Science Sushi

Mythbusting 101: Organic Farming > Conventional Agriculture

By Christie Wilcox on July 18, 2011

People believe a lot of things that we have little to no evidence for, like that vikings wore horned helmets or that you can see the Great Wall of China from space. One of the things I like to do on my blogs is bust commonly held myths that I think matter. For example, I get really annoyed when I hear someone say sharks don't get cancer (I'll save that rant for another day). From now onward, posts that attack conventionally believed untruths will fall under a series I'm going to call "Mythbusting 101."

Ten years ago, Certified Organic didn't exist in the United States. Yet in 2010, a mere eight years after USDA's regulations officially went into effect, organic foods and beverages made $26.7 billion. In the past year or two, certified organic sales have jumped to about $52 billion worldwide despite the fact that organic foods cost up to three times as much as those produced by conventional methods. More and more, people are shelling out their hard-earned cash for what they believe are the best foods available. Imagine, people say: you can improve your nutrition while helping save the planet from the evils of conventional agriculture - a complete *win-win*. And who wouldn't buy organic, when it just sounds so good?

Here's the thing: there are a lot of myths out there about organic foods, and a lot of propaganda supporting methods that are rarely understood. It's like your mother used to say: just because everyone is jumping off a bridge doesn't mean you should do it, too. Now, before I get yelled at too much, **let me state unequivocally that I'm not saying organic farming is bad - *far from it*.** There are some definite upsides and benefits that come from many organic farming methods. For example, the efforts of organic farmers to move away from monocultures, where crops are farmed in single-species plots, are fantastic; crop rotations and mixed planting are much better for the soil and environment. My goal in this post isn't to bash organic farms, instead, it's to bust the worst of the myths that surround them so that everyone can judge organic farming based on facts. In particular, there are four myths thrown around like they're real that just drive me crazy.

Myth #1: Organic Farms Don't Use Pesticides

When the Soil Association, a major organic accreditation body in the UK, asked consumers why they buy organic food, 95% of them said their top reason was to avoid pesticides. They, like many people, believe that organic farming involves little to no pesticide use. I hate to burst the bubble, but that's simply not true. Organic farming, just like other forms of agriculture, still uses pesticides and fungicides to prevent critters from destroying their crops. Confused?

So was I, when I first learned this from a guy I was dating. His family owns a farm in rural Ohio. He was grumbling about how everyone praised the local organic farms for being so environmentally-conscientious, even though they sprayed their crops with pesticides all the time while his family farm got no credit for being pesticide-free (they're not *organic* because they use a non-organic herbicide once a year). I didn't believe him at first, so I looked into it: turns out that there are over 20 chemicals commonly used in the growing and processing of organic crops that are approved by the US Organic Standards. And, shockingly, the actual volume usage of pesticides on organic farms is not recorded by the government. Why the government isn't keeping watch on organic pesticide and fungicide use is a damn good question, especially considering that many organic pesticides that are also used by conventional farmers are used more intensively than synthetic ones due to their lower levels of effectiveness. According to the National Center for Food and Agricultural Policy, the

top two organic fungicides, copper and sulfur, were used at a rate of 4 and 34 pounds per acre in 1971 [1]. In contrast, the synthetic fungicides only required a rate of 1.6 lbs per acre, less than half the amount of the organic alternatives.

The sad truth is, factory farming is factory farming, whether its organic or conventional. Many large organic farms use pesticides liberally. They're organic by certification, but you'd never know it if you saw their farming practices. As Michael Pollan, best-selling book author and organic supporter, said in an interview with Organic Gardening,

> *"They're organic by the letter, not organic in spirit... if most organic consumers went to those places, they would feel they were getting ripped off."*

What makes organic farming different, then? It's not *the use of pesticides*, it's *the origin of the pesticides used*. Organic pesticides are those that are derived from natural sources and processed lightly if at all before use. This is different than the current pesticides used by conventional agriculture, which are generally synthetic. It has been assumed for years that pesticides that occur naturally (in certain plants, for example) are somehow better for us and the environment than those that have been created by man. As more research is done into their toxicity, however, this simply isn't true, either. Many natural pesticides have been found to be potential - or serious - health risks.[2]

Take the example of Rotenone. Rotenone was widely used in the US as an organic pesticide for decades [3]. Because it is natural in origin, occurring in the roots and stems of a small number of subtropical plants, it was considered "*safe*" as well as "*organic*". However, research has shown that rotenone is highly dangerous because it kills by attacking mitochondria, the energy powerhouses of all living cells. Research found that exposure to rotenone caused Parkinson's Disease-like symptoms in rats [4], and had the potential to kill many species, including humans. Rotenone's use as a pesticide ~~has already been discontinued in the US as of 2005 due to health concerns~~***, but shockingly, it's still poured into our waters every year by fisheries management officials as a piscicide to remove unwanted fish species.

The point I'm driving home here is that just because something is natural doesn't make it non-toxic or safe. Many bacteria, fungi and plants produce poisons, toxins and chemicals that you definitely wouldn't want sprayed on your food.

Just last year, nearly half of the pesticides that are currently approved for use by organic farmers in Europe failed to pass the European Union's safety evaluation that is required by law [5]. Among the chemicals failing the test was rotenone, as it had yet to be banned in Europe. Furthermore, just over 1% of organic foodstuffs produced in 2007 and tested by the European Food Safety Authority were found to contain pesticide levels above the legal maximum levels - and these are of pesticides that are *not* organic [6]. Similarly, when Consumer Reports purchased a thousand pounds of tomatoes, peaches, green bell peppers, and apples in five cities and tested them for more than 300 synthetic pesticides, they found traces of them in 25% of the organically-labeled foods, but between all of the organic and non-organic foods tested, only one sample of each exceeded the federal limits[8].

Not only are organic pesticides not safe, they might actually be worse than the ones used by the conventional agriculture industry. Canadian scientists pitted 'reduced-risk' organic and synthetic pesticides against each other in controlling a problematic

pest, the soybean aphid. They found that not only were the synthetic pesticides more effective means of control, the organic pesticides were *more ecologically damaging*, including causing higher mortality in other, non-target species like the aphid's predators[9]. Of course, some organic pesticides may fare better than these ones did in similar head-to-head tests, but studies like this one reveal that the assumption that natural is better for the environment could be very dangerous.

Even if the organic food you're eating *is* from a farm which uses little to no pesticides at all, there is another problem: getting rid of pesticides doesn't mean your food is free from harmful things. Between 1990 and 2001, over 10,000 people fell ill due to foods contaminated with pathogens like *E. coli*, and many have organic foods to blame. That's because organic foods tend to have higher levels of potential pathogens. One study, for example, found *E. coli* in produce from almost 10% of organic farms samples, but only 2% of conventional ones[10]. The same study also found Salmonella only in samples from organic farms, though at a low prevalence rate. The reason for the higher pathogen prevalence is likely due to the use of manure instead of artificial fertilizers, as many pathogens are spread through fecal contamination. Conventional farms often use manure, too, but they use irradiation and a full array of non-organic anti-microbial agents as well, and without those, organic foods run a higher risk of containing something that will make a person sick.

In the end, it really depends on exactly what methods are used by crop producers. Both organic and conventional farms vary widely in this respect. Some conventional farms use no pesticides. Some organic farms spray their crops twice a month. Of course, some conventional farms spray just as frequently, if not more so, and some organic farms use no pesticides whatsoever. To really know what you're in for, it's best if you know your source, and a great way to do that is to buy locally. Talk to the person behind the crop stand, and actually ask them what their methods are if you want to be sure of what you're eating.

Myth #2: Organic Foods are Healthier

Some people believe that by not using manufactured chemicals or genetically modified organisms, organic farming produces more nutritious food. However, science simply cannot find any evidence that organic foods are in any way healthier than non-organic ones - and scientists have been comparing the two for over 50 years.

Just recently, an independent research project in the UK systematically reviewed the 162 articles on organic versus non-organic crops published in peer-reviewed journals between 1958 and 2008 [11]. These contained a total of 3558 comparisons of content of nutrients and other substances in organically and conventionally produced foods. They found absolutely no evidence for any differences in content of over 15 different nutrients including vitamin C, ?-carotene, and calcium. There were some differences, though; conventional crops had higher nitrogen levels, while organic ones had higher phosphorus and acidity - none of which factor in much to nutritional quality. Further analysis of similar studies on livestock products like meat, dairy, and eggs also found few differences in nutritional content. Organic foods did, however, have higher levels of overall fats, particularly trans fats. So if anything, the organic livestock products were found to be worse for us (though, to be fair, barely).

“This is great news for consumers. It proves that the 98% of food we consume, which is produced by technologically advanced agriculture, is equally nutritious to the less than 2% derived from what is commonly referred to as the 'organic' market," said Fredhelm Schmider, the Director General of the European Crop Protection Association said in a press release about the findings.[12]

Joseph D. Rosen, emeritus professor of food toxicology at Rutgers, puts it even more strongly. "Any consumers who buy organic food because they believe that it contains more healthful nutrients than conventional food are wasting their money," he writes in a comprehensive review of organic nutritional claims[13].

Strong organic proponents also argue that organic food tastes better. In the same poll where 95% of UK organic consumers said they buy organic to avoid pesticides, over two-thirds of respondents said organic produce and meats taste better than non-organic ones. But when researchers had people put their mouths to the test, they found that people couldn't tell the difference between the two in blind taste tests[14, 18].

So, in short, organics are not better for us and we can't tell the difference between them and non-organic foods. There may be many things that are good about organic farming, from increased biodiversity on farms to movement away from monocultures, but producing foods that are healthier and tastier simply isn't one of them.

Myth #3: Organic Farming Is Better For The Environment

As an ecologist by training, this myth bothers me the most of all three. People seem to believe they're doing the world a favor by eating organic. The simple fact is that they're not - at least the issue is not that cut and dry.

Yes, organic farming practices use less synthetic pesticides which have been found to be ecologically damaging. But factory organic farms use their own barrage of chemicals that are still ecologically damaging, and refuse to endorse technologies that might reduce or eliminate the use of these all together. Take, for example, organic farming's adamant stance against genetically modified organisms (GMOs).

GMOs have the potential to up crop yields, increase nutritious value, and generally improve farming practices while reducing synthetic chemical use - which is exactly what organic farming seeks to do. As we speak, there are sweet potatoes are being engineered to be resistant to a virus that currently decimates the African harvest every year, which could feed millions in some of the poorest nations in the world[15]. Scientists have created carrots high in calcium to fight osteoperosis, and tomatoes high in antioxidants. Almost as important as what we can put into a plant is what we can take out; potatoes are being modified so that they do not produce high concentrations of toxic glycoalkaloids, and nuts are being engineered to lack the proteins which cause allergic reactions in most people. Perhaps even more amazingly, bananas are being engineered to produce vaccines against hepatitis B, allowing vaccination to occur where its otherwise too expensive or difficult to be administered. The benefits these plants could provide to human beings all over the planet are astronomical.

Yet organic proponents refuse to even give GMOs a chance, even to the point of hypocrisy. For example, organic farmers apply *Bacillus thuringiensis* (Bt) toxin (a

small insecticidal protein from soil bacteria) unabashedly across their crops every year, as they have for decades. It's one of the most widely used organic pesticides by organic farmers. Yet when genetic engineering is used to place the gene encoding the Bt toxin into a plant's genome, the resulting GM plants are vilified by the very people willing to liberally spray the exact same toxin that the gene encodes for over the exact same species of plant. Ecologically, the GMO is a far better solution, as it reduces the amount of toxin being used and thus leeching into the surrounding landscape and waterways. Other GMOs have similar goals, like making food plants flood-tolerant so occasional flooding can replace herbicide use as a means of killing weeds. If the goal is protect the environment, why not incorporate the newest technologies which help us do so?

But the real reason organic farming isn't more green than conventional is that while it might be better for local environments on the small scale, organic farms produce far less food per unit land than conventional ones. Organic farms produce around 80% that what the same size conventional farm produces[16] (some studies place organic yields below 50% those of conventional farms!).

Right now, roughly 800 million people suffer from hunger and malnutrition, and about 16 million of those will die from it[17]. If we were to switch to entirely organic farming, the number of people suffering would jump by 1.3 billion, assuming we use the same amount of land that we're using now. Unfortunately, what's far more likely is that switches to organic farming will result in the creation of new farms via the destruction of currently untouched habitats, thus plowing over the little wild habitat left for many threatened and endangered species.

Already, we have cleared more than 35% of the Earth's ice-free land surface for agriculture, an area 60 times larger than the combined area of all the world's cities and suburbs. Since the last ice age, nothing has been more disruptive to the planet's ecosystem and its inhabitants than agriculture. What will happen to what's left of our planet's wildlife habitats if we need to mow down another 20% or more of the world's ice-free land to accommodate for organic methods?

The unfortunate truth is that until organic farming can rival the production output of conventional farming, its ecological cost due to the need for space is devastating. As

bad as any of the pesticides and fertilizers polluting the world's waterways from conventional agriculture are, it's a far better ecological situation than destroying those key habitats altogether. That's not to say that there's no hope for organic farming; better technology could overcome the production gap, allowing organic methods to produce on par with conventional agriculture. If that does occur, then organic agriculture becomes a lot more ecologically sustainable. On the small scale, particularly in areas where food surpluses already occur, organic farming could be beneficial, but presuming it's the end all be all of sustainable agriculture is a mistake.

Myth #4: It's all or none

The point of this piece isn't to vilify organic farming; it's merely to point out that it's not as black and white as it looks. Organic farming does have many potential upsides, and may indeed be the better way to go in the long run, but it really depends on technology and what we discover and learn in the future. Until organic farming can produce crops on par in terms of volume with conventional methods, it cannot be considered a viable option for the majority of the world. Nutritionally speaking, organic food is more like a brand name or luxury item. It's great if you can afford the higher price and want to have it, but it's not a panacea. You would improve your nutritional intake far more by eating a larger volume of fruits and vegetables than by eating organic ones instead of conventionally produced ones.

What bothers me most, however, is that both sides of the organic debate spend millions in press and advertising to attack each other instead of looking for a resolution. Organic supporters tend to vilify new technologies, while conventional supporters insist that chemicals and massive production monocultures are the only way to go. This simply strikes me as absurd. Synthetic doesn't necessarily mean bad for the environment. Just look at technological advances in creating biodegradable products; sometimes, we can use our knowledge and intelligence to create things that are both useful, cheap (enough) and ecologically responsible, as crazy as that idea may sound.

I also firmly believe that increasing the chemicals used in agriculture to support insanely over-harvested monocultures will never lead to ecological improvement. In my mind, the ideal future will merge conventional and organic methods, using GMOs

and/or other new technologies to reduce pesticide use while increasing the bioavailability of soils, crop yield, nutritional quality and biodiversity in agricultural lands. New technology isn't the enemy of organic farming; it should be its strongest ally.

As far as I'm concerned, the biggest myth when it comes to organic farming is that you have to choose sides. Guess what? **You don't.** You can appreciate the upsides of rotating crops *and* how GMOs might improve output and nutrition. You, the wise and intelligent consumer, don't have to buy into either side's propaganda and polarize to one end or another. You can, instead, be somewhere along the spectrum, and encourage both ends to listen up and work together to improve our global food resources and act sustainably.

See more on this, in response to critiques: In the immortal words of Tom Petty: "I won't back down"

More Mythbusting 101:

Sharks will cure cancer

**** Oh, it turns out Rotenone got re-approved for organic use in 2010.* See for yourself.

Regarding the use of GMOs: perhaps Andy Revkin from The New York Times says it better.

Based on the responses, I just want to make this clear: this is NOT a comprehensive comparison of organic and conventional agriculture, nor is it intended to be. That post would be miles long and far more complex. My overall belief is that there shouldn't be a dichotomy in the first place - there are a variety of methods and practices that a farmer can use, each with its pros and cons. The main point here is that something "organic" isn't intrinsically better than something that isn't, and that you have to approach all kinds of agriculture critically to achieve optimum sustainability.

Ok, and while I'm adding in notes: stop citing Bedgley et al. 2007 as evidence that organic farming produces equal yields: this study has been shown to be flawed (see my comments in the follow up post to this article), and was strongly critiqued (e.g. this response article).

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Credit: Nick Higgins