanto seeds too, and Monsanto doesn't have a monopoly on GM technology. And what do life saving technologies, such as insulin, have to do with Monsanto? What about Golden Rice? What about bananas designed to combat nutritional deficiency in Uganda? I've been taken aback at how vehemently these consumer focused products are opposed, just because of the Monsanto-boogie-man.

7) **Transgenic seeds are not sterile.** I was certain that transgenic seeds could not be replanted, even if a farmer wanted to. I was dead wrong. When farmers buy seeds from a biotech company such as Syngenta, they sign an agreement, and they are not allowed to replant seeds. However, the seed is not sterile or unviable. (The topic of replanting seeds and terminator seeds was covered by the Genetic Literacy Project here).

8) **Peer review often may not mean very much. Papers should be evaluated based on their quality.** Even if you don't factor in the issue of predatory or pay-for-play journals, peer review needs a new paradigm (check out this article for a great expose of predatory journals). In an article that sounds an awful lot like a story about drug trafficking, a "peer-review ring" was recently busted for abusing the academic review process. Although there's a growing number of ways to share concerns or criticisms about a paper, that hasn't led to a change in the review process. Setting aside the reason behind errors in scientific journals, be they deliberate or not, there needs to be a positive feedback loop.

Personally, I think that scientists in the private sector should be able to provide feedback to the reviewers and editors if a study tests or compares their goods. Companies generally provide press-statements anyway once the paper's been published, so wouldn't it make sense to have their feedback and criticism in hand as a non-voting voice in the review process? Do you know who would read every single sentence several times, including the Supporting Materials section, in a paper that suggests that a GM trait is harmful? Or that Coca-Cola causes cancer? Or that an Apple tablet is more durable than a Samsung tablet? The scientists or engineers who made these products and the company that commercialized them. If anyone is going to identify a flaw in a paper, it would be them. I don't think that their statement should carry weight in the decision of whether a paper should be published. But it would make the editor's job easier to have their observations in hand.

I know that there are many who will disagree with me on this issue. I want to stress that this is my own personal opinion, which is probably biased from having worked in biotech's private sector and noting that we don't have devil-like horns or carry pitchforks.

9) **The world's most reputable scientific organizations have evaluated the data on the safety of GMOs.** That's right, there's a scientific consensus on the topic of GMO safety (see this infographic from the Genetic Literacy Project). This doesn't surprise me as much as the fact that there's still so much debate and controversy on a matter where there's an established consensus. As with many other scientific matters, including the safety of vaccines, there are papers whose results are contrary to the consensus and these have to be individually evaluated and, if need be, replicated. If reproducible evidence is found to the contrary, then the consensus shifts. But right now it's very strong and consistent: GMOs are safe.

For the final point, I interviewed my husband to find out what had surprised him most from all our discussions:

10) **That the greatest tool in combating misinformation on scientific topics is for scientists to be better communicators and to better educate the public.** I was surprised to see that the link between the public's superstition regarding GMOs is directly related to its education or lack thereof. If we had better scientific literacy or better science education, there would be fewer freak-outs. As a non-science person, my AHA!-moment came when I finally understood how eating a "strawberry-fish" smoothie would be same thing as eating a strawberry with a fish gene in it, because we can process and digest proteins from both species. That's such a small-little thing, but it created such a mental barrier."

Well, there you have it. Feel free to comment on the things that have surprised you most on this topic.

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