Ask A Biologist Vol 069 (Guest Kevin Folta)

Food for Thought About GMOs

What is a genetically modified organism (GMO)? How do you make something that is a GMO? Are they safe? These are just a few of the things Dr. Biology discusses with biologist Kevin Folta. The two also talk about how and where you can find information about science that you can trust to be the most accurate.

Transcript

Dr. Biology: This is "Ask-A-Biologist," a program about the living world, and I'm Dr. Biology.

My guest today is Kevin Folta. He's a biologist, professor, and Chairman of the Horticultural Scientist Department at the University of Florida, Gainesville.

Today we caught up with him by phone in Sebring, Florida. This is the heart of citrus country. We'll learn a little bit more about this later on in the show. It's kind of a sad story what we're going to learn about some trees that are under attack.

We're also going to talk a bit about GMOs. This is G-M-O. The acronym, those three letters, we're going to talk about those as well as what you should do when you're out on the Web searching for some information. How do you decide what's a good resource, what's an accurate resource, and one that you can trust?

Welcome to the show, Kevin Folta, and thank you for visiting with me today.

Kevin Folta: Thank you, Dr. Biology. It's great to be here.

Dr. Biology: Now, before we jump into the world of GMOs, let's talk about what a GMO is, and what a GMO is not.

Kevin: A GMO is kind of a more familiar term for what we think of as the science as transgenic plants, which means that we've taken a gene from one plant or maybe a bacterium and moved that into the plant. What it means is that we can move traits, one trait at a time.

What it's not is really just any of the other ways that people have achieved plant genetic improvement, maybe that's by during cross breeding or mixing genes from another species just by rubbing the flowers together occasionally can give you fertilization. This is the way that GMO contrasts is that modern ability to move single trait to the prime versus this very random process of traditional breeding.

Dr. Biology: For those that don't know about the acronym, GMO is genetically modified organism. This isn't just plants either. There are also animals that fit in this category. One of the famous one are the GloFish.

Kevin: Yes, the GloFish is the only one that's available commercially, yet many other animals exist that are laboratory models that help us understand disease because specific genes have been affected or animals that produce things like anti-clotting agents that help people who can't respond to things like chemicals called heparin, very useful products that can come through animal biotechnology.

Dr. Biology: One of the challenges with the Web is anyone can post content on a website. That's the good news. A lot of people can get information out there. At Ask-a-Biologist, we often get questions from students who find conflicting information, for example, on a variety of topics.

In many cases, the information they find is not just inaccurate, but the science behind it is bad. I suspect this is also common with materials on GMOs.

Kevin: 100 percent.

Dr. Biology: What should a person look for when researching the topic of GMOs?

Kevin: The best way to find that information is maybe to look under PubMed, at pubmed.com. If you go to PubMed, you can usually find at least what it suggests are good articles from higher-impact journals. Even then, that's not the perfect solution, because occasionally work is published that's of very poor quality but sneaks through the peer-review process.

Really, the best way to look at this is to look at, "How does it fit with the consensus?" How does it fit with the consensus? How does it fit within what the majority of scientists are saying, and what our national organizations are saying? If it's something that is in stark opposition, it could be right. However, you have to look at those very carefully to make sure they're good experiments, to make sure that the statistics are proper, and that their interpretations are good.

What this means is that we frequently as non-experts have to rely on experts, and who are the experts? Usually the folks who don't have agendas, the folks working in universities are good resources. Maybe consider, "Is this a good piece of research?" is, does it grow?

What you find out is that if some piece of science really is breakthrough, and true, and revolutionary, you'll find that scientists are really into the "me too" kind of mentality. Everybody wants to be number two. What it means is that if the first piece of research comes out and says something as startling as GMO plants cause cancer.

Then, you'll have hundreds, thousands of other papers that will soon come out that would follow up on that. Show how it works. What exactly the problems are.

Dr. Biology: The idea of repeating or replicating the experiments themselves is really critical, or the study they've done. This is one of the things a lot of people don't think about. The fact that just because you did the experiment once doesn't mean that's the end.

Kevin: That's true. It's really a question of replication by multiple independent groups, and the expansion of that field. That's how I go, you know what, maybe they were onto

something. However, you just don't see that in the negative reports on GMO plants or environmental effects. What you find there that these are single papers that usually occur in obscure journals, that aren't indexed on PubMed by people who never replicate their data and no one else replicates it either.

A very anti-GMO movement holds them up as gospel. This is what we, as scientists have to work against, is helping people separate the real science from this one-off kind of nonsense.

Dr. Biology: You mentioned going to PubMed, and while I really like the idea of going to PubMed because it's primary research, one of the challenges we found is that most people don't understand what the scientists are writing. It can be very challenging for them. There are two things in here. One is a plug that Ask-A-Biologist has a companion site or a piece of it that's called PLOSable, which is tied with the Public Library of Science.

There, we do these intro types of papers that actually pull components out of a primary research article so that you can get basically a primer before you dive into the actual research article, and it's just a click away.

Those were the kinds of things that I find challenging when we're trying to get the non-expert, the non-scientist, to go to primary research articles. If there's anything else out there besides or in addition to the PubMed, that would be welcome as well.

Kevin: There are a number of good resources. If you look on Bio-Fortified, they frequently will distill some of these topics, biofortified.org. Academics Reviews looks at some of the major papers and articles that are out there, critically, especially the articles which are critical of transgenic technology.

GMO Answers is an industry-sponsored site, so it's important to keep that in mind. It's industry-sponsored, yet all of their experts, or most of their experts, are independent. I answer a lot of things there. Nobody tells me what to write, nobody pays me for my discussion. I'm currently undergoing a lot of issues about that. People who think we're in collusion with them while we're not.

Those are good independent sources. You always can reach out to your university people, reach out to me, I answer about an hour of questions a night. In a strange way, write a letter to the companies. Write a letter to Monsanto. Say, "How can you help me understand this." They have a whole elite crack team of people whose job it is, is to take care of your concerns.

They'll at least give you something that you can compare against the literature and against other opinion.

Dr. Biology: On Ask-A-Biologist, it's not uncommon for someone to come to us through our question and answer feature. When they get multiple answers to a question they have, and they are from some sources that you and I might actually think they're very valid. How do you assess that?

Kevin: I think a lot of the sources that people frequently cite are sometimes people who are in this really to make a buck off of the hysteria around this topic. There are hundreds of documentaries, many books, many websites, and many organizations. All are nucleated around this idea that modern food is poison, when really our evidence suggests exactly the opposite.

We have to be really careful about asking, is this person even a scientist? Is this person somebody who is simply making a dollar off manufacturing risk and peddling fear?

Dr. Biology: How do we know someone who is in favor of GMOs doesn't fit in that category?

Kevin: What you find is that one of the main ways to assess that, is to ask how well does what they describe fit into the fabric of what we know about science. Somebody who would come out for instance, and say, "Vaccines are dangerous and killing people," doesn't fit within the modern view that demonstrates over many decades now that vaccines are a safe and healthy important part of public health.

If someone's giving a message which is contrary to what we know and what we accept, then we may find there's some scrutiny. Otherwise, I think it's important to just to consider that they're another voice that leads to a growing consensus.

Dr. Biology: Let's jump into the world of GMOs. How does someone go about making a genetically modified organism?

Kevin: If we confine that discussion to plants, it's a pretty interesting process that's very well-understood. What we do is exploit the properties of plants that allow single cells to grow into entirely new plants. If you've taken a cutting from a plant and stuck it in a glass of water, you can see that the cells on the stem can turn into root cells, which is a pretty cool trick.

You're taking a cell which is terminally differentiated, meaning it has achieved its final identity, but then shifts into something else so that the plant can live. In science, if we can take a gene of interest and install that into a single cell, using a bacterium that does this for a living, this bacterium called agrobacterium tumefaciens. It puts DNA into plant cells. That's how it survives.

What we've done with science is give agrobacterium our gene to deliver. It places it into a single cell, and then we grow that single cell into a clump of cells, and then eventually a whole new plant that all comes from that one clonal original cell that received a copy of our gene. It's really a simple process.

Dr. Biology: Does it take a person to genetically modify a plant?

Kevin: In this form, yes, because this has to happen through a laboratory intermediate in very careful control of that process. That's just what we do, and we call make a transgenic plant. I tend to stay away from the GMO and genetically modified words, because people

have been genetically modifying plants by rubbing the flowers together, and crossing them.

That creates an offspring which is remarkably different than both parents, because it is genetically modified, relative to the parents. The really precise language is that we create a transgenic through the lab, and that would be a plant that contains one, or maybe a couple of other genes, that the scientist has decided should go in there that encodes a very specific trait that's helpful to farmers, or maybe the environment, or the media.

Dr. Biology: The process of transgenics is actually much more precise?

Kevin: Absolutely. Despite what people say, where they say it's an imprecise science, we can tell you exactly what gene goes in, and where it goes, what protein product it encodes, and how well it's working, if there's been any other collateral changes in the plant. We can do that very easily with transgenics, and it's a wonderfully precise process these days.

When we do traditional breeding, we just mix plant pollen together. We don't know what 80 percent of the genes do, and the offspring we have no idea what's produced, but this is a perfectly safe, and acceptable way to generate new varieties. The GM way is just much safer.

Dr. Biology: How much of our food has already been genetically modified?

Kevin: Meaning with the addition of the transgene? Very little. Let me put it this way, it's in about 70 percent of our grocery store products, but it's only corn, soy, cotton, papayas from Hawaii, some squash, and then sugar beets, and...I'm missing one more. Alfalfa. That's it.

Just recently we had apples and potatoes deregulated, but they're not available commercially, yet.

Dr. Biology: Then if we look at the broad spectrum of the ones that are doing it non-transgenically, this has been going on forever?

Kevin: Yes. You would not recognize the great-great-great-grandparents of corn, or soy, or citrus. They produce inferior little products that over the course of tens of thousands of years humans have brought under human control, and bred, either on purpose or by accident, products that are better for human beings. All of farming is not natural.

All of farming disrupts natural ecosystems. It's not a natural process. All we're doing here by this kind of transgenic technology, or GMO technology, is just moving one single gene. It's just an extension of what humans have done for a very long time.

Dr. Biology: Can you help me with my fuzzy memory on the plight of the monarch butterfly, and the corn crops, I believe it was, was it Monsanto?

Kevin: A paper came out in the late '90s that suggested that the pollen from a Bt-corn plant. Bt is the protein that comes from bacteria that every cell in the plant produces. The plant makes its own insecticidal protection.

This is a great thing, because you don't have to spray the plants. The plant makes its own protection, and it only affects the caterpillars of moths and butterflies, which is really cool. The concern was how does it affect monarchs?

In the original study, a group fed monarch butterfly larvae large amounts of pollen, and it showed a negative effect on their health. What was later shown was that the amounts used were not the kind that would occur in nature, and not consistent with what would happen near a transgenic corn field.

Ever since then, there's been this discussion back and forth, but the overarching feeling is that Bt was not contributing. In more recent times, there have been folks that said, "Well, it's a lack of milkweed refugia, that are the host plants for monarchs," and that those are all being destroyed by Glyphosate.

Maybe there's some element of truth to that, but if you don't kill it with Glyphosate, which is the herbicide, you're going to kill those plants with plowing, or with cultivation, or with other herbicides, or on an organic farm you'll tear them out by hand. There always is an issue with weed control. I can't necessarily blame the monarch decline just on that.

Dr. Biology: Why do we want to modify plants and animals, genetically? What's the advantage?

Kevin: I can give you a wonderful example that means a lot to me right now. I'm sitting in the middle of citrus country, in Florida, where a devastating bacterial disease is destroying an entire industry. I can look around me and see these gray skeletons of trees that used to be full of lush green foliage, and oranges.

It's a bacterium, and how do you breed a tree that's resistant? It's going to take decades, maybe a hundred years. We can add, and it's already been done, a single gene from a plant into citrus that makes it resistant to the disease.

That's why you need to do genetic modification. We've achieved in five years the genetic modification that can't be done for decades through traditional breeding.

Dr. Biology: When we look at different countries, I know that many of the countries have either banned, or partially banned, GMOs. In general, the US is much more open to GMOs. How many countries have banned them?

Kevin: I think two. Right now it's either Ecuador or Peru. I think it's Ecuador and Kenya. Only two countries have done a complete ban.

Dr. Biology: How many are regulating them, and again, why do you think they're regulating them, from their standpoint? Do you think it's just a campaign?

Kevin: It's something like 68 have regulations as to what comes in, and whether or not it requires a label. Mostly that's protection, it's policy, that they don't want things to compete against their internal farmers, or it's a bad political decision.

Like in many countries in Europe where the scientists in Europe don't understand, the farmers don't understand, but politicians are easily malleable, because the opinion of a population that's been scared by activists with really bad information.

Dr. Biology: The farmers that are down in Florida, that you're spending time...Sebring, Florida?

Kevin: Yes.

Dr. Biology: I'm assuming they've invited you down there, because of the actual disease that's attacking these citrus trees.

Kevin: We're trying to manage a disease in the state, using a variety of solutions. It's not just GMO, that hasn't even come out yet. That's not even close. We're trying to use other genetic techniques, such as mixing with root stocks, so the bottom half of the tree is spliced on to a different top of the tree, different nutrient management, insect management, anything else we can do to help curb the spread.

The soonest you'll see a GMO solution is 2019, and that's the absolute soonest.

Dr. Biology: Are there more risks with GMOs, if any, for children than adults?

Kevin: Absolutely not. When we talk about risk assessment here, the synthesis of the National Academies of Science, the American Association for the Advancement of Science, and dozens of other agencies are extremely clear about this statement, that transgenic technologies pose no more risk than conventionally bred crops.

That's an important statement, because traditional breeding does have risk. You're mixing genes in ways you don't understand. Transgenic technologies are adding a gene that is understood into a background that's understood. In that way, it probably carries a lot less risk.

Dr. Biology: Along those lines, I know that you think GMOs are safe, but why?

Kevin: I have no problem eating the stuff, I feed it to my family and it's no big deal. It's because I understand how it works. I understand what the insect resistance gene is. It's a protein that's only dangerous to specific caterpillars. I understand how the herbicide resistance works. It's just switching a version of a metabolic gene for a bacterial version of the same metabolic gene. It does the same job.

There's no way in my mind that I can possibly imagine how this change would be dangerous. There's certainly ways that when you introduced a gene that there wouldn't be some small amount of risk. However, there's no evidence that that's occurred and over 20 years, we haven't had one case of a human illness that you can tie back to this scratch.

Scholar-safe record and reinforcing the lack of any plausible mechanism apart.

Dr. Biology: What's the next big thing in GMO technology?

Kevin: My interests are really in how do we provide for people in the developing world a standard of living even close to what we enjoy here. We should all be so grateful for living in the time of the greatest most abundant food supply in human history.

I would love to see that extent to them so it takes two kinds of plant. It takes plants to provide better nutrition things like vitamin A and Folate. All these plants exist now and are being blocked from our ability to distribute them and plants that can grow in weather extremes. Maybe plants that can grow in severe drought, or in a flooding, maybe plants that can survive in the salty soil or extreme heat.

These plants exist today and it's really sad for me as a scientist to say that we have a tool that can ease human suffering and we can't let them have it.

Dr. Biology: What if I gave you 60 seconds two-sentence opportunity to tell someone about GMOs, what would you say?

Kevin: What GMOs are are really an extension of what humans have been doing with plants and food for a long time or just changing the genes to change the traits. This way of doing it as a much more precisely of doing. It allows us these transfer traits that can help the environment, help farmers, help the needy and provide more resources for the consumer.

Dr. Biology: Now, I have one more question before we get into a section that I do with all my scientists. This one is, the world as we know it now and the world of what it would be like if we did not have GMOs today. What would the world look like?

Kevin: The big thing that you would notice is different is mostly in food and medicine. Cheese making requires enzymes that comes from the stomach of a calf, would be raising loads of calves for slaughter simply to make the enzymes for cheese.

A lot of animals have been raised simply for slaughter for an enzyme. Diabetics would be requiring insulin to be purified from the pancreases of slaughtered cattle from bull lines or cow sources. You would see growth hormones that would be harvested from the pituitary gland of cadavers rather than produced from a GMO bacterium.

In plants, you would see farmers requiring higher amounts of insecticides on corn and cotton, which right now the gene provides a very strong anti-insect component and you would see the use of different herbicides. Instead of safer herbicides like glycol safe, which is the stuff used in Roundup.

You would see old school herbicides that weren't nearly as safe. It would be a very different place if we didn't have this kind of a common DNA technology.

Dr. Biology: Would we have a food shortage?

Kevin: I don't think we'll have a food shortage, but I think we'll have a lot more expensive meat products and higher expenses for fuel. The majority of our GM crops are going into cattle feed and for fuel and also quite a bit is exported for the same purposes. Minority of it goes into food for humans.

Dr. Biology: Now, we're going to switch into a part of the show where I ask three questions of all my guests. Some of them will seem familiar and I suspect some won't.

Kevin: OK.

Dr. Biology: When did you first know you wanted to be a biologist?

Kevin: [laughs] Probably when I was about somewhere between three and four. I've always been interested in dinosaurs and plants and studied that stuff from the time I was little. I was the first kindergartner in a Science Fair that started with fifth to eighth graders that I insisted on being in.

I took my first book under Recombinant DNA when I was 10. I've been fired up about this topic for a long time.

Dr. Biology: We didn't actually mention the fact we said you're a biologist, which you are that's the broad brush, but you're also more specifically in the world of horticulture.

Kevin: Yes.

Dr. Biology: When you think about it, there's an art, there's a science, there's a technology and some would say a business of plant cultivation. This is where you spend your time. It wasn't that you got into this for GMOs?

Kevin: Absolutely not. My training is formally in Molecular Biology. I understand the process of GMOs and how you make extraction of plants very well, but I'm a practicing researcher, but I'm also department chair.

In my department, we have a faculty member that has plants on the space station. I work with faculty that work with organic and sustainable farming. We work on tomatoes, blueberry, strawberries, you name it.

The GMO stuff is really just a great technology that could do a lot more but hasn't. I think what's exciting to implement it so that it can help our farmers in the future. Right now, we're in the state that barely grows any GMO acreage. All our farmers are growing traditionally bred conventional crops, organic crops and those are the folks I'm taking care of right now.

GMOs are tool in the toolbox and the tool we'll use it more in the future.

Dr. Biology: Now, I'm going to take it all away from you. You can't be a biologist. I'm going to take you out of academia, in other words you're going to be out of college. I'm not going to let you do any teaching, but I'm going to let you do anything else that you may have wanted to do. What kind of career or what would you be?

Probably, Rodeo Clown. I must be honest. I love any job I do and I work everything from waiter to bartender, to [inaudible 25:36] taker to electronic sky, you name it. For me, every single job is exciting. If I have an opportunity to do something outside of science, I'd love to be able to participate in media, be able to spend more time speaking to people about how to speak and how to communicate ideas.

Maybe that will be the best way that I'll be able to amplify the important message of science without actually being a scientist.

Dr. Biology: I have one final question. What advice would you have for a young biologist or perhaps someone who always wanted to be a biologist, but they never did it so they need to make that change in career?

Kevin: Make sure that you're trying your best to understand the basic sciences and do your best in things like chemistry, physics, and math even if they may not be your best subjects. Just get through them, use them as fundamental building blocks for what you'll learn later on.

The most important thing that you can do to be a scientist today is learn how to write and learn how to speak. I know that sounds really backwards, but our science is only as good as our ability to convey it and get others interested in it. Get fired up about science and learn the science, but also spend a lot of time learning how to share it with others.

Dr. Biology: On that note, Kevin Folta, thank you for visiting with me today.

Kevin: Thank you very much. I really appreciate the time.

Dr. Biology: You've been listening to Ask-a-Biologist. My guest has been Kevin Volta, a biologist and professor in the horticultural sciences department at the University of Florida, Gainesville. He's also the Chairman of that department.

We caught up with them and in Sebring, Florida, where he's been spending some time with some rather sick trees down there. We'll hope the trees are going to do better soon. For those of you might want to explore this topic more, just pop over to the website. We'll give you some links from this podcast page so you can go explore and learn more about the topics we talked about today.

The Ask-a-Biologist podcast is produced on the campus of Arizona State University and is recorded in the Grassroots Studio housed in the School of Life Sciences, which is an academic unit of the College of Liberal Arts and Sciences.

Remember, even though our program is not broadcast live, you can still send us your questions about biology using our companion website. The address is askabiologist.asu.edu, or you can just Google the words "Ask A Biologist."

I'm Dr. Biology.

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