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ORGANIC FAQs

In the developed world, sales of organic produce are growing rapidly. But how far can this trend extend? That depends on how strictly you define organic farming ... and the answers to three other pivotal questions.

What is organic farming?

At the core of the organic philosophy lies a ban on the use of synthetic fertilizers, pesticides and herbicides. That means adopting other techniques to nourish crops and protect the soil, such as growing 'cover' crops between seasons to prevent erosion and to restore organic matter.

The organic movement also encompasses such tenets as animal welfare, energy efficiency, social justice and the simple agrarian ideal of small farms growing produce for local communities. It is on this last point that the success of organic farming is starting to divert the movement from its pure vision.

Although organic produce remains a niche market, global sales have risen by about 20% per year for five years running[1]. This growth has seen some 'organic' producers turn into industrial-scale ventures that ship their products over thousands of kilometres. Organic proponents may aim to reduce the fossil fuel expended in transporting crops by encouraging farmers to sell to local markets, but the popularity of organic food in wealthy countries has spawned a huge export market. North America and Europe account for 97% of global organic food and drink sales, but nearly half of the world's organic farmland is found in Asia, Australia and Latin America (see Map, page 794). It's hardly what the movement's pioneers had in mind.

Organic standards also differ in their details from country to country. Most rules governing organic farming, including those laid down in the European Union, Japan and the United States, are based on standards set by the non-profit International Federation of Organic Agriculture Movements in Bonn, Germany. "Anyone who is really credible will adhere," says Bruce Pierce, deputy research director of the Elm Farm Research Centre in Berkshire, UK, which studies methods of organic cultivation. But standards are not always comprehensive: Japan, for instance, has no rules for organic meat.

And there are important differences between regions of the world. For instance, an American farmer who chooses to use Chilean nitrate, a mined source of sodium nitrate, permitted under US rules, could not sell the resulting produce in Europe. Although Chilean nitrate is a natural substance, European organic standards consider it to be the equivalent of a synthetic fertilizer because it is highly soluble and leaches readily from the soil. Nor could the US farmer market milk from a cow that had been raised on an organic diet for less than a year — European rules are stricter than US standards, which require only six months.

Similarly, a consumer buying organic produce in the United States cannot be sure that it is free of contamination from genetically modified (GM) crops unless this is explicitly stated on the label. In Europe, GM content in all GM-free food, including organic produce, is limited to 0.9%, and some certifying bodies, such as Britain's Soil Association, allow no detectable GM.

Because organic products fetch premium prices, there are concerns about the possibility of cheating. Organic rules are enforced by farm inspections, but the logistics can be difficult, particularly in remoter parts of exporting countries. "The inspection process is not completely foolproof," admits Francis Blake, standards director of the Soil Association and a former inspector. "It relies on trust."

As a result, some researchers have begun to look for ways to test organic products for authenticity. Alison Bateman of the University of East Anglia in Norwich, UK, is developing a test based on the higher proportion of the isotope nitrogen-15 in organically farmed soil. This is because nitrogen-fixing plants accumulate more of this heavy isotope than is present in synthetic fertilizers. Other researchers are investigating whether concentrations of trace elements such as calcium, boron, magnesium and selenium differ between organic and conventional produce.

But tests such as these address only the final products, and so cannot verify whether the farm from which the food came adhered to the principles of organic agriculture. "They cannot tell you if a product has been organically managed or not," says Blake. **Laura Nelson**

Is organic food better for us?

This is the claim that attracts many of the consumers who buy organic, so it's no surprise that the movement's advocates answer with an unequivocal 'yes'. In 2001, for instance, the Soil Association concluded unambiguously that organic food contains less of the bad stuff, such as pesticides, and more of the good stuff, such as vitamins and minerals[2].

But independent scientists are less convinced. They say that many comparisons between organic and conventional produce are let down by poor methodology. For example, some studies fail to take into account the fact that organic farmers prefer crop varieties that are resistant to disease, whereas conventional farmers focus on high-yielding strains. Such studies confuse the effect of production system with variety.

Apparent benefits may also turn out to be superficial. Several studies have shown that organic crops contain higher levels of nutrients such as vitamin C and iron[3], for example, but most people in developed countries already have enough of these compounds in their diet. "When evaluating relative nutritional value, these are not important targets," says Kirsten Brandt, an agricultural scientist at the University of Newcastle upon Tyne, UK.

On the other hand, plant secondary metabolites, substances that may be present at higher levels in organic food, could be an appropriate target, says Brandt. Phenolic metabolites, which fruit and vegetables produce to ward off insects, are believed to have anticancer properties, for example. Last year, food scientist Danny Asami and his colleagues at the University of California, Davis, looked at organic and conventionally grown marionberries and maize (corn) from the same farm, and found 30–50% more phenolics in the organic samples[4]. Studies of organic pears and peaches have also showed raised levels of phenolics[5].

Brandt, who tracks such studies, says that the evidence points to organic crops containing 10–50% more secondary metabolites than conventional equivalents. This may be because fertilizers applied to conventional plants supply a surfeit of nutrients, encouraging the plant to channel more energy into growth, rather than defending against pests.

But do plant secondary metabolites really do us any good? Anthony Trewavas, a plant scientist at the University of Edinburgh, UK, and a high-profile critic of the organic movement[6], questions whether we should be trying to boost levels of secondary metabolites before we know the answer to this question. About 10,000 of these metabolites are thought to exist. Many that have been studied seem to behave paradoxically, acting as carcinogens at high doses and showing anticancer properties at low doses[7].

At the very least, it seems reasonable to expect organic food to be free from pesticides, which are banned or severely restricted under organic regimes. Food-safety authorities monitor pesticide residues in conventional crops, but levels do occasionally exceed maximum legal limits. And according to a 1998 study by Britain's Consumers' Association, some pesticides remain on fruit and vegetables even after they have been washed[8].

But should we be worried about this? Most researchers believe that allowed residues are safe, although uncertainties exist. The difficulty in applying results from animal experiments, which are the mainstay of toxicological assessments, to humans is one problem. Opinions can also be revised. The chlorine-containing pesticide lindane was banned in Europe in 2001, for example, because of concern that it might promote breast cancer[9]. Ultimately, most toxicologists urge caution in assessing and regulating pesticide residues, but they don't see the need to eliminate them entirely. **Jim Giles**

P. DEAN/GARNT HEILMAN PHOTOGRAPHY

Where there's life: the broad biodiversity supported by this organic cereal crop is clear to see.

F. GILSON/STILL PICTURES

Is organic farming better for the environment?

This is a more complex question than it at first appears. In some arenas, such as biodiversity, organic farming has clear benefits. But in others, such as runoff and atmospheric emissions, the differences between the two systems are difficult to establish.

Although few large, long-term studies directly comparing the systems exist, several literature surveys have brought together smaller studies to build overall comparisons[10,11]. There is general agreement on some benefits. For example, organic farms do better than conventional farms at nurturing abundant and diverse populations of plants, insects and other animals. And organic farms release no synthetic pesticides or herbicides, some of which have the potential to harm wildlife.

Organic farms also score points for using less energy — both per unit area and per unit of yield — and producing less extraneous waste, such as packaging materials for chemicals and feed. A typical study at Washington State University in Pullman totted up the energy consumed by labour, machinery, electricity, fertilizer, pesticides and weed control to grow apples in organic and conventional orchards, and found the organic orchard to be 7% more energy efficient[12].

On the flipside, organic methods have a greater environmental impact in some small ways, studies show. Methane emissions from organic farms are likely to be higher per unit of food production, for example. At least in the United States, where dairy cows receive growth hormone, organically raised cattle yield considerably less milk than their hormone-assisted peers — requiring more cows, which collectively pass more methane.

But findings are less definitive about the much more significant environmental impact of farm runoff — through which nitrates and phosphorus leach into streams, rivers and lakes, causing algal blooms that suffocate fish. Several studies have suggested that organic methods will reduce nitrate leaching, but according to a 2003 assessment of the literature sponsored by the British government, the various factors that affect runoff mean that this is not guaranteed[13]. Too few measurements of phosphorus runoff have been made to determine which system releases less, the report concluded.

In theory, organic farms are friendlier to the atmosphere. They should, for instance, generate less carbon dioxide, which is released in abundance in conventional farming by burning fossil fuels to manufacture, transport and spread nitrate fertilizers. And the ploughing into the soil of crop residues and cover crops should pull carbon back out of the atmosphere more efficiently. Organic methods might also be expected to produce less nitrous oxide — one of the causes of acid rain — than is released by heavily fertilized soils.

Although the British assessment found that organic farming does lead to lower CO_2 emissions, it also said that a lack of firm data made it impossible to compare emissions of nitrous oxide — which is also produced by legumes and manure on organic farms. Nor were there enough data to evaluate the effectiveness of the two systems as sinks to capture atmospheric carbon.

For organic advocates, the key environmental issue is not the year-by-year balance of farming inputs and outputs, but rather the long-term sustainability of the system. By recycling both nitrogen and organic material back into the soil, they believe, organic agriculture can ensure this.

Many studies support the idea that organic methods are good for soil quality[14]. "I used to be sceptical about organic methods, but the evidence on organic material changes things," says Mark David, a biogeochemist at the University of Illinois at Urbana-Champaign. But in the absence of long-term comparative studies, the argument about sustainability is difficult to prove. **Colin Macilwain**

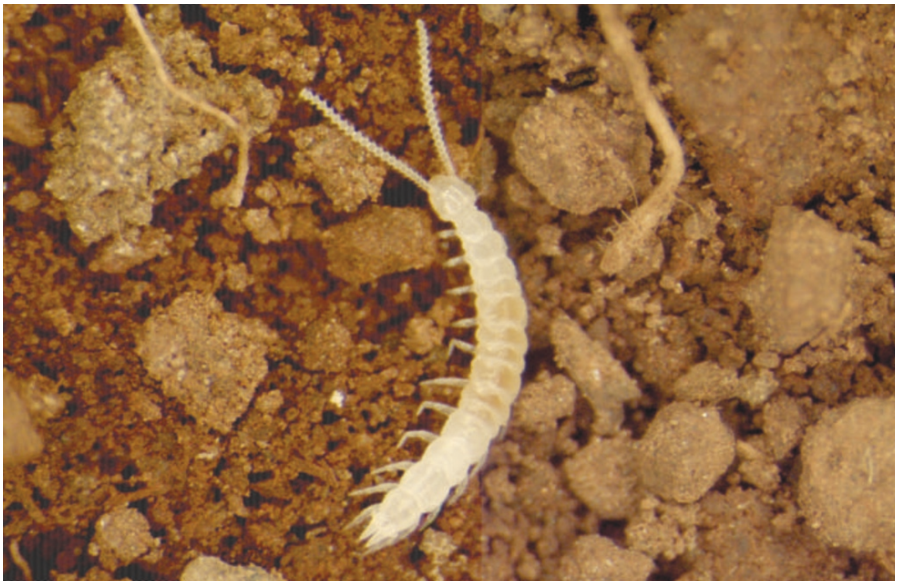
Can organic farming replace conventional agriculture?

Not if the world wants a meat-rich diet, as even die-hard organic proponents are willing to concede. But if the world's demand for cheap, abundant meat can be curbed, then quite possibly it could.

Ultimately, it's a question of efficiency and yield. The elimination of pesticides and herbicides does not seem to reduce yields as much as you might expect. Because pests tend to prefer particular plants, the crop rotations favoured by organic farmers help to prevent insect populations from accumulating to damaging levels. Continuous cover cropping in winter also keeps weeds down, so the soil accumulates fewer weed seeds. Natural pesticides and mechanical weeding finish the job.

Still, there are some regional pest problems for which no organic solution has yet been found. Notorious in the northwestern United States is the garden symphylan (*Scutigerella immaculata*), a centipede that can attack asparagus, maize, mint and strawberries and is controlled by soil fumigants in conventional systems. Years of research have yielded no effective organic control — all organic farmers can do is replough the field in an attempt to kill the centipedes.

A bigger influence on yield is the means by which organic fields are supplied with enough nitrogen to maintain productivity. Conventional fields get a generous dose of nitrogen each season from synthetic fertilizer, whereas organic fields get theirs from manure and cover crops, sometimes called 'green manure'.



J. UMBLE

Soil survivor: the garden symphylan has so far proved resistant to any organic pest controls.

Season to season, the two approaches can produce comparable yields. A 21-year study by the Research Institute of Organic Agriculture in Frick, Switzerland, concluded that organic fields produce yields 20% lower than conventional fields, on average[15]. Meanwhile, another long-term study by the Rodale Institute in Kutztown, Pennsylvania, obtained roughly equal yields of maize and soya beans with the two systems. The Rodale team also found that organic systems can achieve 20–40% higher yields in drought years[16].

But to maintain the soil's nitrogen content in the long term, organic farmers must grow a legume or other nitrogen-fixing crop regularly. This takes land out of commercial production, reducing the overall yield of a plot over time. Although some legumes are edible, the most efficient nitrogen-fixers, such as clover, are not. The Rodale researchers managed to minimize lost yield by growing legumes over the winter, but this may not be practical in harsher climates; nor will it provide the same benefit in warmer regions where cash crops are grown year round.

Vaclav Smil, a natural-resources researcher at the University of Manitoba in Winnipeg, Canada, calculates that there is an even bigger obstacle to organic edging out conventional farming any time soon. He says that the total nitrogen available to organic farmers through manure and legumes amounts to less than half the total nitrogen consumed by the world's farms today — some 85 million tonnes. More cover cropping may increase the available nitrogen, but this is a luxury farmers in places such as Indonesia or China can ill afford. "In these countries, you cannot plant crops that no one will eat," Smil says.

In large part, the huge nitrogen inputs required by modern agriculture are needed to grow sufficient grain to raise livestock: producing a kilogram of lean meat requires 25–50 kg of grain. Even with sufficient nitrogen, organic farms would have a hard time meeting this demand, Smil says, because they must grow a variety of crops to maintain soil health and defend against pests. Turning over entire farms to grow maize and soya beans to feed livestock isn't a viable option.

Even stalwart supporters of organic agriculture agree. But their line is that we should eat less meat and more vegetables, and embrace an organic future. The argument that organic farming can't produce enough food "only works if you assume that we continue to expand production of cheap meat", says Peter Melchett, policy director of Britain's Soil Association. **Virginia Gewin**

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