AGRICULTURAL GENETIC ENGINEERING AND BIODIVERSITY

Global Consequences of Genetically Modified Crop Cultivation

NABU

Commercial Cultivation of Genetically Modified Plants

Genetic engineering in agriculture still sparks massive controversies in the 13th year of its employment in commercial cultivation. From the perspective of GM proponents agricultural genetic engineering is indispensable in order to supply the world of tomorrow with food and natural resources. The intensive industrial agriculture of recent decades has however resulted in a dramatic decrease of diversity in field fauna and flora. The spreading of high performance cultivars and commercial seeds has eliminated well-adapted local varieties. Farmers are becoming increasingly unable to cultivate their own seed. Genetically engineered super-plants designed for the implementation in monocultures accelerate the reduction of diversity and economic sovereingty. As a consequence, many variants are irretrievably lost.

Cultivated Areas, Cultures and Characteristics

While the cultivation of genetically modified organisms (GMO) covered only about 3.100 hectares in Germany in 2008, a relatively small area, agricultural genetic engineering has been on the rise in other European countries and is now on a large scale. In many places this has come about without public notice. Transgenic maize was cultivated on agricultural areas of more than 20.000 hectares in France for instance, until it was banned from the fields in the spring of 2008 at the behest of the government. In 2009 the German government imposed a ban on all kinds of Bt-maize.

Commercial Cultivation of Transgenic Maize in Germany (Bt-maize), 2005-2008 (area in hectares)

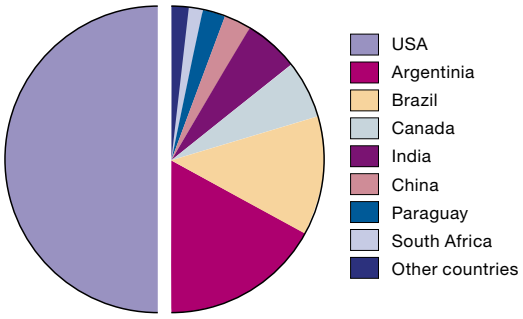
	2005	2006	2007	2008
Conventional maize	1.705.658	1.742.053	1.871.397	2.081.520
Bt-Maize	342	947	2.685	3.173
Percentage of Bt-maize per area	0,02%	0,05%	0,14%	0,15%

Reference: Location Register, Federal Office for Consumer Protection and Food Safety (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL), 2008.

Commercial cultivation of genetically modified organisms in Germany is limited to Bt-maize MON810, which is predominantly grown in the new states of the federation.

In 2008 genetically modified plants were cultivated on 125 million hectares in 25 countries according to the industry-oriented ISAAA agency (International Service for the Acquisition of Agri-biotech Applications). This equals roughly eight percent of the agriculturally cultivated area worldwide. However 99 percent of the cultivation is concentrated in eight countries. The USA assumes the top position with 62.5 million hectares (cf. pie chart).

Worldwide Commercial Cultivation of Genetically Modified Plants, 2008*



** Compiled from: ISAAA, 2009.*

The validity of the data supplied by the pressure group agency ISAAA is not clear; the information is however the only accessible information on the cultivation of genetically modified plants worldwide.

Four agricultural crop cultures commanding a large volume of trade have been approved for cultivation, namely: **soy beans, maize, cotton** and **rapeseed**. The genetic modifications can be retrieved in all plant cells from roots to pollen. They are protected by lucrative patent rights and possess two main characteristics:

- **Tolerance against total herbicides:** e.g. Glyphosate by Monsanto (trade mark: Roundup) or Glufosinate by Bayer (trade marks: e.g. Liberty and Basta). The herbicide resistance (HR) implemented in the plant's genes makes it possible to employ broad spectrum herbicides throughout the entire cultivation period without harm to the transgenic agricultural crops.
- **Resistance to a species group of insects:** A gene derived from the bacterium Bacillus thuringiensis (Bt), which is introduced into the plants, produces a toxic substance. The introduced Bt-toxin is then effective in all parts of the plant and is lethal for the caterpillars of, for example, the European corn borer or the cotton bollworm, once they feed on the plant.

Biodiversity Risks

Independent studies on the effects of transgenic cultures on beneficial organisms are still scarce. For a long time such issues did not appear on the agenda of researchers focussing on agricultural genetic engineering. Only recently have a few research teams started to investigate them.

The Influence of Transgenic Plants on Eco-Systems and Agricultural Crops

Individual elements such as plants, animals or soil interact with each other within eco-systems. Transgenic plants also become part of the natural habitat. The consequences of interactions between transgenic plants and their natural surroundings may eventually become evident only after several years, in which the fragile equilibrium in the soil, the species' susceptibility to illnesses or the pollination processes may have changed.

Genetically modified plants may spread through natural processes such as pollen flight and hibernation of the seed and may thus become a threat for neighbouring farms or conservation areas. Rapeseed or maize pollen can be transferred by wind and insects over long distances. This may result in a transmission of herbicide and insect resistance to wild or non-GM varieties growing far away. Genetically modified plants and seed are also dispersed by seed drills or during the harvest and get carried off along the trade and proceeding routes in many directions.

For large bioengineering concerns in the agricultural industry the cultivation of genetically modified organisms pays off twice over: They do not only earn by selling seeds, but also by selling large amounts of the corresponding total herbicide. Whenever total herbicides are employed in agriculture, they might harm soil and water as well as human beings and animals in the surroundings. The cultivation of Bt-crops may also promote the increase of secondary pests such as bugs and mites, which need to be controlled by insecticides eventually.

Misapprehensions of Agricultural Genetic Engineering

It has turned out to be a misapprehension that:

- **the cultivation of genetically modified crops is entirely beneficial for agricultural practice**
  In fact the necessity for the deployment of herbicides may be reduced in the first few years, but it normally increases quickly afterwards as the associated weeds grow increasingly resistant. According to data supplied by US authorities the consumption of the total herbicide Roundup increased fifteen-fold due to the cultivation of herbicide-resistant soy, maize and cotton cultures between 1994 and 2005.
- **transgenic plants yield large crops**
  The so-called first generation of genetically engineered plants is still substantially less productive compared to conventional species. Transgenic soy beans yield crops reduced by between six and eleven percent on average.The international report of the World Food Council (IAASTD) as well as a current study of the Office of Technology Assessment at the German Parliament (TAB) proves that assertions cannot be confirmed, according to which agricultural genetic engineering is economically efficient especially for poor farmers in countries of the southern hemisphere.

Global Problems and Risks

Over the past ten years numerous cases of contamination and crop damage or damage to other economic goods as well as damage to biodiversity have been documented. The trend is increasing:

- The large scale cultivation of herbicide-resistant rapeseed in Canada resulted in the contamination of neighbouring fields and crops by genetically modified organisms. Up to five percent of contamination were detected in certified conventional seeds.
- Crossbreeds of Bt-maize originally grown in the U.S. were found in Mexico. The novel characteristics first turned up in regional maize species and cognate wild plants in 2001.
- In Costa Rica, where genetically modified seeds of cotton and soy beans have been reared on an experimental level and cultivated for the global market since 1992, transgenic cotton now grows unhampered along bank slopes, field paths and even in front gardens.

- In Argentina, Brazil and Paraguay, forests are being cleared for the monocultures of glyphosate-resistant soy and subsequently substantial amounts of pesticides are deployed. Wind-blown dispersal of those into neighbouring settlements and onto fields harm human beings, plants and animals and pollute water resources.
- Early in 2008 scientists at the University of Arizona (USA) proved that pests have become resistant against the Bt-toxin in genetically modified cotton plants.
- In South Africa farmers growing Bt-cotton need to deploy insecticides against secondary pests such as aphids or cicadas. New pests have turned up there since 2000. Especially stink bugs account for great damages.
- The introduction of Bt-cotton in India was especially momentous. Resistance and secondary pests have spread there in several growing areas to such an extent that massive crop failure resulted. Thousands of farmers who had got into debt with credits for seeds and pesticides committed suicide as a result.

- Genetically modified plants do not only affect the actual target organisms but also endanger numerous agriculturally important beneficial organisms.

Responsibility? Negative

The insurance industry keeps refusing to safeguard anyone against the risks of agricultural genetic engineering technology. The companies producing seeds and agricultural chemicals have so far exerted massive pressure to block international provisions regulating liability and claims settlement. Ever since the Cartagena-Protocol on biological safety has come into effect 2003, the countries producing the majority of genetically modified plants have obstructed the passing of a resolution in cooperation with the pressure groups of the concerns in the agricultural genetic engineering industry. In most cases of damages the polluter is thus exempt from punishment. Either claims are not settled as no-one wants to appear as a plaintiff for lack of financial means or the producers as well as the importers and exporters of genetically modified plants rely on passing on the costs to the general public.

Global Protests

The spreading of transgenic products has led the agricultural genetic engineering industry to meet with global criticism. Genetically modified crop growing and trade of such crops are accompanied by protests. They are motivated by the legitimate concern to curtail ecological risks in the crop growing countries as well as the fear of economic losses. Despite the lack of public acceptance, the area on which genetically modified crops are grown still increases – fuelled by an enormous expectation of profits on the part of science, industry and politics.

What can you do?

- Be careful when buying meat or dairy products. The majority of transgenic plants end up in the feeding trough. Enquire whether the animals are fed with genetically modified plants. In Germany, the Federal Council resolved in early 2008 to pass a label "Gentechnik-frei" for food products. Traders however still defy this identification.
- Ask politicians, industry and traders to inform you clearly and transparently on the origin, trading routes and on the provenance of their products. More than 40 percent of the global cotton production is based on genetically modified seeds. Genetically modified cotton does not have to be labelled. Please buy organic cotton and look out for cotton textiles labelled as "Gentechnik-frei". More and more such products are now available
- Participate in supporting environment-friendly agriculture and thus biodiversity on fields and grassland, in gardens and stables worldwide.

NABU – a powerful lobby

NABU (NATURE AND BIODIVERSITY CONSERVATION UNION) is one of the oldest and largest environmental associations in Germany. NABU`s main objectives are the preservation of habitats and biodiversity, the promotion of sustainability in agriculture, forest management and water supply and distribution, as well as to enhance the significance of nature conservation in our society.

Further Information:
The complete text including a list of references can be downloaded on www.NABU.de/gentechnik free of charge.

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