

Urban myths of organic farming

Organic agriculture began as an ideology, but can it meet today's needs?

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There is a widespread belief that low-yielding organic agricultural systems are more friendly to the environment and more sustainable than high-yielding farming systems. The current aims of organic systems — maintenance of soil fertility, avoidance of pollution, use of crop rotation, animal-welfare concerns and wider environmental aspects — would be hard to quarrel with. But the rules and regulations that have to be followed to achieve these ends caused one leading organic researcher to admit that that in organic farming “there is very little science” and “this gives rise to a great deal of illogicality and confusion particularly in some areas of production”¹.

Only two principles really distinguish organic farming from other farming methods. Soluble mineral inputs are prohibited (Box 1) and synthetic herbicides and pesticides are rejected in favour of natural pesticides (Box 2, overleaf). But agriculture based on these principles results in a more costly product, mainly because of lower yields and inefficient use of land.

Organic agriculture developed from the philosophical views of Rudolf Steiner and later Lady Eve Balfour, who in the 1940s founded the Soil Association. In the United Kingdom this association licenses about 70% of organic production and sends inspectors to check that its regulations are being followed. Although its supporters assert that organic agriculture is superior to other farming methods, the lack of scientific studies means that this claim cannot be substantiated.

Conventional agriculture is a diverse set of technologies using the best available knowledge, whose ultimate goal is the safe, efficient provision of foods in abundance and at lowest price. As with all technologies, problems often arise in the practices of conventional agriculture — but rejection of a technology because of problems also means losing potential benefits.

There is a widely held belief that organic farming is environmentally superior. But although reduction in pesticide use (Box 2, overleaf) leads to higher reported levels of some insects and reported sightings of birds on organic farms (pages 121–138 of ref. 1), current synthetic pesticides are very unstable; only transient declines of most field insects are reported even at full pesticide dosage². Similarly, the lower levels of aphids observed on organic farms could well reflect lower nitrogen and protein content of organ-



Organic farming claims environmental superiority, but lack of scientific data makes this hard to verify.

ic crops, and lower yield. Expressed as a ratio of crop yield/aphid population, the difference is negligible². It is also often overlooked that some conventional mixed farming can maintain species diversity. For example, conventional mixed farming in smaller plots (providing more field margins) or farming based on the traditional ley system (for example undersowing wheat with legumes) maintains conventional yields and low costs¹. The benefits for wildlife equal those provided by organic farming but at far lower cost to the consumer¹.

Nor do organic farming practices necessarily conserve the environment. Competitive organic farmers keep their fields clear of weeds through frequent mechanical weeding — a method that damages nesting birds, worms and invertebrates — and high use of fossil fuels, which greatly increases pollution from nitrogen oxides³. A single treatment with innocuous herbicide, coupled with no-till conventional farming, avoids this damage and retains organic material in the soil surface. Similarly, although use of manure means higher, beneficial levels of earthworms in organic fields, there are numerous problems with the use of manure (Box 3, overleaf), including possible effects on human health⁴.

Use of soluble mineral salts prohibited by organic regulations is another contentious issue. The minerals taken out of farmland as food produce must balance those put back by some other means. Organic farmers typically rely on legume nitrogen fixation, rain water or mineral recycling

in the farm. The few detailed accountings suggest slow but accumulating mineral deficits, particularly of potassium and phosphate^{5,6}, in organic farmlands. Organic farms are required to try to balance manure

Box 1 Confusion of principles

Organic proponents assert that better plants are produced from minerals derived from manure breakdown, so that organic food is superior and improves human health. Hundreds of rigorous tests have failed to reveal better-tasting properties or improved nutritional value, but have consistently shown that organic produce has lower nitrate and protein content¹⁶. Conventionally farmed food seems to be better for children¹⁷, although rodents apparently favour organic food¹⁶. Overall cancer rates have dropped 15% during the era of synthetic pesticide use. Stomach cancer rates have dropped 50–60%, probably an effect of plentiful, cheap conventional fruit and vegetables¹⁸. But this may not be the whole story, because food mycotoxins from contaminating fungi (which can be controlled by specific fungicides) definitely contribute to European cancer rates — fumonisin and patulin are both reported to be higher in organic products^{19,20}, and failure to use effective fungicides on organic farms has led to these farms acting as repositories of disease^{21,22}. Organic farms may be protected from the full effects of disease outbreak because they are surrounded by conventional farms using proper fungicides.

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and straw production with use on the farm itself. Excess organic manure or straw is thus usually not available to provide for inevitable deficits with year-to-year climate and agriculture variation. Ultimately, many organic farms can become dependent on products that are conventionally produced with inorganic minerals⁷.

Developments in the past 25 years have shown how conventional agriculture can be much more sustainable and environmentally friendly than organic farming⁸. A conventional farm can match organic yields using only 50–70% of the farmland. Excess food is being produced in Europe, so farmers are being encouraged by governments to set aside up to half of their land for fast-growing willow plantations which are then frequently coppiced and the wood used as fuel. With this novel conventional approach, now in commercial operation throughout Europe, total fossil-fuel use and carbon dioxide production are much lower than in organic farming⁹, and because of carbon recycling it is much more sustainable¹⁰. The plantation of willow trees, with its undercover of weeds, bird-nesting sites and mammal (including deer) and insect refuge, outperforms organic farms on any biological measure of environmental diversity⁸. But this practice crucially depends on the most efficient use of land for food production.

Application of any ecological approach to agriculture is fraught with uncertainty. Ecosystems are thought to maintain stability as a result of diverse species composition. Modern agriculture, with its single-crop monoculture system, is claimed by organic proponents to be inherently unstable and unsustainable. It is true that crops rapidly disappear from fallow fields as they cannot compete with weeds, but wild, stable monocultures of species such as phragmites, wild wheat, (genetically uniform) *spartina* and mangroves indicate that ecological stability is not understood¹¹. Furthermore, although mixed cropping (supposedly mimicking ecological diversity) can reduce disease, other crop combinations accelerate disease spread^{12,13}. Farms are land-management sys-

Box 2 Problems with pesticides and chemicals

Organic pesticides, it is asserted, work with nature and are environmentally unstable, unlike synthetic pesticides. About 60% of natural and synthetic chemicals are known rodent carcinogens²³, and around 20 different chemicals are used to maintain the safety of processed organic food¹.

Approved pesticides for organic farmers include

- copper sulphate, which has caused liver damage in vineyard workers, kills worms and is persistent in soil and produce (to be banned by the European Commission after 2002)
- rotenone, recently shown to induce Parkinson's disease²⁴
- *Bacillus thuringiensis* spores, causing fatal lung infections in mice²⁵.

Organic pesticides may be used more sparingly, yet more frequent treatments of crops with copper sulphate than good conventional practice have been reported on organic farms. Natural pyrethroids have to be used at much higher doses than some of the prohibited, equally unstable and much more effective synthetic pyrethroids, such as bioresmethrin.

tems maintained to produce food, in which farmer activity replaces normal ecosystem feedback controls.

In the search for a more environmentally sensitive way forward, integrated farm management combines the best of traditional farming with responsible use of modern technology¹⁴. This system integrates care and concern for the environment with safe, efficient methods of production. Detailed information on farm soil structure and field fertility is used to target minerals, and integrated pest management to control pesticides and avoid waste. But flexibility is emphasized, to take account of site-specific factors within a framework of conservation of wildlife habitat and landscape. Integrated farm management is a prime example of how to retain the benefits of technology while minimizing the problems. In contrast to organic farmers, who receive money for conversion, no financial supplement is given by

the UK government for good environmental behaviour and there is no government support to enable farmers to learn integrated farm management.

A common argument is that organic farming is 'holistic' and thus superior to reductionist 'chemical' agriculture on conventional farms. The dichotomy drawn between reductionist and holist views is, however, false and neither is superior to the other¹⁵. The organic system is really only an aggregate of regulations ensuring efficient use of resources, and as such no different from integrated farm management¹⁴. The organic community resists dissection of its system, claiming, for example, that direct comparisons of organic and conventional land are inappropriate and only the whole system can be compared². But resistance to comparison and examination invites suspicion. Any proper system can be subjected to a sensitivity analysis to identify constraints¹⁵. A genuine holistic approach emphasizes the importance of the context of the system. The flexible site-specific approach of integrated farm management uses a contextual attitude that is denied the organic farmer working under restrictive regulations.

Organic agriculture was originally formulated as an ideology, but today's global problems — such as climate change and population growth — need agricultural pragmatism and flexibility, not ideology. ■

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Box 3 Uses and misuses of manure

Soluble minerals are not used on organic farms. Although crude rock phosphate may be allowed, potassium chloride is banned; sylvanite, another form of potassium chloride, may be permitted. The main alternative mineral source for crop nutrients is animal or green manure. Manure treatment used on any mixed farm improves soil quality, but conventional crop rotation seems equally effective². Manure breakdown cannot be synchronized with crop canopy growth, as is desirable, but continues throughout the growing season. Ploughing in of legume crops (a necessary part of the organic method to build soil fertility) and continued manure breakdown leads to nitrate leaching into aquifers and waterways at identical rates to conventional farms¹. Degradation of organic material from manure in the soil produces significant amounts of nitrous oxide and methane, the most potent greenhouse gases. Manure is variable in composition, yielding unpredictable nutrition for crop growth: there is only a poor relationship between available nitrogen for crop growth and organic content of soil. Organic regulations recommend hay for animal feeding, but hay-fed animals infected with *Escherichia coli* O157 incubate this dangerous organism longer than 'conventional' animals fed with grain²⁶.