Genetic engineering versus organic farming.

From bees and carrots – 4 stories

Your questions – our answers

The fact and the fiction.

IFOAM

International Federation of Organic Agriculture Movements

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Who benefits? Who needs it? Where does it lead?

These are useful questions to ask when assessing a new technology. In the case of GMOs (genetically modified organisms) there are no benefits for either consumers or producers – only for the companies producing and selling them.

If farmers feel they need herbicide-resistant varieties that is because they are locked into a production system that depends on chemical inputs.

Genetic engineering is just one more step into a cul-de-sac (blind alley) that leads to further degradation of the environment, increased dependency of farmers and more risks for everybody.

The organic movement rejects GMOs in all agriculture, from an economic and ethical perspective, from a political perspective, from a risk perspective and simply because it is not needed.

We also offer a real alternative. Millions of organic farmers, big or small, rich or poor, demonstrate daily that organic agriculture can produce sufficient safe food for everyone – without using GMOs.

Gunnar Rundgren
IFOAM President

Push-and-Pull: an innovative and low-tech solution to control stemborers in Africa

The stemborer is Africa's worst maize pest. In combination with the Striga weed it can destroy whole crops. The International Research Institute ICIPE in Kenya, together with local farmers, developed a successful Push-and-Pull strategy: The farmers plant 3 rows of the fodder grass Napier around the maize field. Napier grass has a chemical aroma that attracts the stemborer larvae out of the maize crop. Most of them are killed in the sticky sap of the Napier grass. Between the rows of maize farmers also plant the legume Desmodium, which exudes a chemical aroma that repels stemborers. Desmodium also suppresses Striga. It is a perfect Push-and-Pull strategy, which provides healthy maize, additional feed and protection for the soil.

Another approach to control the stemborer is genetically engineered Bt-maize: This maize, with genes from the soil bacterium Bt, produces a toxin to combat the stemborer. The Swiss multinational company Syngenta started a project with Bt-maize in Kenya, together with a Kenyan Institute. But is it sensible to invest everything in an unproven and risky technology, which also increases once again the dependency of small farmers?

Left: Mrs Ouzo's fields were completely destroyed by the stemborer. Now – with Push-and-Pull – she has good yields.

Middle: Stemborer in maize.

Right: close-up of an advertisement of a biotech company: The vision is monocultures.

Vitamin A rice - a grand illusion?

Vitamin A rice – a genetically engineered rice producing pro-vitamin A – is being offered to the Third World as a remedy for widespread Vitamin A Deficiency (VAD). But there are fundamental problems: An adult would need to eat 9 kg of cooked rice a day for the required intake of vitamin A (whereas eating just two carrots would be enough). It is an open question whether transgenic rice will work in practice, and nothing is known about long-term threats to ecosystems and human health. Furthermore, there are many patents on Vitamin A rice. "The problem is that the transgenic rice will not remove VAD. It is a technology that fails in its promise, because there are no silver bullet solutions to such complex problems", says the Indian scientist Vandana Shiva.

The MAIN point is, however, that there are many better, cheaper and already proven solutions. The root cause of VAD and many other diseases is a totally unbalanced diet: rice, rice and nothing but rice. So changing dietary habits is essential. Small gardens with green leafy vegetables and with fruits, leaves from wild plants, dried mango slices, dried Baobab leaves, sweet potatoes... Even the World Bank has admitted that rediscovering and using local plants and conserving vitamin A rich fruit and vegetables has dramatically reduced the number of VAD threatened children in inexpensive and efficient ways.

Left: The beauty of diversity–the best prevention for VAD.

Right: The genetically engineered rice is also patented.

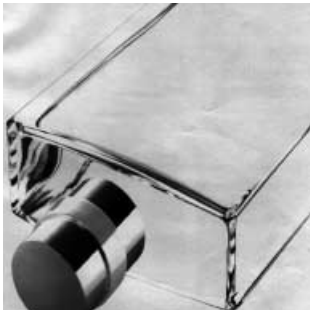
Using bees as 'Flying Doctors'

Grey mould is the worst disease affecting strawberries. A clever new organic control uses honey bees or bumble bees. When the bee leaves the hive, she passes through a footbath containing an antidote to grey mould. This is a harmless fungus. When bees pollinate the strawberry blossoms, they deliver the harmless fungus precisely into the blossoms. The beneficial fungus thus inoculates the blossoms preventing infection by grey mould. Recent studies in the US and Switzerland show that strawberry yields can be more than doubled with the help of these 'Flying Doctors'.

More findings from modern organic research: plants can 'talk' to each other. When attacked by a caterpillar, a tomatoe plant starts to produce defence chemicals. It also warns neighbouring plants by exuding a scent as an SOS-signal. These tomatoes then also start to produce the defence chemicals, even though they are not being attacked. (This scent, methyl-jasmonate, is often used in perfumes. During the experiments women were asked not to use perfume because this could confuse the plants.) Scientists are trying to find out if these scents could be used to warn tomatoe plants in advance of a caterpillar invasion. The plants would be perfectly prepared: a clever strategy, using nature's own methods.

Left: Bumble bee

Right: Perfume flask: tomatoes 'talk' to each other with scents.



Genetic contamination - a serious problem

Maize comes originally from Mexico and Peru. Here the greatest diversity of maize cultivars and wild species can be found. This 'centre of origin' with its amazing genetic diversity is essential for the future of maize breeding and thus for world-wide food security.

But this 'centre of origin' is already contaminated. A US-study shows that even in remote Mexican valleys local maize varieties contain genes from transgenic Bt-maize. "We were surprised by these results. We didnot expect any such thing, and it's most disturbing. What this means is that an entire species in its native state may soon become, in effect, genetically contaminated " says scientist Ignacio Chapella from the University of California (USA), who's team did this research.

The Mexican study indicates that genes from transgenic plants can spread across geographic areas and between varieties more quickly than scientists had previously thought.

Left: Great variety of maize cultivars.

Right: Genetic engineering in the laboratory.

Your questions - our answers

1. What is genetic engineering?

Genetic engineering is a new technology, involving the manipulation of genes. Scientists can transfer genes from one species to another, unrelated species. This is possible because of the universal 'gene language' – the genetic code. It is the same for all living beings, be it animal, plants or micro-organisms. For example, genes from a fish can be transferred to a tomatoe plant to render the tomatoe plant more resistant to frost. The engineered tomatoe plant is genetically forced to produce the fish chemical, because of this universal 'gene language'. So it produces an 'antifreeze' chemical which the fish normally produces to survive in freezing cold water.

With genetic engineering it is possible to break down the species boundaries set up by millions of years of evolution. Never before was it possible to transfer genes from animals to plants or from bacteria to humans. By combining the genes of unrelated species, permanently altering their genetic codes, novel organisms are created that will pass the genetic changes onto their offspring through heredity.

Genetic engineering is a corporate technology, mainly applied by industrial agriculture. In the year 2000:

- just five multinationals dominated the whole biotech business in agriculture.
- 98% of all transgenic crops were grown in three countries: the USA, Canada and Argentina.
- Two features were dominant: well over 70% of all GM-crops grown world wide are herbicide-resistant plants, and over 20 % are insect-resistant Bt-plants.

2. What is organic farming?

Organic agriculture is a sustainable form of production. It promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on methods that restore, maintain and enhance ecological harmony. Organic farming does not use synthetic chemical pesticides, herbicides and fertilisers relying instead on developing a healthy, fertile soil and sound crop rotations. In this way, the farm remains biologically balanced, with a wide variety of beneficial insects and other organisms to act as natural predators for crop pests and a soil full of micro organisms and earthworms to maintain its vitality. If direct control measures have to be taken to prevent serious crop damages, different agents of natural sources (for example Neem and Pyrethrum extracts) and biocontrol agents (for example ladybirds against aphids) can be used.

Organic livestock production focuses on animal welfare and husbandry methods that prevent the need for veterinary treatments. It is a method of agricultural production that is environmentally friendly, requiring high standards of animal welfare with health benefits for people. Organic farming recognises that human health is directly connected to the health of the food we eat and, ultimately, the health of the soil. Organic agriculture both

Vandana Shiva, President of the Research Foundation for Science, Technology and Ecology, India; winner of the Alternative Nobel prize 1993:
"Genetically engineered plants are patented. Farmers are not allowed to save or exchange seed from their crops. Through patenting a thousand-year-old tradition is turned into a criminal act. This cannot work. I'm convinced that organic farming is the only option - for the South and for the North."

relies on the vast knowledge and skills of farmers and on modern research to provide innovative new technologies.

'Organic farming' is a term defined by IFOAM standards and all organic food production and processing is governed by a strict set of standards and guidelines.

3. Why are genetic engineering and organic farming incompatible?

Organic farming and genetic engineering are two contradictory world views, two different philosophies, the two main options for the future.

The basic principles of organic farming are holistic. Rather than looking at isolated parts, the whole farm as a living entity is the focus. It is seen as a whole, enmeshed in the intrinsic web of life and part of the interactions and relationships between all living beings. Organic farming seeks to maintain an overall balance, by enhancing biodiversity (for example, flowering plants are sown on the borders of fields to attract beneficial insects into the crops). Organic pesticides are only used in emergencies cases, as supplementary measures.

Genetic engineering, on the contrary, isolates and reduces complex problems to single issues and then tries to find a technical solution. The very basis of genetic engineering depends on the search for single-factor-solutions, whereas all major problems of the environment and agriculture are multi-factoral. An example: Bt-maize expresses a toxin that kills the maize pest stemborer. But what if other, often beneficial, insects (such as lacewings, the monarch- or the black swallowtail-butterfly) are harmed as well? What consequences follow if the toxin also influences the soil-food-web or if the stemborer acquires a resistance to the Bt-toxin?

4. What are the differences between conventional breeding and genetic engineering?

Proponents of genetic engineering often claim that they are doing the same work as conventional breeding, just faster and with more precision. It is true that gene transfers also occur in conventional plant breeding, but these only take place between individuals of the same species, or, in some cases, between closely related species. A rice plant can cross with a different rice species, but not with a walnut. Genetic engineering is not bound by these limits. So, for example the genetically engineered Vitamin A rice contains newly inserted genes from daffodils, viruses and bacteria. As a result a new form of life has been created.

5. Is genetic engineering affecting organic farming?

The standards established by IFOAM categorically exclude genetically engineered organisms and products containing GMOs from the organic production system. With the application of transgenic organisms problems of contamination arise at different levels:

Hans Herren, Director of the ICIPE , Kenya, winner of the World Food prize 1995:
"When I'm visiting agricultural research institutes in Africa and India, I find the labs for biological control half empty and with broken windows. But the biotech-labs will be all new, with new equipment and stuffed with staff. Biocontrol projects, as we do it, are not so spectacular, not so sexy. Here I see a big problem."

- In the field: Pollen from genetically engineered plants is blown by wind or carried by insects into other fields, thus contaminating these crops. Bees are known to distribute pollen over a distance of 3 kilometres.

- In seed production: Breeding and multiplication of organic seed and seedlings is also affected by contamination from pollen from GM-plants.

- During harvesting, transport and processing: At all points from the field to the final processing facility (during transport on trucks, ships or trains, in mills, in food-processing factories etc.) there are many opportunities for contamination. Only strict segregation can minimise the risk.

Farmers, processors and traders wanting to produce and sell organic and GMO-free products; and consumers wanting to buy it, are confronted with massive problems of genetic pollution.

Another problem is that the pests may develop resistance to the Bt-toxin of transgenic plants. Bt-sprays are also used in organic farming, however, as an effective, natural insecticide. If this resistance were to occur they would become ineffective.

6. Will genetic engineering feed the hungry?

No agricultural revolution has ever solved the problem of world hunger. Hunger is a social and political problem and not a problem of production techniques. There is more than enough food for everybody in the world today. Genetic engineering may actually lead to more food insecurity and hunger because it will encourage the planting of monocultures, highly vulnerable to disease and pests, and it will make farmers more dependent on multinational companies that will demand payment for the patented GM-plants and seeds, and for chemicals and fertilisers. GMO-agriculture is the continuation of industrialised agriculture with all its known problems in an even more threatening dimension. Through unequal promotion of an industrialised GMO-agriculture the natural resources for all our food – biodiversity, healthy soils and clean water – will be further destroyed.

7. Will organic farming feed the hungry?

The main question confronting organic and sustainable farming is: how can farmers increase their yields with cheap, locally available and simple technologies, without damaging the environment? Organic farmers take their fate again in their own hands, and as many examples show, they can often increase their production – especially in the developing countries – significantly. One example: In Cuba the traditional 'three-sister-agriculture' with maize, beans and cassava produces yields twice as high as the sum of each one in monoculture. The maize plants function as bean sticks for beans and the beans fix nitrogen into the soil. Meanwhile, cassava grows well in the shady and damp conditions with the maize and beans, and helps suppress weeds.

Food for all is a long-term project, and only the protection of biodiversity and the cultural diversity of agriculture adapted to local conditions can secure

Regina Fuhrer, president of the Swiss Organic Farmers association:
"I'm an organic farmer. For me it's obvious that genetic engineering has to be kept out of agriculture. The risk of contamination is far too big. But above all we have much better solutions, dealing carefully and respectfully with nature."

Dr. Tewolde Gebre Egziabher, Ethiopia, leader of Third World countries in international negotiations around patents, genetic engineering and biodiversity, winner of the Alternative Nobel prize 2000:
"With patents big companies make our farmers dependent from their seed. Here I see a great risk for worldwide food security and biodiversity".

Recommended further reading:
IFOAM dossier "Organic Agriculture and Food Security" available at the website or from the Headoffice.

this. "For us organic farming is not a luxury, but the only possible solution to fight hunger and poverty", says Tewolde Egziabher, leader of Third World countries in international negotiations concerning patents, genetic engineering and biodiversity.

8. Is genetic engineering affecting biodiversity ?

Many experts fear that genetic engineering will dramatically accelerate the loss of biodiversity. An example: an English study predicts that a massive release of herbicide-resistant GM-crops could lead to the extinction of the already threatened skylark. This bird feeds on weed seeds. In herbicide-resistant GM-monocultures some of these weeds may be eradicated. This could not only threaten the skylark, but also other seed-eating birds and insects.

In general, genetic engineering represents a new dimension in an industrial agriculture with a strong tendency towards more monocultures, and thus a continuing loss of biodiversity.

Furthermore, genetic engineering removes the barriers that have protected the integrity of species for millions of years. "There are probably good reasons why it is impossible for a conventional plant-breeder to combine plant genes with animal genes. Those reasons have to do with the very survival of life on earth, and we ignore them at our peril", writes the US institute Sierra Club.

9. Is organic farming affecting biodiversity ?

Organic farming is by its very nature based on biodiversity. Many of its practices conserve and enhance a rich diversity, for example:

- Mixed farming with crops and animals. For example rice farmers in Bangladesh stopped using pesticides and started to rear fish in their rice fields and planted vegetables on paddy field dikes, thus introducing a substantial increase in biodiversity.
- Crop rotation is required practice in all organic farming.
- Trees, hedges and field margins maintain a rich diversity of natural predators such as spiders, birds and beetles that help to control pests.
- By solely using organic fertilisers the fertility of the soil and the diversity of soil organisms is enhanced.

10. Will my health be affected by genetic engineering ?

Maybe. Maybe not. GM-food is a new product, with new proteins we have never eaten before. We have never eaten bacterial proteins in maize, nor fish proteins in tomatoes, nor viral proteins in potatoes. Our bodies have no experience of these; and there is no way to predict if the novel food will cause allergies or other chronic bodily ailments in 5 or 10 years.

Recommended further reading:
IFOAM dossier 'Biodiversity and Organic Agriculture' available at the website or from the Headoffice.

Miguel Altieri, Professor of Agricultural Ecology, University of Berkeley, USA:
"We have shown on hundreds of examples that small scale sustainable agriculture in the South can lead to enormous production increases. In some examples the yields increased by more than 100%. The key to success was each time: diversity instead of monocultures. But genetic engineering is pushing monocultures. It's no recipe for the South".

Hardy Vogtmann, Honorary president IFOAM, Head of the German Federal Agency of Nature Protection (BfN):
"The 'green biotechnology' pretends to be eco-friendly and to reduce the chemical input. I'm sceptical. Our future lies in decentralised and organic solutions."

Genetic engineering is not a precise technology: there is no means of inserting a gene into a specific position within the host cell. The genes end up in random locations. But genes do not operate in isolation, they interact with each other. The inserted genes may disrupt vital other genes, they might affect neighbour relationships, they might disturb vital interactions. Possibly no acute toxic food will enter the market, but nobody can predict possible harmful long-term effects.

According to scientists, GM-food might have the following harmful effects:

- Allergenic and immune system reactions to the new substances contained in GMOs
- Antibiotic-resistant genes, often used in genetic engineering, could be transferred to pathogens in the gut. Disease triggered by these pathogens could no longer be treated with these antibiotics.
- New genes could alter the expression of native genes and so may have unexpected secondary effects.

11. What are the ecological consequences of GMOs released into the environment?

GMOs are living beings, they can spread and propagate. They can pass their foreign genes to wild species. Once released, it will be virtually impossible to recall genetically engineered organisms back into the laboratory. We are opening Pandora's box.

Some possible negative consequences for the environment include:

- Pollen from genetically engineered plants can contaminate wild species.
- Resistance amongst pests and diseases can develop.
- Soil organisms may be adversely affected by GM- crops. Toxic Bt has been found to persist in the soil for months, thus causing potential damage to soil-food-webs.
- Fish are being engineered to grow fast and increase in size. Giant GM-fish, having escaped from fish farms, may out-compete or even make native species extinct.
- Bacteria and viruses are genetically manipulated for a wide range of traits. If they escape or if they are released to the environment, they could have even worse 'side-effects' than plants and animals, because they reproduce and mutate much faster.

12. Where do patents come in?

In former times, nobody thought of patenting plants, animals or human genes and cells. No one thought it could be possible that an animal or a human gene might ever be considered as an 'invention' or

Mae Van Ho, Professor of biology at the open University, GB:
"I'm a scientist who loves science and believes science and technology can help build a better world and combat world hunger. But it must be the right kind of science and technology, and it must be decided by people themselves. Nature is interconnected and dynamic. But proponents of genetic engineering got stuck in the age of mechanics - the technology is just not innovative enough!"

the ‘intellectual property’ of some large company. But in the developing age of genetic engineering, industry is under pressure to expand the patent system from lifeless materials to living beings, in order to protect their financial investment in genetic engineering. But is it right to patent a tomatoe plant in the same way as a chemical or a vacuum cleaner? If life is put on the same base as a patentable commodity, if there is no longer a difference between a living being and a non-living thing, this will dramatically change our relationship to animals, to plants, to other people and to ourselves.

Farmers have to pay royalties for every patented seed, for every patented hen. And also for the chickens produced by this hen, and for all further chicken generations, for as long as 20 years. A farmer planting patented GM-crops is not allowed to save seed from this harvest for the next season. Some farmers in the USA and Canada were sued by the Monsanto company for doing this. With patented seed the control is taken away from farmers, from local areas, and passes into the hands of private companies. Many critics regard this as a major threat to world-wide food security and biodiversity.

Cecilia Oh, lawyer, Researcher for TWN (Third World Network):
"Many Third World countries object to patenting of seed and of living beings. They are developing ways and model-laws to protect their crop diversity and farmers' knowledge from corporate control. This gives me hope."

About IFOAM

The International Federation of Organic Agriculture Movements (IFOAM) meanwhile unites some 750 member organisations and institutions in about 100 countries from Albania to Zimbabwe. International networking and promotion of organic agriculture is the main task of the federation, which is democratically structured with a grass-roots basis.

IFOAM offers many opportunities for knowledge and information exchange, e.g. at numerous international, continental and regional IFOAM conferences. Information about the organic movement is also exchanged via IFOAM publications such as conference proceedings or the magazine 'Ecology and Farming'.

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