Genetically Engineered Food and Crops in Russia

A report prepared for
ANPED,
The Northern Alliance for Sustainability
and SEU, Socio-Ecological Union

by
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The Northern Alliance for Sustainability (ANPED) is a network of non-government organisations (NGOs) based in the Northern Hemisphere. We strive to change unsustainable consumption and production patterns with an emphasis on the North. ANPED's role is to build sustainable societies by empowering grassroots organisations through sharing information and skills, common campaigns, publications and participation in international governmental conferences. ANPED networks groups working on Genetic Engineering, Local Agenda 21, Corporate Accountability, Extended Producer Responsibility and Clean Production. We are a democratic network of NGOs and voluntary organisations, with most of our members in Central and Eastern Europe (CEE) and the Newly Independent States (NIS). Membership is open to any such organisation sharing our aims.

ANPED's work on Genetic Engineering of Food and Agriculture in CEE and NIS started in 1996. In May 1998, ANPED organised the first skillshare on GMOs and Agriculture for NGOs from CEE and NIS, in Budapest, Hungary. Since late 1999, ANPED has been mapping the level of commercialisation of GMOs and regulatory oversight of GMOs in specific CEE countries. To date, three report have been published:

- ANPED-Green Action report: "*Genetically Engineered Food and Crops in Croatia: A Threat to Sustainable Agriculture*"**,** published in Zagreb, February 2000
- ANPED-EcoSouthWest report: "*Bulgaria: The European Corporate Playground for Genetically Engineered Food and Agriculture*", published in Sofia, May 2000
- ANPED-MURE report: "*What's for dinner Mum? Genetically Engineered Food and Crops in Poland*", published in Warsaw, May 2000

ANPED's GMO programme now includes groups from 8 countries in the region working together to raise public awareness of genetically engineered food in their countries.

ANPED's core activities are funded by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) and the EU DG Environment

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THE SOCIO-ECOLOGICAL UNION (SEU) is a large international non-profit organisation founded in 1988. By the end of 1999, SEU included nearly 300 organisations from Azerbaijan, Armenia, Belarus, Czech Republic, Finland, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Norway, Palestine, Russia, Scotland, Spain, Tadjikistan, Turkmenistan, Ukraine, USA and Uzbekistan, with a membership of some 25,000 people. SEU is an international network of grassroots organisations, where communication and information exchange occurs among network members. SEU has six programs:

- Education for Environmental Problem Solving
- Local Initiatives - Alternative Humanity
- Eco-Settlements for the 21st Century
- Nuclear and Radiation Safety
- Chemical Safety
- Forest Conservation

SEU's Center for Co-ordination and Information (CCI) was created to promote information exchange and co-operation between SEU members and to distribute environmental information from SEU members to the media and other environmental organisations. Over the years, a permanent information exchange was established on environmental problems, activities undertaken, and support needed or available,. SEU CCI and its Press Service produce the bulletins: *Esosvodka* and *Ecosvodka-Obozrenie* - for journalists, and *SEU Vesty* and *SEU-Times* - for environmental organisations. The Press Service's activities include the organisation of information campaigns on conservation of the primeval Karelian forest, promotion of Ecodom (eco-house), protection of environmental rights, and a campaign against the construction the oil terminal in a nature reserve on the Black Sea coast. The main campaign for the last three years has been against genetic engineering. **For more information:** Seupress@yahoo.com, Http://www.ecoline.ru/seu PO Box 211, RU-121019 Moscow, Russia. Tel/Fax: 7-095-124-7934.

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EXECUTIVE SUMMARY

This report is the result of investigative research undertaken to determine the current level of commercialisation of genetically engineered (GE) crops and foods and the emerging situation with genetically modified organisms (GMOs) used in agriculture, in Russia. Its purpose is to prevent Russia from becoming a dumping ground for this dangerous technology and its products, which are unwanted or even banned in the European Union.

The main conclusion of the report is that there is **complete chaos in the regulatory system** supposedly in place to protect the public and the environment. The Ministry of Agriculture is largely ignorant of the functioning of the biotech[1] institutes and the Inter-Agency Commission on Genetic Engineering Activities (GENCOM), that issues permits for releases of GMOs. There is **no central database** of either commercial releases of GMOs or field trials. The database being established is the responsibility of the most aggressive promoter of genetic engineering in Russia, Dr. Skryabin. Approvals of field trials, licensing of GE food imports and registration of GE food products are all underway even though there are still no procedures established by GENCOM. There are **no representatives of consumer, environmental, or church organisations on GENCOM**. Its members are the same genetic engineers doing the experiments, a **clear case of the fox guarding the hen house.**

Although GENCOM claims to have approved only 3-5 sites for experimental field trials, numbers differ even among members of the Commission. However, it is known that at least 18 notifications for deliberate release, including approvals for **field trials and processing/consumption,** have been granted. These appear on a list of deliberate release notifications prepared for the OECD and UNIDO. Monsanto leads with 8 notifications and is most advanced in terms of commercialising their GE varieties of potatoes, soybeans and sugar beet. Of particular concern, are field trials of sugar beet, given that Europe is a centre of diversity for this plant.

Marketing approval has been granted for Monsanto's herbicide-tolerant soybeans and two varieties of Monsanto's GE potatoes. In addition, AgrEvo's sugar beet appears on the OECD notifications list as having approval for processing and consumption. Novartis has completed trials of its GE maize and sugar beet and is awaiting marketing approval. It is highly likely that GE soybeans, maize and potatoes are already on the Russian food market, coming onto the country via commercial imports or food aid, or indeed from illegal domestic cultivation of these crops, in particular *Bt* potatoes.

Domestic research and development of GE agricultural and horticultural products, transgenic animals, GE pharmaceuticals and other industrial applications are all progressing at a rapid pace **- GE horticulture and forestry appear to be the most advanced.**

Biosafety is only being given "lip-service" by the officials and institutions entrusted with protecting the environmental and human health of the country. More effort is being put into protecting field trials from concerned citizens and non-government organisations (NGOs), in the form of dogs, armed guards and fences, than the true threat of cross-pollination of GMOs with other plants through pollen transfer. Even claims have proved to be untrue.

The U.S. government together with US agribusiness is actively promoting agricultural biotechnology throughout the region.

There is **no public access to information**. Information about the environment, although guaranteed in the Russian Constitution, is not available from the regulatory bodies such as GENCOM or the various ministries

[1] Genetic engineering is part of the science of biotechnology; in this report, the two terms are used synonymously. This report is focussed on agricultural biotechnology viz. the use of genetic engineering techniques and GMOs in agriculture, specifically plants.

with oversight powers. Neither the membership of GENCOM nor the procedures they follow are transparent. The register of GE food products on the Russian market is inaccessible to most of the Russian population, being available only on Internet, particularly those that are responsible for local enforcement of the labelling law – strangely, the shopkeepers. The database to be established by Skryabin's institute will also be available only on Internet.

There are many **viable alternatives to GE agriculture in Russia**. Russia has a long and successful tradition of breeding new plant varieties. According to Dr.Vitaliy Pukhalskiy at the Vavilov Institute: "*Russia's agriculture is in very poor condition right now…But now with the work of our breeders, I do not think that we need genetically engineered food here*."[2]

SEU Demands
In the light of these findings, SEU urges the Russian Government to protect the environment and the Russian people from the risks posed by genetically engineered organisms. Most urgently, international food companies and Russian food producers must source GE-free raw material and ensure the provision of GE-free food to Russian consumers. The Russian Government must immediately:

- Introduce a moratorium on **all** environmental releases of Ratify the international Biosafety Protocol, and introduce a national biosafety law.
- Ratify the international Biosafety Protocol, and introduce a national biosafety law.
- Immediately prohibit the import of products derived from GE crops containing antibiotic resistance marker genes
- Introduce a proper labelling regime and ensure traceability of all GE crops or products thereof.
- Ensure wide representation on GENCOM, which must be reconstituted to remove scientists that have a conflict of interest and add representatives of environmental, consumer and health NGOs.
- Provide support for organic farming by stimulating demand for organic food through education, public procurement policies and by providing economic incentives.

[2] Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Russian Academy of Science. Personal interview, Moscow, Russia, 6 July 2000.

1. Introduction

In 1994, for the first time ever, a genetically engineered plant was commercially grown. The introduction of the FlavrSavr tomato in the US was the beginning of a global change in agriculture - or so the big transnational companies, such as Monsanto, AgrEvo and Pioneer Hi-Bred had planned. However, when the first harvest of GE soybeans was about to be shipped to Europe in 1996, consumers there voiced an unforeseen rejection of this food. Consumers demanded the right to know. They wanted to know what they were eating and asked for the labelling of GE food.[3] In many countries of the European Union (EU), the introduction of genetically engineered food onto the market failed, and the major EU food producers and retailers now guarantee a GE-free food supply. Corporate food processors, such as Nestle and Unilever, have made public commitments to source only GE-free ingredients in their products in several countries.

Only Spain, and to a very limited extent France and Germany, were growing GE maize 1997-1999. To date, the EU has approved the deliberate release of 18 GMOs (under Directive 90/220/EEC), of which 11 are agricultural plants, but their status is uncertain, given that national bans have been imposed on 8 of these GMOs by 5 different EU countries. No GMO has been given authorisation for deliberate release since October 1998 and since June 1999, the EU has a de facto moratorium on all new approvals.[4] There are also bans in Saudi Arabia, Thailand, Sri Lanka, and some regions of Brazil and Australia. Since 1999, there is an increasing awareness about the dangers of GE crops even in the US, and the acreage planted with GE crops has dropped this year. According to a survey by Reuters at the Farm Bureau Convention in the US planting of herbicide-tolerant RoundUp Ready maize are down 22%; *Bt* maize 24% and RoundUp Ready soybeans down 15%.

Another nail in the coffin for GE food has been the Biosafety Protocol, finally agreed in Montreal in January 2000. It clarifies the issue of international trade in GMOs. The Protocol, adopted by 130 countries world wide, including Russia, allows countries to apply the ‘precautionary principle’[5] and reject imports of GMOs if they think there is a safety risk.

Objectives of this Report

- Analyse the situation regarding the level of commercialisation of GE crops and food in Russia
- Expose the situation and thus help raise awareness of GE and its dangers in Russia to change the positive perceptions of GE food and agriculture among the media and the public, to prevent Russia becoming a dumping ground for GE food
- Alert Russian citizens and societal sectors, such as churches, consumer groups, teachers to the dangers posed by GE crops
- Close the widening gap in public awareness with respect to GE food and agriculture between Western and Eastern Europe
- Add pressure for the ratification of the Biosafety Protocol and Aarhus Convention[6]
- Promote awareness of more sustainable alternatives to GE agriculture e.g. organic farming.

This report is one in a series of country reports being undertaken by ANPED with a partner NGO in CEE/NIS. Reports on Bulgaria, Poland, and Croatia, that have been launched over the past few months, have been successful in starting public debate and heightening public awareness and participation in those countries -

[3] The term 'GE-free food', is used to mean food that does not contain any raw material derived from GE plants.

[4] Full text of press release announcing the continuing moratorium issued by the European Commission, 13 July 2000 available: www.europa.eu.int/comm/dgs/health_consumer/library/press/press62_en.html

[5] The Cartagena Protocol on Biosafety states: “*Lack of scientific certainty due to insufficient relevant scientific information . . . shall not prevent the Party of import, in order to avoid or minimise such potential adverse effects, from taking a decision, as appropriate, with regard to the import of the living modified organism in question*.”

[6]UN ECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, signed by Environmental Ministers in Aarhus, Denmark, June 1998.

Russia is the fourth in the series. Since Russia is not an EU accession country, there may be a chance to use this report to push for the type of strong biosafety laws that are currently being developed by African states.

Russian consumers have a right to know the true facts about genetic engineering and what is in their food. Moreover, they have the right, based on full disclosure of information, to make an educated decision for themselves about which agricultural path they want to follow. Until now, there has been minimal public awareness, and no national debate.

Activities of Russian NGOs

Some Russian environmental organisations are now running modest campaigns against GE food. The focus of these activities has been translating information into local languages and disseminating it through the media and NGO newsletters. Since most of the information relates to public opposition in the West, it has created a misguided impression among some Russians that this is a problem pertinent only to Western Europe.

Since 1998, representatives from the Russian NGOs, SEU, VIOLA (Bryansk), and No Corporations! (Voronezh) have been raising public awareness on the problems of GE food. However, this issue is still not a high priority issue for the Russian media, which has just begun to understand or take notice of this new threat.

Methodology

Investigative research was undertaken by ANPED and SEU to establish the level of commercialisation of GMOs, and the current and emerging situation with respect to GMOs used in food and agriculture in Russia. In July 2000, interviews - in person and on the phone - with experts from government, research institutions and NGOs were conducted in Russia to gather information about the legal, administrative, scientific and political situation concerning genetic engineering. The situation regarding the cultivation of GE crops (field trials and commercial cultivation) and imports of GMO-contaminated foodstuffs to Russia was also researched by undertaking a media review. Visits were made outside Moscow to centres of biotechnology in Pushchino, Orel, Voronezh, and Krasnodar, There are of course other regions of interest such as Blagoveshchensk in the Russian Far East where 70% of Russian soy is grown, but investigation must await a second phase.

Many would argue that Russian journalists and environmental activists are more than capable of doing this research on their own and do not need a foreigner to do it for them. However, the lack of openness by decision-makers and scientists in Russia's fledging democracy, combined with aggressive security measures against Russian environmental activists and journalists, makes it next to impossible for the information to be collected by Russians. Journalists and activists have been threatened with machine guns and had their cameras broken when trying to gather information on biotechnology in Russia.[7] Furthermore, President Putin recently dissolved the Ministry of Environment, and has repeatedly and publicly asserted that environmentalists are undercover foreign spies and terrorists.[8] Strangely, these same institutes and decision-makers that refused to meet with Russian journalists and the concerned public were prepared to speak to a foreign journalist.

Background

One of the most telling indictments of the Soviet economic system was the persistent queues for food at State stores even as the government spent billions of dollars to import massive quantities of grain. The region's food supply problems stemmed largely from the unproductive nature of collective agriculture, unrealistic prices and an inefficient and wasteful food processing and distribution system.[9]

Russia's main crops include potatoes, wheat, sugar beet, barley, oats, rye, cabbage and sunflower seed. Since the beginning of the 1990s, there has been a considerable decline in the cultivated area of grain. In 1999,

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[7] Velikodnaja, Natalia. SREDA Environmental Program, NTV. Personal interview. Moscow, Russia, 4 July 2000.

[8] "*Putin Abolishes Lone Russian Environmental Agency*", Washington Post, 23 May 2000.

[9] DJ Peterson. *Troubled Lands*: Westview Press, 1993.

Russia produced only 54.6 million tonnes (mt) of grain (after processing) as compared to 89 million tonnes in 1991. Similar drops in production have been seen in sugar beet, 15.2mt in 1999 compared to 24.2 mt in 1991, and potatoes, 31mt compared to 34mt in 1991.[10] Potato production has been declining continuously during the last two decades as both yields and the cultivated area has decreased. Losses in processing, storage and transport are at least 30 percent and even higher by some estimates.[11] Today, individual households produce some 60-90% of Russia's potato crop.[12]

Soybeans are of particular interest in terms of genetic engineering, because they are one of the top five commercialised GE crops worldwide. However, Russia's soybean production is small. Compared to annual US production of 85 million tons of soybeans grown annually, the 400,000 tons grown in the Amur Region (Russian Far East) is insignificant. Today, half of the Russian soybean crop goes to China, Russia's traditional market, and is bartered for industrial products.[13]

Russia's agricultural population has been dropping steadily over the past decade. Between 1995-98, some 700,000 workers left the agricultural sector that in 1998 still employed some 11.1% of Russia's working population. This sector still represents an enormous proportion of Russia's employed population when compared to other countries in 1998, such as the UK's 1.9%, Spain's at 8.1%or France's at 3.7%.[14]

The devaluation of the rouble in August 1998 and the subsequent sharp rise in imported food prices has aggravated the food situation. Because of the poor harvest, agricultural output in the third quarter of 1998 was 17.7% lower than in the same quarter of 1997; for example, the potato harvest shrunk by 10%.[15] Dr. Konstantin Skryabin, Director of the Centre for Bioengineering claims that the Colorado Beetle destroyed 40% of 1999's potato crop, causing a loss of over US$ 2 billion. He uses this to justify pursuit of agricultural biotechnology.[16] The Russian Ministry of Agriculture contradicts this opinion, claiming that 1999 was the first profitable year in agriculture in the last ten, and the year 2000 also promises to be a good. "*We have a good breeding selection process. We can do without transgenic potatoes*."[17] Dr.Vitaliy Pukhalskiy at the Vavilov Institute of General Genetics supports this view: "*Russia's agriculture is in very poor condition right now…But now with the work of our breeders, I do not think that we need genetically engineered food here.*"[18]

There are many viable alternatives to GE agriculture in Russia. Russia has a long and successful tradition of breeding new plant varieties, and has established breeding centres across the country, each working on specific crops e.g. Soybean Institute in Blagoveshchensk, the Sugar Beet Institute in Ramony and the Potato Institute in Krasnodar. Although these centres undertake research and development on transgenic plants, they are also expanding the range of traditional varieties, improving hybrids, creating regionally adapted seeds and working on virus-free plants. Russia also has excellent centres of biodiversity and gene banks, such as the country's largest collection in St. Petersburg. The Academy of Agricultural Sciences has been able to largely extend the area in which soybeans can grow in the north, without resorting to genetic engineering.[19]

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[10] Interstate Statistical Committee of the CIS, *CIS in 1999, Statistical Abstract* (Moscow: 2000).

[11] Michael S. Strauss, Sandra M.B. Thompson, ed., Science, *Agriculture and the Environment in the Former-Soviet Union*, American Association for the Advancement of Science: Washington, DC 1993.

[12] Dr. Yrij Spiridonov, Head of Department of Herbology, Russian Institute of Phytopathology. Personal Interview, Moscow, 12 July 2000 at the Institute of Plant Protection.

[13] Takhir Bikbov, Scientific Consultant, Inter-Soy. Personal interview. Moscow, Russia, 4 July 2000.

[14] *FAO Yearbook – Production: Eastern Europe and the CIS 1999*, 4th Edition Vol. 52, (Europa Publications Ltd.: 1998).

[15] *Russian Economic Trends* Vol. 7, No. 4. 1998, Russian European Centre for Economic Policy (RECEP)

[16] Dr. Skryabin. Director, Centre for Bioengineering of Russian Academy of Science. Interview, Moscow, 7 July 2000.

[17] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July

[18] Dr.Vitaliy Pukhalskiy, Vavilov Institute. Personal interview, Moscow, Russia, 6 July 2000.

[19] Takhir Bikbov, Scientific Consultant, Inter-Soy. Personal interview. Moscow, Russia, 4 July 2000.

PART A: Part A: Genetically Engineered Crops and Food in Russia

2. Russian Domestic Research[20]

GE Agriculture and Horticulture Research and Development

"*We talked with many companies, but they were interested only in our supporting their safety claims for their GE crops. These companies wanted to promote GE in a very practical application. We don't work with them*".

-- Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Russian Academy of Science.[21]

Unlike in the West, where R&D is driven by the search for corporate profits, in Russia domestic research in ag-biotech has traditionally been driven by the need to increase food production. However, this situation is changing. Despite the absence of significant foreign investment, the pace and extent of Russian research has not slowed. Experiments have not been limited to crops, but include extensive research and field trials of GE trees, and to a lesser extent, transgenic animals.

The Institute of Bio-Organic Chemistry of the Russian Academy of Sciences in Puschino is one of the main research and development centres of biotechnology, and one of only two institutes we interviewed that had contracts with western companies. The institute's primary line of research is the development of biotechnology methods for medicine.[22]

The main experiments conducted at the Institute involve horticultural crops: apple, pear and pineapple[23]; radial pine trees; strawberries; various vegetables like the carrot, tomato, broccoli and potato; sunflower and flowers such as chrysanthemum, carnation and African violet. Some years ago in collaboration with the Center for Bioengineering in Moscow, the Institute of Bio-Organic Chemistry developed a system for transferring foreign genes to the sunflower - the most commonly cultivated oil-bearing plant in Russia. This development is particularly alarming because the introduction of GE sunflowers could wreck havoc with the genetic diversity of sunflowers developed by Russians over many decades. The first large-scale cultivation of sunflowers started in Russia in the 1830s when the first sunflower oil mills were built. Later breeding efforts by Russian breeders resulted in the creation of a second centre of diversity of the sunflower, the centre of origin being the US.[24]

There are several scientific centres using genetic engineering to introduce new traits to fruit trees. At the Institute of Horticulture in Orel, field trials of GE apple and pear trees began in June 2000. These trees have been genetically modified to be tolerant to AgrEvo's herbicide Basta. In other experiments, scientists have inserted a gene from the defence mechanism of plants that was cloned in the Institute of Agriculture and Biotechnology of Moscow to improve resistance of apples, strawberries and pears to plant pathogens. Elsewhere, the Puschino Institute is already field testing some apple, pear and strawberry varieties resistant to fungal diseases.[25]

Experiments with the Bt toxin [26]

In order to genetically modify crops to resist attacks by insects, the Institute of Physiology and Biochemistry of Microorganisms in Puschino is experimenting with the *Bt* toxin gene. Plants that contain a modified gene of a

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[20] For a list of the main GE research establishments, see Annex C

[21] Personal interview, Moscow, 6 July 2000.

[22] Dr. Sergey Dolgov, Director of artificial climate station "Biotron" at the Institute of Bio-Organic Chemistry of Russian Academy of Science. Interviewed 17 July 2000

[23] Pineapples are being grown in the laboratory

[24] "*Centres of Diversity - Global heritage of crop varieties threatened by genetic pollution*", Greenpeace, September 1999

[25] Dr. S. Dolgov, Institute of Bio-Organic Chemistry

[26] The cryIIIA gene from *Bacillus thuringiensis* subsp. *tenebrionis* (*Btt*)

natural toxin taken from the bacterium, ***Bacillus thuringiensis*** **(***Bt*) have been designed to provide a built-in pesticide against insect pests like Colorado Beetle and European Corn Borer. The Institute cloned the original *Bt* gene and has used it to create the first GE chrysanthemum in the world - one that demonstrates **resistance to butterflies and moths.** Puschino has a joint project with a Dutch company and a scientific centre in Wageningen to improve ornamental flowers, especially the chrysanthemum and carnation.[27]

The First Taste is the Sweetest?

Another project is the use of genetic engineering to alter the taste of some crops. Dr. Dolgov of the Institute of Bio-Organic Chemistry justified these experiments by stating that strawberries, apples and pears grown in countries such as Australia, are not very sweet. The Russians transferred the gene for taumatine (a supersweet protein) into plants. This not only resulted in sweeter fruits, but also sweet leaves. An unexpected effect of the genetic manipulation was resistance to some fungi. These GE plants are expected to bear their first fruit in 2001.[28]

The scientists are even playing the role laboratory rabbits for their own experiments. Dr. Naraditskiy has tasted the leaves of his transgenic pear and apple trees, modified with a protein from the taumatine gene. "*We have not tried the fruit, but the leaves of this plant is sweet, even the leaf is sweet! I have chewed this leaf and I am not dead*".[29]

Virus-Free Crops

General Genetics claims that by inserting the gene of alpha-interferon (obtained from the US) into tobacco, viral resistance in tobacco increases. However, the real purpose of these experiments is most likely to enable the plant to produce interferon for human medicine. Fortunately, there is some caution: "*We should not be in haste and plant this tobacco all around. I do not foresee much harm or consequences if we would receive human interferon from tobacco, but I cannot foresee what would happen if it would be planted in an open field and if this gene were transferred to other plants*."[30] Clearly, the consequences of releasing GE plants producing bioactive compounds - people eating and smoking vaccines, medicines and other drugs - are so dire, that these plants should never be released into the environment.

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[27] Dr. Sergey Dolgov, Institute of Bio-Organic Chemistry. Interviewed 17 July 2000

[28] ibid.

[29] Dr. Boris Naroditskiy and Dr. Emil Khavkin. All-Russia Research Institute if Agricultural Biotechnology. Personal interview. Moscow, 10 July 2000.

[30] Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Russian Academy of Science. Personal interview, Moscow, Russia, 6 July 2000.

3. Releases of GE Crops during Field Trials and Commercial Cultivation

There is no central database of Russian field trials and commercial releases. The most extensive information comes not from any official, scientist, or GENCOM[31] member we met with, but from an OECD/BINAS[32] website. It is uncertain how the OECD and UNIDO[33] came by this information, but it is fair to assume that it came from A. Golikov, who is the BINAS representative for Russia and Dr. Skryabin's Secretary on GENCOM. During interviews with officials and scientists, when we asked for a list of field trials, initially no one had the information, and then, the disclosed information was frequently contradictory. When shown the BINAS list, the Ministry of Agriculture responded that it was probably incorrect information. On the other hand, they could not deny the information because at the moment they have no way to control GMO releases. "*It's like these GMOs are almost ready to be commercialised. So it's probably incorrect information. These are not official variety trials. We should know. But I cannot say it is wrong.*"[34]

According to Drs. Dzhavauhiya, Spiridonov and Filippov, all of whom are members of GENCOM, this Commission has a special Working Group that licenses field trials.[35] When asked about the BINAS list, they said that: "*The information is correct because first there are biosafety trials, for example for potatoes it is 2-3 years, and then variety trials, how it behaves in different regions.*[36] *There are 22 permits granted, so you have correct information*". However, they then go on to contradict themselves: "*If they do not have permits to do these variety trials - and they do not - then this is a legal offence. I am not sure if these variety trials are being done*."[37] The Commission on Variety Trials is not allowed to permit variety trials until they have approval from the genetic engineering commission (GENCOM).

Different Types of Field Trials?

In Russia, it seems that scientists differentiate between two types field trials: for biosafety and variety testing. In the EU and the US, there is no formal difference between field trials, whether they are for seed multiplication, breeding, agronomic evaluation, scientific assessment or biosafety research. In practice, only very, very few field trials in the EU and US are solely for biosafety purposes. Sometimes, a company's field trial is also used for biosafety research, but the bulk of field trials are for industrial purposes (agromonic evaluation, breeding and seed multiplication). One formal difference might be the size. Once a product enters the stage of seed multiplication, one needs hundreds of hectares or more. For variety testing, only about one hectare is needed; for biosafety research, only a few plants are used, but this is not a strict rule and would not make sense for a regulatory system. "*The situation in Russia might be different. I have never heard of any regulatory system that would make a formal difference between variety and biosafety trials, in terms of approval using GE regulation. It makes no sense from a regulatory or scientific point of view*".[38]

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[31] Genetic Engineering Commission. See Section 4: Regulatory Oversight of Genetic Engineering Activities

[32] Organisation for Economic Co-operation and Development (OECD); UNIDO Biosafety Information Network and Advisory Services (BINAS) website: http://binas.unido.org/binas

[33] United Nations Industrial Development Organisation

[34] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July 2000

[35] Dr. Vitaly. Dzhavakhiya, Head of Laboratory of Molecular Biology, Dr. Yrij. Spiridonov, Head of Department of Herbology, Dr. Filipov, all work at All-Russian Research Institute of Phytopathology. Personal Interview, Moscow, 12 July 2000.

[36] Three climatic zones for which GE crops tested: the Moscow Region, the Tambov Region, and the Krasnodar Region

[37] Dr. Vitaly. Dzhavakhiya, Head of Laboratory of Molecular Biology, Dr. Yrij. Spiridonov, Head of Department of Herbology, Dr. Filipov, all work at the All-Russian Research Institute of Phytopathology. Personal Interview, Moscow, 12 July 2000.

[38] Dr. Jan van Aken, BioConsult, personal communication, 24 August 2000

Since it is widely known that the BINAS database is by no means comprehensive, and indeed field trials of fruit trees are not on the list, it is safe to assume that the real number of trials in Russia is much higher.

OECD/BINAS List of Notifications of Deliberate GMO Releases

The OECD's BINAS Database of 16 notifications lists 13 permits for field trials for at least 7 GE potato varieties, one GE variety of soybean, one GE variety of maize and 2 varieties of GE sugar beet. It also includes 2 notifications or permits granted for processing and consumption - for Monsanto's RoundUp Ready soybean and AgrEvo's LibertyLink sugar beet. The list is as follows:[39]

Potatoes

- Centre Bioengineering's virus-resistant (PVY) RAS *Belorusskii3* Potato; restricted biosafety trials in Moscow
- Centre Bioengineering's Basta herbicide-tolerant Prigozhii-*2* Potato; restricted biosafety trials in Moscow
- Two varieties of Monsanto's NewLeaf *Bt* insect-resistant potatoes: Russet Burbank and Superior; restricted biosafety trials in Regions of Moscow, Tambov, Krasnodar, Far East
- Two varieties of Monsanto's NewLeaf *Bt* insect-resistant potatoes: Russet Burbank and Superior; variety trials in 18 regions
- Centre "Bioengineering" RAS' virus-resistant potato; Trait wanted**:** PVX, PVY-resistance
- Institute of Potato Breeding potato for human interferon production
- Monsanto's potato with Colorado beetle resistance (two variants)

Soybeans

- Monsanto's RoundUp Ready herbicide-tolerant soybean; restricted biosafety trials in Krasnodar region
- Monsanto's RoundUp Ready herbicide-tolerant soybean; processing and consumption anywhere in the Russian Federation

Maize

- Monsanto's Roundup herbicide-tolerant maize; restricted biosafety trials in Regions of Moscow, Tambov, Krasnodar, Far East

Sugar Beet

- AgrEvo's LibertyLink herbicide-tolerant; processing and consumption in the Moscow Region
- Monsanto's RoundUp Ready herbicide-tolerant sugar beet; restricted biosafety trials in Regions of Moscow, Tambov, Krasnodar, Far East[40]

The BINAS list reveals that Monsanto is by far the biggest player, as reflected by the numerous trials, particularly of *Bt* potatoes. Field trials of Monsanto's herbicide tolerant sugar beet are particularly alarming. (See also Part B: Plants out of Control: Cross-pollination of Genetically Engineered Plants)

Two GE crops: AgrEvo's sugar beet and Monsanto's soybeans already have permits for processing and consumption. However, it is not know if these are being commercially grown in Russia or if these permits relate only to imports. Aventis[41] is awaiting approval for a Basta-tolerant (herbicide-tolerant) GE sugar beet while an environmental impact assessment is being undertaken by GENCOM,[42] which suggests that another

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[39] Full information is contained in Annex A

[40] "Field Trials and Commercial Applications in Russia," OECD/BINAS Web Page, http://www.oecd.org/about/member-countries.html; http://binas.unido.org/binas

[41] AgrEvo is now part of the new company Aventis

[42] Dr. Vitaly. Dzhavakhiya, Head of Laboratory of Molecular Biology, Dr. Yrij. Spiridonov, Head of Department of Herbology, Dr. Filipov, all work at the All-Russian Research Institute of Phytopathology. Personal Interview, Moscow, 12 July 2000, at the Institute of Plant Protection.

variety of sugar beet is about to undergo field trials. It seems that foreign companies pay institutes for undertaking field trials. For example, Novartis Russia pays fees for all types of trials, claiming that these fees can constitute up to half of the annual budget of an institute.[43]

GENCOM has designated the Institute of Plant Bio-Protection in Krasnodar as one of two institutes to conduct GE biosafety field trials. Field trials of GE soybeans, maize, sugar beet, and three types of potato (NewLeaf, Superior and Russet Burbank), all products of foreign companies, such as Monsanto, have been taking place since 1996. In addition, the institute has also been conducting their own field trials of *Bt* potatoes. Field trials of GE potatoes were also undertaken at the Otradnoye Farm (Krasnodar Region) in 1999.[44] Strangely, the Seed Inspection Unit of the Regional Department of the Ministry of Agriculture has no official information about field trials in the Krasnodar Region.[45]

Contradictions and Misinformation

While Drs. Dzhavakhiya, Spiridonov Filippov, Skryabin and others confirmed the BINAS list of 18 deliberate release notifications in different regions, they also contradicted themselves when they said that GENCOM had approved only 3-5 permits for field trials. Nor could they agree on the number of permitted sites or where those sites were located. The information we received from different sources seldom correlated.

So what is the real situation? Does anyone know? All the above scientists sit on the same committee. Some institutes confirm this information, yet other members of GENCOM and the Ministry of Agriculture say that the information is false or inaccurate, and that if it were true, it would be a criminal offence. The only conclusion that can be drawn is that there is regulatory chaos, and that Russia's environment and human health have been put at significant risk.

However, on balance, it would seem that the full BINAS list of notifications is correct. Monsanto and AgrEvo have their corporate images to protect and would not undertake illegal field trials in Russia. Since the field trials are the first steps to commercialisation, these companies want to ensure that they have all the correct permits, before investing in any activities. More worryingly, the BINAS list could well be just the tip of the iceberg, in terms of trials being undertaken. For example, field trials of GE fruit trees and pine trees, confirmed by scientists, are not on this list. Although field trials undertaken outside the licensed areas clearly violate the law and are a criminal offence, who is there to enforce the law when the fox is guarding the henhouse?

Additional Unverified Field Trials

According to the Ministry of Agriculture, there may be field trials of Monsanto GE potatoes in Voronezh.[46] The Kaluga Region is another place that has long been rumoured to be conducting field trials of GE potatoes. A participant at the conference: "New Varieties and Technologies of Growing Horticultural Crops for Intensive-type Gardens", in Orel related how the region had been doing field trials of a transgenic potato resistant to the Colorado beetle for 2 years. Then, the State Commission (Golikov et al) came and tried to control the field trials and stopped them for some reason. No one knows what happened to the potatoes except that they were taken away to demonstrate that this type of transgenic potato exists.

Commercial Cultivation of GE Crops in Russia?

[43] Mikhail L. Grishin, Novartis Seeds International AB. Personal interview. Moscow, 28 July 2000.

[44] Dr. Dmitriy Nadykta, Director of National Institute of the Bioprotection of Plants, personal interview, 29 June, Krasnodar, Russia

[45] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July

[46] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July 2000

Currently, there are no commercially cultivated GE crops in Russia. This at least, is the official line. Information from Georgia[47] and Ukraine[48] suggest that Monsanto's *Bt* potatoes, and other varieties of *Bt* potatoes are on the loose throughout the region. For example, part of the 1997 *Bt* potato harvest in Georgia was exported to Russia.[49] In Ukraine, Prof. Blume, Head of the Biosafety Committee claims that there are many varieties of *Bt* potatoes in Ukraine, having been smuggled there from Romanian or Russian experiments.

The cultivation of GE soybeans has been covered by Russian TV, which claimed field trials and even commercial cultivation of GE soybeans were taking place in the Russian Far East. However, the Soybean Institute denies this.[50] A representative of Inter-Soy, a company that produces soybean products also claims that there are probably no field trials of GE soybeans, and definitely no commercially grown GE soybeans in the Far East, because their commercial cultivation would require several years in which to acclimatise the GE variety.[51] Although Russia does not traditionally grow many soybeans, but there is an association of soybean producers in Krasnodar[52] called "Assoy." Assoy does not currently deal with GE soybeans, but they are considering doing so in the near future.[53]

[47] "*Monsanto's transgenic potatoes on the loose in Georgia (1996-1998): the need for an international Biosafety Protocol*", Greenpeace, August 1998

[48] "*Why the World needs a strong Biosafety Protocol: Monsanto's GE Potatoes on the Loose in Ukraine (1997-1999)*", Greenpeace, September 1999

[49] Information from Mr Machavariani, Head of Biodiversity Department of the Georgian Ministry of Environment with reference to his discussions with colleagues in Russia; from Greenpeace report: *Monsanto's transgenic potatoes on the loose in Georgia*

[50] Natalia Velikodnaja, SREDA Environmental Program, NTV. Personal interview. Moscow, Russia, 4 July 2000.

[51] Takhir Bikbov, Scientific Consultant, Inter-Soy. Personal interview. Moscow, Russia, 4 July 2000.

[52] Krasnodar is one of the "agricultural regions" of Russia, producing large quantities of soybeans, corn and potatoes. Russia's main agricultural university is based in Krasnodar.

[53] Alexander Podobedov, Chief of Assoy, Personal interview, 28 June 2000. Krasnodar, Russia.

4. Biodiversity and Biosafety Concerns among some Russian Scientists

In order to safeguard Russia's biodiversity, certain vulnerable areas of the country should not be exposed to the potential risks of GE crops. When the Ministry of Agriculture was asked about special areas of biodiversity and those where specific varieties have their origin and where GE activities should be prohibited, these locations matched exactly those where the field trials of GE crops are taking place. Sergey Paklin from the Agriculture Ministry believes transgenic plants should be strictly controlled. Their creation should be restricted for use only in contained experiments, and they should not be released into the environment. According to Paklin, transgenic plants should only be cultivated if a problem cannot be solved any other way. "*No company, no scientist can predict what can happen in a generation or two. We do not know the consequences*."[54]

Some Russian scientists are concerned about the potential dangers of GE crops, cross-pollination and the development of super-weeds. Dr. Khavkin believes that there might be a danger of cross-pollination, especially between rapeseed and its wild relatives, such as *Brassica rofantus*. Dr. Pukhalskiy from the Vavilov Institute goes further, saying that if the dangers of cross-pollination and the development of superweeds cannot be prevented, transgenic plants should never be deliberately released into the environment. Even self-pollinating crops, such as wheat, present a very real danger to biodiversity and biosafety. "*It is all too early, too fast. If we put in the gene that helps you use more herbicides, we do not know how quickly this gene will be transferred to the weeds, or how this heavy use of herbicides will affect the product that we will consume*", he says.[55]

The Vavilov Institute has been studying the possibility of cross-pollination in wheat, a self-pollinating crop,[56] and claims to have discovered that the transgenic wheat cross-pollinates with several weeds and wild species of wheat. In the past, researchers had only looked at their own breeds and varieties not wild species. "*It is at least a lie, it is being insincere, if persons say there is no cross-pollination*." The institute has handed over the results of its research to Dr. Skryabin and GENCOM, recommending that the buffer area should be at least 300 meters, but in a strong wind, even this will not be sufficient to prevent cross-pollination. According to Dr. Pukhalskiy, GE rye or corn require huge buffer zones.[57] Dr. Goncharov, an expert on wheat and triticale[58] confirms that even in cases of strictly self-pollinating crops blossoms sometimes open, therefore a certain percentage of cross-pollination is possible.[59]

Dr. Pukhalskiy is unique among the scientists we spoke to in his sincere caution regarding the very work his career is based on. He does not even want to see his own GE crops planted in the field. For example, his institute created a tobacco plant that expresses the human alpha-interferon gene, but "*Even if we have this result, I don't think that we should be in haste and plant this tobacco all around. I cannot foresee what would happen if it were planted in an open field and if this very gene were transferred to other plants. We need many, many years to study the long-term consequences*".[60]

Buffer Zones

Although the Ministry of Agriculture says that there are no regulations regarding buffer zones for transgenic crops,[61] the biotech institutes insist that adequate and appropriate biosafety measures are in place, and that the

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[54] Sergey Paklin, , Deputy Head of the Department of Plant Protection, Ministry of Agriculture, Interview 6 July 2000

[55] Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Interview, Moscow, 6 July 2000.

[56] Wheat is considered a strong self fertilizer. However, even wheat outcrosses once in a while, even if the rates are as low as 0.1%. The concept of cross- or self-pollination is a gradual one, no plant is 100% selfing or crossing.

[57] Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Personal interview, Moscow, 6 July 2000.

[58] a hybrid of wheat and rye developed during World War II using traditional breeding methods

[59] Sergei Goncharov, TACIS expert, Voronezh State Agrucultural University, Interview. Voronezh, Russia, 26 July 2000.

[60] Dr.Vitaliy Pukhalskiy, Vavilov Institute of General Genetics, Personal interview, Moscow, 6 July 2000.

[61] Sergey Paklin, Ministry of Agriculture, personal interview 6 July 2000

field tests are in clearly separated areas.[62] Dr. Dzhavakhiya claims that the field trial in Golitsyno is a small place, surrounded by a lake on three sides, and by a forest on the other. The buffer zone is 1 kilometre, "*acceptable even for Europe*."[63]

Monsanto sues Canadian Farmer
Percy Schmeiser, a farmer in Saskatchewan is being sued by Monsanto for growing Roundup-tolerant oilseed rape (Canola) seed without a licence, after samples were taken from around his fields. The farmer says that he has been growing oilseed rape for years and freely admits to saving his seed, but denies that it belonged to Monsanto. He claims that there are a lot of GE crops being grown in the neighbouring area and pollen from them is blowing everywhere. "*It's in the ditches, and the roadsides… it's all over….We're just touching the tip of the iceberg in contamination of fields by this Roundup genetic canola [oilseed rape]….It just opens up a vast area of uncertainty*"[64]

In Orel, where the Puschino Institute and Institute of Agricultural Biotechnology are undertaking field trials of GE apple and pear trees, strawberries and chrysanthemums, the biosafety measures have been heralded as extremely strict. Upon inspection, however, it was a completely different story and one must also wonder about other sites. We were told to expect armed guards, though we met only an elderly man in charge of the site. We were warned to expect dogs, though we only saw an empty kennel. Indeed, there was a fence but it consisted of old rotting pallets topped with three strands of rusty barbed wire. This was not exactly the "military camp" Dr. Skryabin described.[65] Beyond this, there was a weedy area approximately 20 metres wide between the fence and the dirt road, and then the houses. The GE crops were not placed in the centre of the field as Drs. Khavkin and Naraditskiy described, but at the nearest corner between the main gate and the road. Neither did other, non-GE crops surround the GE crops**.** This meant that the field trials were taking place very close to private gardens growing traditional varieties of apples and strawberries. Their proximity to the field trial means that cross-pollination could result in these home-grown fruit becoming genetically engineered! (See Part B: Plants out of Control)

Every time researchers or officials were asked about biosafety measures, the immediate response was assurances that entry into the fields was restricted. However, this is no obstacle to widespread releases of GMOs through pollen transfer, insects, microbes, wind and water. Clearly, regulators and scientists are more concerned about keeping NGOs and the press out, than in keeping the GMOs in.

Dr. Khavkin was not even sure that dogs would keep Russian peasants from stealing test crops because they are considered so valuable.[66] The Ministry of Agriculture described a case in which transgenic potatoes were uprooted and removed from the territory of the Krasnodar Region to an unknown location.[67]

During a conference in Orel in July 2000, a demonstration had been planned to show the herbicide-tolerance properties of fruit trees to Basta. Unfortunately, the night before the demonstration, a huge storm blew through the area and stripped all the leaves off these plants. Where this GE-contaminated material landed is anyone's guess. All we know for certain is that it will be sweet (taumatine-engineered) when it lands.

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[62] Dr. Konstantin Skryabin, Director, Center for Bioengineering. Personal interview, Moscow, 7 July 2000.
[63] Dr. Vitaly Dzhavakhiya, Head of Laboratory of Molecular Biology, All-Russian Research Institute of Phytopathology. Personal Interview, Moscow, 12 July 2000 at the Institute of Plant Protection.
[64] Quote from Percy Schmeiser in 'Western Producer', November 1998. Source: '*Will GM crops deliver benefits to farmers?*" on web-site of the Natural Law Party Wessex: www.btinternet.com/nlpwessex/Documents/contentsfall.htm
[65] Dr. Konstantin Skryabin, Director, Center for Bioengineering. Personal interview, Moscow, 7 July 2000.
[66] Dr. Emil Khavkin, All-Russia Research Institute if Agricultural Biotechnology, Iinterview. Moscow, 10 July 2000.
[67] Sergey Paklin, Ministry of Agriculture, personal interview 6 July 2000

5. Regulatory Oversight of Genetic Engineering Activities

As early as 1995, the Russian Ministry of Environment claimed that the country's legal and policy vacuum with respect to GE was being exploited by Western corporations and research institutes to conduct experiments that would not be allowed in their own countries.[68] Until 1996, there was no national legislation on GMOs. The first guidelines for research involving genetic engineering were elaborated in the former USSR in 1978 when genetic engineering was still only a research tool. Ten years later, these guidelines were revised.

Today, several pieces of Russian legislation pertain to genetic engineering, including the laws on:

- Environmental Protection (1991)
- Sanitary-Epidemological Protection (1991)
- Human Health (1993)
- Consumer Rights (1992)
- State Regulation of GE (1996) The Act does not consider the application of GE techniques to human beings or to tissues or cells in the human organism,[69] nor does it say anything about consumers.[70]
- Ministry of Health - Registration of GE Products (1999)
- Ministry of Health - Hygiene and Monitoring of GE Products (1999)
- Government Directive on the mandatory labelling of GMOs (September 1999, effective July 2000)
- Regulation on food quality and safety (2000). This regulation covers novel foods and foodstuffs being imported into Russia for the first time. Such products must now be registered at the federal level.[71]

There is no co-operative mechanism between these laws.[72]

As of 1 July 1999, GE foods imported into Russia have had to be registered with GENCOM, to enable their segregation from non-GE foods. Registration is subject to the successful completion of tests carried out by the Food Research Institute at the Russian Academy for Medical Science. Registered and approved foodstuffs are entered into a Federal Register kept by the Epidemiological Department at the Ministry of Health. Registrations are valid for 3 years. The registration may be rescinded if the agreed production processes, storage and sales conditions are violated. Victor Tutelyan, Deputy General Director of the Food Research Institute at the Ministry of Nutrition has said the tests are intended to "*prevent foodstuffs that may be potentially dangerous from finding their way onto the market. Their effect on human health has not been fully studied*".[73]

The Inter-Agency Commission on Genetic Engineering Activity (GENCOM) - Chaos in Action

In July 1997, Directive No. 464 established an Inter-Agency Commission on Genetic Engineering Activity (GENCOM). This body consists of 18 persons representing various ministries, state committees, academies and state scientific centres. The Minister of Science heads the Committee, and there are 4 vice-chairmen: from the ministries of Health, Agriculture, Environment and Dr. Skryabin. GENCOM can form temporary expert working groups, and claims to cover all fields relevant to modern biotechnology (including education, economic issues and finance). However, there are no representatives of civil society on this Commission e.g. environmental and consumer NGOs, church groups or ethicists.

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[68] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July 2000

[69] K.G. Skryabin and L.P. Matyash, Country Profile: Russian Federation, in "*Biotechnology in the Developing World and Countries in Economic Transition*", G.T. Tzotzos and K.G. Skryabin ed. CABI Publishing, 2000.

[70] Svetlana S. Zavidova, Legal Advisor, Inter-Republican Confederation of Consumer Societies (member of Consumers International). Personal Interview. Moscow, 11 July 2000.

[71] Svetlana S. Zavidova, Legal Advisor, Inter-Republican Confederation of Consumer Societies (member of Consumers International). Personal interview. Moscow, 11 July 2000

[72] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July 2000

[73] AgraFood East Europe, June 1999

The main goals of the Commission are to:

- Establish and improve the infrastructure and control system for biosafety
- Elaborate the rules for safe production, use and transfer of GMOs and their parts
- Provide for the creation and handling of a central database on genetic engineering and biosafety
- Co-ordinate elaboration and implementation of an application/notification system based on risk assessment/risk management procedures
- Co-ordinate activities for the harmonisation of the national biosafety system with already existing regional and international mechanisms
- Make proposals for the development of priority decisions on genetic engineering in the country.

GENCOM's decisions are binding on all state bodies that are present on the list of the Commission or are under their jurisdiction.[74]

Secrecy and Confusion

In most countries, there are two regulatory tracks for putting GE seed on the market: one for GE and a second for seed variety registration. Obviously, GE seeds must follow both tracks, independently. For example, in the EU, a genetically engineered crop variety needs two approvals before it can be marketed: the first has to comply with the GE regulation and includes an assessment of the specific risks related to genetic engineering; the second for the seed variety registration similar to any non-GE variety. The situation in Russia is confusing. However, as in Ukraine, it is likely that Russia is using the existing plant variety testing procedures to enable field trials and commercialisation of GE varieties, in the absence of procedures to implement the GE laws.

GENCOM is a black box, even to those that are members. Those on the Commission have trouble naming the other members, and there is a distinct lack of standard operating procedures. An official at the Ministry of Agriculture, whose deputy minister is a Vice-Chair of GENCOM, could only say that the commission exists, and was completely naïve or uninformed as to how the commission operates and of any standard procedures governing field trials. "*The locations and durations of field trials are still undecided. Right now we are just developing this system*".[75] Yet, decisions are being made, field trials are taking place, and GE crops are being approved for import. How could such an important stakeholder be so completely out of the regulatory loop? Our research has concluded that this situation is widespread. Without the procedures and policies in place to enable proper implementation of biosafety guidelines and approvals for imports and field trials, a moratorium should be put in place - as in the EU - until these rules have been formulated and implemented.

The Fox is Guarding the Hen House

Although the GENCOM was established in 1997, no efforts have been made to make it any more transparent or democratic. Members of the Commission are, for the most part, the exact same scientists that are responsible for the genetic engineering experiments. Essentially, the genetic engineers police each other with no independent oversight.

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[74] A Golikov, "*Implementation of the Biosafety Mechanism in the Russian Federation – Progress Report 1996/1997*" (Moscow, Russia: Ciobiotech Information Centre/BINAS National Code, leaflet distributed at OECD Biosafety Conference in Budapest, Hungary, 1997).

[75] Sergey Paklin, Deputy Head of Department of Plant Protection, Ministry of Agriculture, personal interview 6 July 2000

6. GE Food on the Russian Market

In June 1999, Monsanto estimated that the potential for sowing GE varieties in Russia is huge - up to 4 million hectares of potatoes, 800,000 ha of sugar beet, 450,000 ha of soybeans and large areas of maize. The company believed its NewLeaf *Bt* potato crop could potentially receive approval for planting in 2000, with its RoundUp Ready soybeans and sugar beet reaching the market by 2001 and 2002 respectively.[76] In a leaked internal memo, the company boasted: "*This achievement represents a significant milestone in our efforts to expand biotechnoogy markets in the region. Approval for unconfined (deliberate) release is expected by the end of the year*."[77]

To date, the Russian Ministry of Health has approved Monsanto's RoundUp Ready (RR) soybeans and two varieties of Monsanto's *Bt* potatoes: NewLeaf Russet Burbank and Superior, for import purposes and only for human consumption (not animal feed).[78] In addition, two notifications on the OECD/BINAS list are for processing and consumption of AgrEvo's herbicide-tolerant sugar beet and Monsanto's RR soybeans. Dr. Skryabin, a Vice-Chair of GENCOM, contradicts the Federal Register by stating that five, or maybe even six GE plants have been approved: herbicide-tolerant and insect-resistant cotton, herbicide-tolerant maize, herbicide-tolerant and male-sterile oilseed rape, the above-mentioned varieties of *Bt* potato, and herbicide-tolerant sugar beet.[79]

At present, Novartis is working on the Russian registration of its *Bt* maize and RoundUp Ready sugar beet. Biosafety trials have been completed and the Ministry of Health is now conducting food safety trials prior to granting import approval for human consumption. Since the herbicide RoundUp is a Monsanto product, this is a joint project with Novartis. Monsanto has dedicated a registration manager to work full time on the approval of this one product.[80]

The main GE crops that are likely to be on the Russian market are soybeans and potatoes. According to a representative of Assoy, the soybean association of the Krasnodar region, already sixty per cent of the soybeans in Moscow are transgenic,[81] coming mainly from imports and food aid from the US. It does seem strange that on the one hand Russia exports soybeans to China, but on the other, is importing them as food aid. Any GE potatoes on the market are likely to come from local sources, given that these potatoes are starting to be widely available to farmers. Given that forty percent of all food products are not labelled in the Russian language, and that labels for GM food were not mandatory until after July 2000, there is a fear that GE products from North America will have been dumped on the Russian market, having been rejected by the EU markets. [82]

Labelling

In November 1999, the State Department of Sanitary Protection and Epidemiology (SanEpid) announced that as of 1 January 2000, there would be obligatory labelling of GE food and medicine. From 1 July 2000, every product made from GE sources (including ingredients of processed foods and medicines), must have a label "GE" in Russian.

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[76] AgraFood East Europe, June 1999

[77] "*Monsanto's 'Desperate' Propaganda Campaign Reaches Global Proportions: Leaked Internal Monsanto Memo*", GeneWatch UK Press Release, 6 September 2000.

[78] Reuters 15 July 2000 about soybean approval; Dr. Skryabin about potato approval

[79] Dr. Skryabin, Director, Center for Bioengineering of Russian Academy of Science. Interview, Moscow, 7 July 2000

[80] Mikhail L. Grishin, Head of Representative Office, Novartis Seeds International AB. Personal interview. Moscow, 28 July 2000.

[81] Alexander Podobedov, Chief of Assoy, Personal interview, 28 June 2000. Krasnodar, Russia.

[82] SEU, VIOLA, and No Corporations!

While EU law requires products containing over 1% of GMOs to be labelled, and the scientific ability exists to test for much less than 0.1% contamination, Russia's labelling law has set a 5% threshold based on dry weight! Moreover, oils, lecithin, starch, fructose syrup, glucose and fructose from GMOs, do not need to be labelled.[83] SanEpid explains the lower standards in Russia: "*This percentage has nothing to do with safety because no matter if the threshold is 1%, 3% or 5%, the product is safe if it has been tested and allowed on the market. Five percent is something allowed by the Ministry of Health and producers because this does not change any specific qualities of the product*".[84] Consumers have a right to know what they are eating, yet Russian law allows consumers to be cheated.

Apparently, the legislation is extremely flexible about the way in which the information should be given to the consumer. Unfortunately, the federal register of GE foods can only be found on the Internet. Considering that almost the entire rural population lack a private telephone service, never mind Internet access, the Ministry of Health's claim that the shopkeepers and clerks are well informed is misguided and irresponsible to say the least. Although the Ministry claimed that all shops receive the register during routine inspections for sanitary compliance, this is difficult to believe.[85]

The Consumers Association is also very pessimistic about the effectiveness of the law. They do not think the shopkeepers will label the products, and it is still unclear how they will label them if they do. As the law now stands, it will not protect the safety of consumers.[86]

All food products that have been produced, processed, grown or cultivated must be marked with a **clear and visible label**, to inform consumers about the production process and to allow choice between genetically engineered and conventional food products.

Market Sensitivity

A 1999 survey of 28 food companies by the NGO No Corporations! asked: "*What is your official position on GE food?*" Nineteen companies refused to give information; one baby food manufacturer guarantees its products are GE-free. [87]

One company that is extremely concerned and up to date is Inter-Soy, a small Russian company making soymilk-based products in Moscow. The company uses only domestically produced soybeans from the Russian Far East (Amur Region). Today there are no GE soybean varieties regionally adapted for the Far East, so Inter-Soy feels comfortable that it can maintain a 100% GE-free guarantee for another 5 years, because they use do not source soybeans from the Krasnodar or Stavropol regions that may be GMO-contaminated. The company's caution stems mainly from market sensitivity.

Shopping at one of Inter-Soy's factory stores, SEU found ADM's Good Morning powdered soy milk and soy-burger mix on the shelves, both without GE labels. Given that both these products are listed on the Federal Register of GMO products, they are likely to be GE.[88] Mandatory labelling came into force in January 2000, with a six-month period for companies to complete implementation of procedures and the labelling of their

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[83] "*Monsanto's 'Desperate' Propaganda Campaign Reaches Global Proportions: Monsanto's Leaked Internal Memo*", GeneWatch UK Press Release, 6 September 2000.

[84] Anatoliy Petukhov, Vice-director of Department of Hygiene, Sanitary Inspection of Ministry of Health. Personal interview, Moscow, 5 July 2000.

[85] Anatoliy Petukhov, Sanitary Inspection of Ministry of Health. Personal interview, Moscow, 5 July 2000.

[86] Svetlana S. Zavidova, Legal Advisor, Inter-Republican Confederation of Consumer Societies (member of Consumers International). Personal Interview. Moscow, 11 July 2000.

[87] No Corporations!, Voronezh, Russia and SEU

[88] *Federal Register of GMO Products*, last updated 16.05.2000. www.depart.drugreg.ru/cnis/txt/sertif/reestr/index.html

products. However, none of the products in this shop or any other shop that was checked displayed labels stating they contained GMOs.

GE Food Safety Testing

Novartis is undertaking food safety testing in Russia because this is required by Russian law. According to Novartis, from the perspective of gaining public acceptance for the product, it is important to say that it has not only been tested in Western Europe, or in the US, but also in Russian laboratories.[89] The Institute of Nutrition and others do the actual testing for Novartis. Apparently, all the food safety tests that have been done in Europe are being done in Russia.[90] But no thorough food safety tests on GE food have been done in Europe, and even less so in the US.

Food Aid

"*I think that many companies are too hasty to introduce transgenic plants. A lack of food provides a good way for some rich countries to make a field trial of less rich countries. We should be very careful and work to prove the safety of GE food before we recommend it to developing countries like Russia"*.[91]

In 1999, the US donated 3 million tonnes (mt) of food aid to Russia. In September 1999, Russia again submitted a formal request to the US, asking for over 5mt in food aid. The request included 1mt of bread wheat, 1.5mt of feed wheat, 1.5 mt of maize, 700 Kilotonnes (Kt) of soybean meal, 300 Kt of soybeans and 40 Kt of seed.[92] As of February 2000, the US Government had approved 200,000 tonnes of food, 300Kt of wheat and 20Kt of seed, which was expected to arrive in March or April 2000.[93] In June, 2000 it was announced that Russia is facing its third successive grain shortage, with a shortfall of 2 million tonnes of feed grain and the government is preparing to make another request for US food aid.[94] According to the USDA, US food aid has increased threefold over the last year.[95] Some Russian NGOs believe that the increased willingness to provide food aid to Russia is due to the loss of EU markets for GE-contaminated commodities and the need to dump these unwanted products elsewhere.[96]

In 1999, there was a scandal involving food aid and Assoy, the soy association of the Krasnodar Region. Assoy signed a contract with an American-based NGO called "To Feed the Children" to import food aid to the Krasnodar Region. In July 1999, when a ship carrying soybeans was unloaded in Novorossiysk (a Black Sea port) it was discovered that the shipment was contaminated with several weeds, including ambrosia. These weeds are all strictly forbidden in the region because they might cause serious damage to the environment and human health. The soybeans were then tested for GE contamination at the National Bio-Protection Institute in Krasnodar, and the results were positive. As a result, the region's Chief Sanitary Inspector was fired and regional authorities issued an order to stop the import of all crops.[97]

The position of the Ministry of Agriculture had been to restrict imports of transgenic plants and transgenic foods provided by food aid, until a US Government representative acting on behalf of President Clinton, met with the Ministry in 1999. Paklin, from the Agriculture Ministry explains: "*The position of the US President's*

[89] Mikhail L. Grishin, Head of Representative Office, Novartis Seeds International AB. Personal interview. Moscow, 28 July 2000.

[90] Mikhail L. Grishin, Novartis Seeds International AB. Personal interview. Moscow, 28 July 2000.

[91] Dr.Vitaliy Pukhalskiy. Vavilov Institute of General Genetics. Personal interview, Moscow, 6 July 2000.

[92] Agra Food East Europe, October 1999.

[93] Agra Food East Europe, February 2000.

[94] AgraFood East Europe June 2000.

[95] Steve Suppan, Institute for Agriculture and Trade Policy, USA, interviewed by Iza Kruszewska, 2 September 2000

[96] SEU

[97] Alexander Podobedov, Chief of Assoy, Personal interview, 28 June 2000 in Krasnodar, Russia.

representative was that it is allowed in Russia. I answered that no, we do not have such legislation for this in Russia. But then the US representative said that he already had an agreement with then Deputy Prime Minister President Sherbak. He said that it was all decided and that there was no such problem, and that it would be imported. We do not have any documents permitting, controlling and limiting the use of transgenic plants".[98]

U.S. Influence

The U.S. government and US agri-business are very actively promoting the adoption of agricultural biotech around the world. For example, in the budget for 2001, the US is looking to allocate at least US$30 million to promote U.S. agro-biotechnology in the former communist bloc. Additional funding is earmarked for technical exchange programmes for foreign officials to teach them about the U.S. regulatory system "*to approve agricultural products using* biotechnology".[99]

A US agribusiness coalition with the misleading name of Citizens' Network Agribusiness Alliance (CNAA) comprising 250 agri-businesses, lenders and industry associations[100] is another player active in the region. CNAA is part of the Citizens' Network Foreign Affairs (CNFA).[101] Since 1994 CNFA and CNAA have been working the US Government to restructure the food and agriculture sectors in Russia, Ukraine, Moldova and southern Africa. The US Agency for International Development (USAID) has provided more than $82 million to entice US food and agricultural enterprises to build and improve market-based agricultural infrastructures. In March 1999, CNFA and 32 US commodity organisations, producer groups, industry associations and agribusiness firms[102] called on Vice President Gore to structure the second US food aid assistance package to Russia in a way that would strengthen the country's emerging private sector. The coalition argued that stronger Russian farm, food and agricultural businesses would become long-term purchasers of US equipment, inputs, and commodities.[103]

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[98] Sergey Paklin, Deputy Head of Department of Plant Protection, Agriculture Ministry. Personal interview 6 July 2000

[99] ANPED press release: "Green Groups in Eastern Europe and Former Soviet Union Oppose U.S. Budget Proposals to push agricultural biotech in their region", 11 July 2000

[100] Members include Commodities International Limited, Monsanto, Global Agricultural Management Enterprises, Cargill Seed, Cargill Fertilizer, American Cyanamid, Progressive Genetics, Pure Sunshine, Developed Technology, Resource, Inc., Kyiv-Atlantic, Food Pro.

[101] CNFA website: www.cnfa.com

[102] Some signatories included: American Crop Protection Association, American Farm Bureau Federation, American Home Products Company, American Meat Institute, American Soybean Association, Archer Daniels Midland, Cargill Incorporated, Caterpillar Inc., ConAgra, Inc., Dow AgroSciences, Inc., DuPont de Nemours International, Monsanto Company, Pioneer Hi-Bred International, U.S.-Russia Business Council and the US Wheat Associates. "*Second Food Aid Package to Russia Should be Market Oriented*" CNFA News Release, March 5, 1999.

[103] "*Second Food Aid Package to Russia Should be Market Oriented*" CNFA News Release, March 5, 1999.

7. Access to Information and Russian Media Coverage

"People do not have reliable information about what GE really is...In this country we have almost zero information and this is the main problem".

-- Takhir Bikbov, Scientific Consultant, Inter-Soy[104]

Despite the right to public information on the environment guaranteed by the Russian Constitution, Russian NGOs have been repeatedly refused interviews and information from decision-makers on genetic engineering and field trials. When environmental journalists went to visit a field trial in Golitsino (near Moscow) they were threatened by guards with machine guns who tried to break their camera.[105]

As outlined above, the register of GE food products on the Russian market is currently available only on the Internet, meaning that very few people have access to it. Neither is there a central database of field trials. According to Article 10, information about possible risks is not available to everyone. Information on GE is considered a State or commercial secret, thus making it nearly impossible to obtain information related to public health and environment.[106]

If an article appears against genetic engineering, it is immediately countered with large full-page "articles" criticising the author as being a non-scientist and a scaremonger, sometimes even before publication of the original piece. Moreover, some biotech proponents are quick to accuse any anti-biotech article as coming from a mysterious, perhaps foreign-paid source.[107]

However, when we reviewed what the media had uncovered, such as fish-strawberries and the poor biosafety measures at field trials, reports slammed by officials and the biotech industry as fantasy and hysteria, we found that many turned out to be true.

The information blackout in Russia is not a totally desperate situation. The Ministry of Agriculture was particularly open and accessible, as were the Vavilov and Puschino Institutes and the Institute of Agricultural Biotechnology. In fact, the latter actually requested a meeting with us before we had contacted them.

[104] Personal interview. Moscow, 4 July 2000.
[105] Natalia.Velikodnaja, SREDA Environmental Program, NTV. Personal interview. Moscow, 4 July 2000.
[106] Natalia.Velikodnaja, SREDA Environmental Program, NTV. Personal interview. Moscow, 4 July 2000.
[107] Dr. Konstantin Skryabin, Director, Center for Bioengineering. Personal interview, Moscow, 7 July 2000

8. Conclusions and Recommendations

Domestic research and development of GE products, including agriculture and horticulture, transgenic animals, GE pharmaceuticals and other industrial applications are all progressing at a rapid pace. **GM forestry and horticulture appear to the most advanced in Russia**.

Field trials are taking place throughout Russia on a vast number of GE crops; the 14 notifications of field trials on the OECD/BINAS list representing only the tip of the iceberg. For example, there is evidence of field trials of GE fruit trees, strawberries and chrysanthemums, yet these are not on the BINAS list. Although the official line is that there is no commercial cultivation of GE crops in Russia, evidence points to *Bt* potatoes being on the loose, not only in Russia, but throughout the NIS.

Biosafety is only being given "lip-service". In the absence of regulations on buffer zones and other biosafety measures during field trials and other environmental releases of GMOs, it is left to the biotech institutes to implement whatever measures they deem necessary. Officials and scientists seem more concerned about keeping NGOs and journalists out of field trials, than in keeping GMOs in. An Agriculture Ministry official quotes the case of transgenic potatoes being uprooted and taken away.

GE food and seed are highly likely to be coming into Russia, both as **food aid from the US and commercial imports**. The Ministry of Health claims to have approved only three GE crops, Monsanto's RR soybeans and two varieties of potato, yet the OECD/BINAS Notification List also includes AgrEvo's herbicide-tolerant sugar beet. Dr. Skryabin, the chief proponent of GE in Russia and Vice-Chair of GENCOM, adds herbicide-tolerant and insect-resistant cotton, herbicide-tolerant maize and herbicide-tolerant/male sterile oilseed rape to the list of GE crops approved for human consumption.

The incomplete and often contradictory information stems from the **chaos in the regulatory system**. Although Russia has laws to protect biosafety and human health relating to potential threats of agricultural biotechnology, there are no procedures and only opaque structures to regulate GMOs. For example, members of GENCOM are often the same genetic engineers doing the experiments. **The fox is guarding the hen house.** There are **no civil society representatives on** GENCOM e.g. from consumer, environmental, or church/ethical organisations.

There is no public access to information on GMOs. There is **no central database** of either contained use or deliberate release. **Media coverage** though criticised by Russian scientists and authorities as being hysterical and inaccurate, when investigated has actually been fairly accurate in its coverage of experiments.

SEU's Demands

In the light of these findings, SEU urges the Russian Government to take all necessary measures to safeguard the environment and protect the Russian people from possible risks posed by genetically engineered organisms. Most urgently, the Russian food producers must source GE-free raw material and must ensure to provide GE-free food to the consumers. The Russian Government must immediately:

- Introduce a moratorium on **all** environmental releases of GMOs until such time as standard operating procedures and guidelines can be established within GENCOM - ones that adequately address biosafety concerns. These standards and access to information must also be extended to encompass food safety testing, field trials, and contained use experiments.
- Take measures to prevent any accidental releases of GMOs into the environment.
- Destroy any GE seed already in Russia
- Ratify the international Biosafety Protocol, and introduce a national biosafety law.
- Ratify the Århus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters. This Convention gives the public the right to have information about GMOs and

will help ensure transparency and public participation by guaranteeing citizens' access to information on all genetic activities. The Government must establish processes and procedures for public participation in decision-making.

- Declassify information about GE; prohibit the withholding of information on the grounds of state or commercial secrets.
- Issue administrative procedures to enable enforcement of the GMO regulations.
- Immediately prohibit the import of products derived from GE crops containing antibiotic resistance marker genes.
- Ensure true labelling of all products containing GMOs or products thereof with a clearly visible sticker.
- Ensure traceability of all imports of GE crops or products thereof. They must be labelled and handled separately from conventional crops from plot to plate, or (for imports) from the port of entry to the plate.
- Mandate transnational food producers, such as Nestle and Unilever, to extend their GE-free policies worldwide and take all their GE products off the Russian market, or label them accordingly.
- Ensure the GENCOM has wide representation; remove scientists from GENCOM that have a conflict of interest reviewing their own research; add representatives of environmental, consumer and health NGOs
- Provide support for organic farming by stimulating demand for organic food through education, public procurement policies and by providing economic incentives. Making Russian agriculture GE-free would also be a sensible market decision, given the rejection of GE food in Western Europe.

We call on all concerned social organisations - environmental, consumer, church groups - to join our campaign and support our demands. In the countries of the European Union, public pressure has resulted in a de facto moratorium on approvals of new GE crops.

PART B: THE ENVIRONMENTAL AND HEALTH RISKS OF GMOs

9. The difference between traditional biotechnology and genetic engineering

GE crops are more than just the next generation of high-tech varieties. They feature two specific characteristics that could make them a special threat to human health and to the environment:

Firstly, GE plants contain genes and traits that are completely new to the target species, its environmental context, and its genetic background. While traditional breeding can move genes only among related varieties or closely related species, genetic engineering allows for a movement of genes across radically different species. No traditional breeder is able to cross a carp with a potato, or a bacterium with a maize plant. There is no history of bacterial genes in maize. There was no evolution or selection over thousands of years that would have qualified the bacterial gene to be an integrated part of the maize population. The effect of newly introduced genes and gene fragments under real world conditions, in different climates or in reaction to different pests or diseases, is completely unpredictable, posing a threat not only to the crop, but also to related species and the ecosystem.

Secondly, the process of genetic engineering is neither targeted nor precise, but a rather crude intervention or bombardment. The newly introduced genes could end up being integrated anywhere in the plant genome. It can neither be directed to a specific site within the plant's genes, nor is the site of integration necessarily known afterwards. Because the expression of a given gene or gene fragment depends heavily on the site of integration and the genetic background, it is merely a matter of luck if the newly introduced gene works as expected and no major changes in the plant performance are induced. Several natural mechanisms are known (e.g. pleiotropy, epistasis, or position effects) to influence the specific outcome of a foreign gene transfer and these cannot be anticipated.

These are the two fundamental differences between conventional plant breeding and genetic engineering. Either can have unforeseen consequences when GE plants are released into the environment.

10. Environmental risks

Genetic engineering and its products have only emerged over the last 20 years. It is almost impossible to evaluate the potential impact of transgenic species on the environment. However, based on what they have observed in similar situations with naturally occurring species, scientists have suggested the following effects:[108]

Creating new pests: a crop which has been genetically engineered to be salt-tolerant could escape cultivated fields, invade estuaries, stifling the natural estuarine vegetation.

Increasing problems with existing pests: crop plants are capable of transferring genes, via wind or insect pollination, over several kilometres to related plants, some of which may be weeds. Thus the foreign genes of crops with engineered traits, such as tolerance to herbicides or drought, could be transferred to weeds, making them even more difficult to control.

Harming non-target species: viruses, micro-organisms or plants engineered to kill insect pests could also affect beneficial insects. In experiments, bacteria engineered to convert plant residues, such as leaves, to alcohol for use

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[108] C.A. Hoffman, "Ecological Risks of Genetic Engineering of Crop Plants", Bioscience, Vol. 40, No. 6, 1990, p434; Also: T. Klinger and N.C. Ellstrand, "Engineered Genes in Wild Populations: Fitness of Weed-Crop Hybrids of Raphanus sativus", Ecological Applications, 1990, Vol. 4, No. 1, pp. 117-120; Also: I. Skogsmyr, "Gene Dispersal from Transgenic Potatoes to conspecifics: A Field Trial", Theor. Appl. Genet., 88, pp. 770-774, 1994; Also: T.R. Mikkelsen, B. Andersen and R.B. Jorgensen, "The Risk of Crop Transgene Spread," Nature, Vol. 380, 7 March 1996; Also: R.B. Jorgensen and B. Andersen, "Spontaneous Hybridisation between Oilseed Rape (Brassica napus) and Weedy B. Campestris (Brassicaceae): A Risk of Growing Genetically Modified Oilseed Rape," American Journal of Botany, 81 (12), 1994, pp.1620-1626.

as fuel decreased the populations of beneficial fungi. In some cases, it also killed nearby grasses from alcohol poisoning.[109]

Destroying biodiversity by replacing native species: GE crops with a survival advantage could escape fields, invade other ecosystems and replace other species. This type of loss of biodiversity could severely impair the ability of an ecosystem or species to successfully respond to sudden stresses, such as drought or disease.

Squandering valuable biological resources: the bacteria *Bacillus thuringiensis* (*Bt*) is currently used as a natural pesticide. Scientists, however, are genetically engineering many crops with *Bt* and this may speed up the process by which large numbers of insects adapt and become resistant to *Bt*, rendering it ineffective.

Plants Out of Control: Outcrossing (Cross-Pollination) of Genetically Modified Plants[110]

Once released into the environment, GE plants cannot be contained or confined. Like all living organisms, GE plants reproduce and this is an opportunity for gene escape beyond the designated area of growth. Seeds can be picked up by birds and dropped elsewhere, bigger mammals can remove potato tubers, or reproducible plant parts could just be dislocated by wind. The major pathway of escape of the newly introduced gene into the wild is via pollen transfer. When a GE plant flowers, the pollen contains the newly introduced genetic material and can carry it to another plant and fertilise it, resulting in seeds that will also contain the engineered gene. It has been proven that oilseed rape, maize, sunflowers, potato, sorghum, and many other crops can crossbreed with wild plants that grow near agricultural land in many parts of the world. .

Pollen Flow

Recent research has revealed that pollen can travel over much larger distances and can contaminate the harvest of innocent farmers in the vicinity:

- In January 1999, the UK's Soil Association commissioned an independent report by the National Pollen Research Unit at the University of Worcester, UK.[111] The report included references showing that bees pick up pollen from maize plants and can carry it for several miles. The report concluded that "*overall, it is clear that the maize pollen spreads far beyond the 200 metres cited in several reports as being an acceptable separation distance to prevent cross-pollination*."
- Scientists in the UK planted male-sterile oilseed rape plants at various distances up to 4000 m from a field in which transgenic oilseed rape was being grown. The researchers used male-sterile plants that are not able to self-pollinate so that they would know for sure that any seeds produced must come as a result of cross pollination from the field. The scientists found that even at 4000 metres, 5% of flower buds on the test plants were pollinated.[112]

Field trials of sugar beet and oilseed rape and pose a specific threat to the Russian environment. Europe is the centre of diversity of beet, which was probably domesticated in the eastern Mediterranean area, where the wild beet *Beta maritima* is still abundant. In Northern Europe, spontaneous hybrydisation between cultivated beet

[109] T.M. Holmes & E.R. Ingham, "*The Effects of Genetically Engineered Micro-Organisms on Soil Foodwebs*," Supplement to Bulletin of Ecological Society of America 75/2, Abstracts of the 79th Annual ESA Meeting: Science and Public Policy, Knoxville, Tennessee, 7-11 August 1994.

[110] Parts of this section is taken from Luke Anderson, "*Genetic Engineering, Food and Our Environment - A Brief Guide*", Green Books, Devon, UK, July 1999, Chapter Two, pp. 48-50.

[111] J. Emberlin, "*The Dispersal of Maize Pollen*", National Pollen Research Unit, 2 March 1999

[112] Simpson, E.C., Norris, C.E., Law, J.R., Thomas, J.E. & Sweet, J.B. (1999) "*Gene flow in genetically modified herbicide tolerant oilseed rape (Brassica napus) in the UK*", 1999 BCPB Symposium Proceedings No 72: Gene Flow and Agriculture: Relevance for Transgenic Crops, pp75-81. British Crop Protection Council: Farnham, Surrey

and wild beet *Beta vulgaris maritima* has been observed.[113] Experiments have proved that beet pollen can successfully fertilise other beet plants up to a distance of several hundred metres.[114]

Central Europe and European Russia are centres of diversity for food crops of the *Brassica* (oilseed rape) family (i.e. oilseed rape, broccoli, cauliflower etc). These findings have major implications for the environment. Their domestication from wild ancestors took place in Europe, and there are still some wild relatives growing in Europe, which could acquire the artificially introduced genes from the GE crops.[115] Oilseed rape can easily interbreed under natural conditions with at least four relatives that are considered weeds: *Brassica campestris*, also known as wild turnip, bird rapeseed or *B. rapa*,[116] *B. juncea, B. adpressa* and *Raphanus raphanistrum*[117] Danish researches found that genes that have been introduced into oilseed rape by genetic engineering can easily enter a weed population.[118] There is no doubt that any GE oilseed rape grown commercially in its centre of diversity will forward the newly introduced genes to wild and weedy relatives. The same is true for sugar and fodder beet. In Northern Europe, spontaneous hybridisation between cultivated beet and wild beet *Beta vulgaris maritima* has been observed. The hybrids are now considered weeds in beet fields.[119]

The example of rape seed: An array of oilseed rape relatives grow in Europe, some of them are cultivated as crops, others are known as weeds. Spontaneous hybridisation between oilseed rape and at least four weedy relatives has been proven in several scientific experiments. *Brassica campestris*, also known as turnip, bird rapeseed or *B. rapa,*[120] *B. juncea B. adpressa* and *Raphanus raphanistrum*[121] are all known as weeds in at least some areas of Europe, and they can form fertile offspring with cultivated oilseed rape under natural conditions.

Danish researches found that genes that have been introduced into oilseed rape by genetic engineering can easily introgress into a weed population. In an experiment, one backcross was sufficient to obtain plants that resemble the weedy *B campestris* but contained the transgene from oilseed rape.[122] There is no doubt that any genetically engineered oilseed rape grown commercially in Europe, its centre of diversity, will forward the newly introduced genes to wild and weedy relatives.

Oilseed rape has a moderate ability to out-cross, with a selfing rate between 70 and 90 percent, i.e. 70-90 percent of all seeds are the result of a pollination within one flower, and only 10-30 percent of the seed result from cross-pollination, where the pollen comes from another plant. As oilseed rape was one of the first major crops to be genetically engineered in Europe, several experiments to assess its ability to pollinate plants in the vicinity were performed during the past decade. The aim was to determine a "safe" distance for field trials with genetically engineered oilseed rape plants. However, the results differed by orders of magnitude, some

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113 Zeven & de Wet (1982) from : "*Centres of Diversity*", Greenpeace, September 1999

114 Jensen & Bogh (1941) in Dark (1971) Journal of the National Institute of Agricultural Botany 12:242-266 from: "*Centres of Diversity*", Greenpeace, September 1999

115 For extensive background information see "*Centres of Diversity - Global Heritage of Crop Varieties Threatened by Genetic Pollution*" (Greenpeace: 1999), www.greenpeace.org

116 T.R. Mikkelsen, B. Andersen and R.B. Jörgensen, "*The Risk of Crop Transgene Spread*", Nature 380:31, 1996.

117 F. Eber, Chèvre AM, Baranger A, P.Vallée, X. Tanguy and M. Renard "*Spontaneous Hybridisation Between a Male-Sterile Oilseed Rape and Two Weeds*", Theoretical and Applied Genetics 88:362-368, 1994.

118 T.R. Mikkelsen, B. Andersen, and R.B. Jörgensen, "*The Risk of Crop Transgene Spread*"

119 A.C. Zeven and J.M.J. de Wet, "*Dictionary of Cultivated Plants and their Regions of Diversity*", (Wageningen, Netherlands, Centre for Agricultural Publishing and Documentation, 1982).

120 Mikkelsen TR, Andersen B, Jörgensen RB "*The Risk of Crop Transgene Spread*", Nature 380:31, 1996.

121 Eber F, Chèvre AM, Baranger A, Vallée P, Tanguy X, Renard M "*Spontaneous Hybridisation Between a Male-Sterile Oilseed Rape and Two Weeds*", Theoretical and Applied Genetics 88:362-368, 1994.

122 Mikkelsen TR, Andersen B, Jörgensen RB (1996) The Risk of crop Transgene Spread. Nature 380:31

researchers found only 0.1% outcrossed seeds at 1 meter distance from a field with genetically engineered oilseed rape, whilst others found 1.2% outcrossing even at a distance of 1.5 **kilo**meter.

There are probably two reasons for these contradictory results: First of all the experimental design differed significantly. Some of the experiments were designed like field trials, with border rows surrounding the genetically engineered plants. These resulted in low outcrossing rates. Other experiments had no border rows but an isolation area around them. These led to larger outcrossing rates at higher distances. A second explanation for the big differences might be the different localities. It is well known that pollination effectivity is strongly influenced by environmental parameters - insect pollinator abundance, food and water sources for insect pollinators in vicinity, weather conditions, wind etc. - which could cause big differences in outcrossing rates.

There is no "safe" distance: The conclusion that can be drawn from the multitude of experiments is the lack of any "safe" distance for oilseed rape in a field trial. Depending on environmental conditions, pollen can travel even over large distances and pollinate plants far away from the experimental plot. Similar multiple trials are lacking for most other crops.

In Summer 1998, France decided provisionally to stop any commercial growing of genetically engineered plants that have the ability to pass their genes to wild relatives, namely oilseed rape and beet. No approvals for transgenic lines of these two crops will be granted by the French government. The decision for this moratorium was taken by France in view of the fact that any release of genetically engineered oilseed rape or beet would be irreversible due to the high probability of outcrossing and hybridization with wild relatives.

Bt-Cotton in the USA: 'Do not plant south of Tampa'
'*In Florida do not plant south of Tampa (Florida Route 60). Not for commercial sale or use in Hawaii'*. This label is on every seed bag of Monsanto's genetically engineered *Bt*-cotton sold in the US. What is special about Hawaii and the south of Tampa? What makes the US prohibit the commercial growing of a GE crop in a specific region, while the very same variety is grown on more than 2 million hectares (1998) in the rest of the country?

In Hawaii, the reason is called *Gossypium tomentosum* – a wild plant related to cotton. In southern Florida, feral cotton (*Gossypium hirsutum*) occurs in the Everglades National Park and the Florida Keys. In both cases, free exchange of genetic material with cultivated cotton is possible. The US Environmental Protection Agency (EPA)was concerned about gene transfer from the GE varieties to the wild relatives and asked Monsanto to keep the *Bt* cotton out of the areas where close relatives grow.[123]

Selective advantage and competitiveness
While it is commonly agreed amongst the scientific community that gene escape is a likely event, its impact is debatable. One major fear is the possibility that the newly introduced gene will confer a selective advantage and will thus enable the plant to out-compete and overrun other natural vegetation. The risk is greatest when a wild relative of a GE plant is already considered a weed. Should this weed acquire – via pollen transfer –new genetic material conferring a selective advantage, it might wreak havoc in both agriculture and natural habitats. Genetically engineered "super-crops" could transfer their foreign genes to other plants and in time, could totally displace other varieties and accelerate the disappearance of native cultivars on which organic agriculture relies. The impacts are unknown and irreversible.

Many crop species – such as oilseed rape, potato, tomato, or beans – have close relatives that are already considered major weeds. It is obvious that many of the traits favoured by genetic engineers would confer a

[123] "*Centres of Diversity - Global Heritage of Crop Varieties Threatened by Genetic Pollution*", Greenpeace, 1999, www.greenpeace.org

fitness advantage, especially resistance to pest and diseases or tolerance to drought and salinity.[124] Researchers at the University of North Carolina found recently that insect-resistant oilseed rape containing a bacterial gene (*Bt*) had a higher fitness than the conventional oilseed rape. The GE plants produced significantly more seeds than their natural counterparts. The researchers concluded that "*insecticidal oilseed rape could pose an ecological risk upon environmental release. Since oilseed rape is already a minor weed in certain areas, the ability to strongly resist defoliation may allow it to selectively persist to a greater extent by replacing non-transgenic naturalised populations.*"[125]

If GMOs survive and flourish, they could displace natural wild species and those plants and animals that depend on them. The drive to create 'super-crops' designed to protect themselves against their main enemies, such as insects and disease, could result in their proliferation at the expense of native plants. The biodiversity of ecosystems located near fields of 'super-crops' could be threatened. In time, the engineered plants could entirely replace the native flora and threaten the survival of the wildlife that depend on them.

History has already taught us that introducing non-native species into new habitats can have catastrophic results. Predicting all the long-term impacts of exotics has proven to be impossible. A famous example is the introduction of Nile perch into Lake Victoria in the 1960s, which has decimated the native fish species, with over 200 species disappearing. As a further side effect, deforestation and erosion of the shoreline has occurred because Nile perch - unlike the native fish - cannot be sun dried and have to be smoked on wood fires.[126] The dangers of releasing GMOs could be even greater than releases of radioactivity and toxic chemicals into the environment. Unlike the products of nuclear and chemical pollution, GMOs can reproduce. Once released into the environment, they can multiply, spread, mutate and transfer their genetic material to other, often related, organisms. Once released, GMOs cannot be removed.

The Killing fields: Insect resistant plants may affect non-target species

Insect-resistance is one of the key traits currently engineered in the laboratories of the big seed companies. Through genetic engineering, toxins are introduced into crop plants that kill insects that thrive on the plants. The most often used toxins are the so-called *Bt*-toxins, from the soil bacterium *Bacillus thuringiensis*. A whole array of different *Bt*-toxins is known, with different toxic properties.[127] The toxins are selective in that they do not kill every insect, but only a specific selection of some insects. There are *Bt*-toxins that are said to be specific for flies, others for larvae of butterflies or beetles. For decades, bacterial formulations have been used in agriculture - especially in organic agriculture - to fight insect pests.

A series of scientific studies have now disproved the presumption that the *Bt* toxin in transgenic crops has the same favourable characteristics as the *Bt* toxin in its natural state. There is now awareness among scientists that the Bt toxin in transgenic crops – as opposed to the *Bt* toxin in its natural form in bacteria - can harm species higher up the food chain, and may become accumulated in the environment. In its interaction with bacteria, the natural *Bt* toxin will occur in a crystalline inactive state. However, in transgenic *Bt* crops, such as Pioneer's maize, the toxin will occur as a soluble pre-activated plant protein, which is produced throughout the

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[124] NC Ellstrand and CA Hoffman, "*Hybridisation as an Avenue of Escape for Engineered Genes*", Bioscience 40:438-442, 1990.

[125] CN Stewart, "*Transgenic Insecticidal Oilseed Rape on the Loose*" Proceedings of the Workshop 'Commercialisation of Transgenic Crops, Canberra, March 11-13, 1997.

[126] Anon, "*Fishing Out the Gene Pool*", Appropriate Technology, Vol.18, No. 4, March 1992, p.8; Also: M. Toner, "Are Test-Tube Fish Such a Hot Idea?," International Wildlife, Nov-Dec 1991, p.34

[127] Three types of genetically modified maize expressing the toxic Bt gene have been approved by the European Union: Novartis Bt 176, Monsanto MON 810 and Novartis Bt 11, but their approval is being challenged by several Member States. "*Ban These Crops in Europe Now, says Friends of the Earth*", Friends of the Earth Europe Press Release, 22 August 2000.

entire plant life. Genetically engineered insect resistance crops may therefore prove harmful to many non-target species, and may further disturb ecological balance.

Last year, a study by researchers at Cornell University, USA, received considerable public attention, as it showed the deleterious effect of genetically engineered maize on the monarch butterfly. Milkweed dusted with pollen from *Bt* maize led to lower survival and growth rates in the monarch butterfly.[128] A recent laboratory study in Switzerland found that when lacewings (beneficial insects that prey on crop pests) were fed corn borers raised on *Bt* maize, the lacewings suffered from disruption to their development and increased mortality.[129] A recent study by researchers at the University of Iowa (US) published in the scientific journal Oecologia in August 2000, showed that pollen from these plants killed up to 70% of Monarch butterfly larvae.[130] This study was based on field experiments that mirrored the real world scenario.

In a laboratory experiment at the Scottish Crop Research Institute, it was shown that potatoes that had been engineered with a snow drop lectin gene to be resistant to insect pests could also harm beneficial insects further up the food chain. Female ladybirds (am. ladybug) were fed on aphids that had been eating transgenic potatoes, and when compared to ladybirds fed on a normal diet, they laid fewer eggs and lived half as long.[131]

In laboratory experiments at New York University, researchers found that active forms of *Bt*, like those found in some types of transgenic crops, do not disappear when added to soil, but instead become rapidly bound to soil particles. Unlike the naturally occurring forms of *Bt*, microbes do not degrade them, nor do they lose their capacity to kill insects. The accumulation of these toxins, which could be released into the soil as farmers incorporate plant material into the ground after harvest, could represent a serious risk to soil ecosystems.[132]

Recently, laboratory studies have shown that *Bt* toxin can leak from the roots of *Bt* crops into the soil.[133] Thus, beneficial non-target insects in the soil could be exposed to higher levels of *Bt* than previously thought.

It is known that Novartis' transgenic *Bt* maize is harmful to Collembola. Collembola (springtail) is a flightless insect, which feeds on fungi and debris in soil, and which is generally considered as a beneficial insect.[134]

These studies raise major concerns about the impacts of transgenic *Bt* crops on non-target species As a result, species further up the food chain, such as birds, could face reduced food supplies. In addition, the threat to predatory species also threatens to undermine modern pest management. The preservation of predatory fauna associated with crop pests is one of the most important tools for modern pest management. For example, green lacewings together with the ladybird are the most important beneficial predatory species to control pest insects.

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[128] J.E Losey, L. Rayor and M.E. Carter, "*Transgenic Pollen Harms Monarch Larvae*", Nature 399: 214, 1999.

[129] A. Hilbeck, W.J. Moar, M. Pusztai-Carey, A. Filippini & F. Zigler, "*Toxicity of Bacillus thuringiensis CrylAb Toxin to the Predator Chrysoperla carnea (Neuroptera:Chrysopidae)*", Environmental Entomology, Vol. 27, No. 4, August 1998.

[130] "*Ban These Crops in Europe Now, says Friends of the Earth*", Friends of the Earth Europe Press Release, 22 Aug 2000. Also Laura C. Hansen Jesse and John J. Obrycki, Department of Entomology, Iowa State University (Ames, IA 50011, USA), "*Field Deposition of Bt Transgenic Corn Pollen: Lethal Effects on the Monarch Butterfly*", Oecologia, And "*Transgenic Pollen Harms Monarch Larvae*", Nature Magazine, May 20, 1999.

[131] A.N.E. Birch et al, "*Tri-trophic Interactions Involving Pest Aphids, Predatory 2-spot Ladybirds and Transgenic Potatoes Expressing Snowdrop Lectin for Aphid Resistance*", Molecular Breeding 5: 75-83, 1999.

[132] "*Build-up of Bt Toxins in Soil*", The Gene Exchange - A Public Voice on Biotechnology and Agriculture, Union of Concerned Scientists, Fall/Winter 1998 <www.ucsusa.org/publications/index.html>; Also, C. Crecchio and G. Stotzky, "*Insecticidal Activity and Biodegradation of the Toxin from Bacillus thuringiensis subsp. Kurstaki Bound to Humic Acids from Soil*", Soil Biology and Biochemistry, Vol. 30, pp. 463-70, 1998.

[133] D Saxena, S. Flores and Stotzky, "*Insecticidal Toxin in Root Exudates from Bt Corn*", Nature 402:480, 1999.

[134] EPA MRID NO 434635, Bt maize (corn) leaf protein (LP176-0194) - 28 days survival and reproduction study in Collembola (*Folsomia candidia*).

Bt-resistance: an environmentally friendly insecticide in danger

Bacillus thuringiensis (Bt) is a soil bacterium that produces a toxin that is highly valued by organic farmers. These bacteria have been sprayed on crops for more than 50 years as a safe form of biological pest control. *Bt* targets particular species of insect, such as caterpillars, and the sprays are especially valuable to organic farmers in instances where there is a serious pest infestation.

Crop plants, such as maize, have now been engineered with the gene for the *Bt* toxin to give them a built-in insecticide. Of the 41.5 million hectares sown with GE crops in 1999, 21% were insect-resistant (i.e. *Bt*) and 7% combined herbicide tolerant and insect-resistant (69% were herbicide-tolerant).[135] In marked contrast to the occasional application of the *Bt* toxin in organic farming, the transgenic *Bt* toxin is produced in the plants all the time they are growing. This means that insects are continually exposed to the toxin, and are therefore under constant pressure to develop resistance. There is overwhelming scientific data showing that resistance to *Bt* toxin will develop with the use of GM *Bt* crops. This is a most serious concern as it may jeopardise the further use of natural *Bt* formulation in environmentally friendly farming systems.

Bt resistance has already been noticed among some insect populations,[136] and the US EPA has predicted that most targeted insects could be resistant to *Bt* within 3-5 years.[137] Insect resistance to natural insecticides such as the *Bt* toxin, is a major problem for organic farming. Organic farmers have been using natural preparations of *Bt* toxin as an environmentally friendly pest control tool for decades. For example, in the US, potato farmers have been using the natural *Bt* formulation to control the Colorado potato beetle (CPB). In some areas where there was widespread resistance of the CPB to synthetic insecticides, the natural *Bt* sprays saved the potato industry.[138]

Natural preparations of *Bt* toxin are composed of natural crystals of toxin contained in spores. These are simply sprayed on the crop but then are rapidly inactivated by sunlight and other environmental factors. The crystals have a half-life of around 2.7 days and although spores can remain viable in soil for two years, they are inactivated within a few days on leaves.[139] In contrast, the *Bt* toxin from genetically modified crops is produced on an on-going basis in the crop and herbivores are therefore likely to be exposed to it for long periods.

In the US, all field populations of the Colorado potato beetle (CPB) are still susceptible to *Bt* toxins. However, a *Bt* resistant CPB has been detected in a laboratory experiment.[140] This selected CPB strain could survive for two generations on the transgenic *Bt* plants.[141] Moreover, the development of resistance of an insect to one *Bt*

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[135] Working Document, EU DG Environment: "*Economic Impacts of GM Crops on the Agri-Food Sector*" Summer 2000.

[136] B.E. Tabashnik, "*Evolution of Resistance to Bacillus thuringiensis*", Annual Review of Entomology, Vol. 39, 1994, pp.47-49; Also, B.E. Tabashnik, U-B Liu, N. Finson, L. Masson, and D.G. Heckel, "*One Gene in Diamondback Moth Confers Resistance to Four Bt toxins*", Proceedings of the US National Academy of Sciences, Vol. 94, 1997, pp.1640-4.

[137] *Bacillus thuringiensis Cry IA(b) delta-endotoxin and the Genetic Material Necessary for its Production* (Plasmid vecor pcIB 4431) in Corn. EPA Pesticide Fact-Sheet, 4/98, US Environmental Protection Agency, OPPTS, 1994.

[138] M. Whalon and D. Ferro, "*Bt Potato Resistance Management*", Now or Never, Serious New Plans to Save a Natural Pest Control, Union of Concerned Scientists, USA, edited by M. Mellon and J. Rissler., 1998.

[139] RJC Cannon, "*Bacillus thuringiensis Use in Agriculture: A Molecular Approach*", Biological Reviews 71: 561-636, 1996.

[140] M. E Whalon, D.L. Miller, R.M. Hollingworth E.J. Grafius and J.R. Miller, "*Selection of a Colorado Potato Beetle (Coleoptera: Chrysomelidae) Strain Resistant to Bacillus thuringiensis*", J. Econ. Entomol. 86: 226-33, 1993.

[141] M. Whalon and D Ferro, "*Bt Potato Resistance Management*", Now or Never, Serious New Plans to Save a Natural Pest Control, Union of Concerned Scientists, USA, edited by M. Mellon and J. Rissler, 1998.

toxin often leads to cross-resistance with other *Bt* toxins. For example, insects selected for resistance to CryIA(c) *Bt* toxin also developed resistance to CryIA(a), CryIA(b), CryIB, CryIC, and CryIIA *Bt* toxins.[142]

Herbicide Use on Herbicide-Tolerant Plants

"The ability to clear fields of all weeds using powerful herbicides which can be sprayed onto GE herbicide-resistant crops will result in farmlands devoid of wildlife and spell disaster for millions of already declining birds and plants." -- Graham Wynne, Chief Executive of the UK's Royal Society for the Protection of Birds[143]

Until now, most of the research by the biotech industry has focused on making crops resistant or tolerant to their own 'broad spectrum' herbicides. These herbicides are non-selective, they kill every green plant. This means that a field can be sprayed with chemicals and nearly all plants will die except the resistant crop. Of the 41.5 million hectares of GE crops planted worldwide in 1999, 69% were herbicide-resistant.[144] Herbicides themselves are known environmental polluters found in food, soil and water. By developing herbicide-tolerant plants, it is clear that the intention is to use them in agricultural systems that include the use of herbicides.[145]

Some Health Consequences of RoundUp Poisoning[146]

Symptoms of acute poisoning in humans following ingestion of RoundUp include gastro-intestinal pain, swelling of the lungs, pneumonia and destruction of red blood cells. Eye and skin irritation has been reported by workers mixing, loading and applying glyphosate, the chemical name for Roundup. Between 1966 and 1980, well before Roundup came to widely used, the US Environmental Protection Agency's Pesticide Incident Monitoring System had 109 reports of health effects, including nausea, diarrhoea and fever, associated with exposure to glyphosate.[147]

RoundUp is 100 times more toxic to fish than to people, toxic to earthworms, soil bacteria and beneficial fungi. Scientists have measured a number of direct physiological effects of RoundUp in fish and other wildlife, in addition to secondary effects attributable to defoliation of forests. Breakdown of glyphosate into N-nitrosoglyphosate and other related compounds has heightened concerns about possible carcinogenicity of RoundUp products.[148]

A 1993 study at the University of California at Berkeley's School of Public Health found glyphosate was the most common cause of pesticide-related illness among landscape maintenance workers in California, and the third most common cause among agricultural workers.[149]

A 1996 review of the scientific literature by members of the Vermont (USA) Citizens' Forest Roundtable revealed updated evidence of lung damage, heart palpitations, nausea, reproductive problems, chromosome aberrations and numerous other effects of exposure to Roundup herbicide.[150]

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[142] W.H. McGaughey and M.E. Whalon, "*Managing Insect Resistance to Bacillus thuringiensis Toxins*", Science 258:1451-1455, 1992.

[143] Luke Anderson, "*Genetic engineering, Food and Our Environment - A Brief Guide*", (Devon, UK: Green Books, July 1999), p. 27.

[144] C. James, "*Global Review of Commercialised Transgenic Crops: 1998*", ISAAA Briefs No. 8, (Ithaca, NY, ISAAA, 1998).

[145]Working Document, EU DG Agriculture: "*Economic Impacts of GM Crops on the Agri-Food Sector*" Summer 2000.

[146] Information in this box is by Brian Tokar, and is reprinted from article: "*RoundUp: The World's Biggest-Selling Herbicide*", by Joseph Mendelson, The Ecologist, Vol. 28, No. 5, Sept/Oct 1998.

[147] Carolyn Cox ,"*Glyphosate Fact Sheet*", Journal of Pesticide Reform, Vol 11, No. 2, Spring 1991.

[148] Ibid.

[149] Carolyn Cox, "*Glyphosate, Part 2: Human Exposure and Ecological Effects*", Journal of Pesticide Reform, Vol 15, No. 4, Autumn 1995.

Last year, a study on herbicide use in herbicide-tolerant plants revealed that US-farmers growing RoundUp Ready (RR) soybeans used 2-5 times more herbicide measured in pounds applied per acre, compared to the other popular weed management systems used on most soybean fields not planted to RR varieties in 1998.[151] A grower survey in Missouri, USA revealed that most if not all fields planted to RR soybeans received at least one herbicide application.[152] Thus, data directly and strongly refutes claims by industry that GM crops will reduce chemical use – it actually binds farmers even more tightly to this environmentally destructive and unhealthy system.

Margaret Mellon, from the Union of Concerned Scientists believes that many farmers may be turning towards GE herbicide-resistant crops because they are becoming desperate for new weed control tools. Farmers growing monocultures of maize and soybeans are facing serious weed problems. Many weeds have become resistant to chemical herbicides and multiple applications of herbicide are no longer effective as new weeds emerge.

But, herbicide tolerant plants could themselves pose environmental risks:

- Herbicide-tolerant plants may themselves become weeds;
- Weeds which are resistant to herbicide may evolve, in the same way that 'super-rats' have evolved which are resistant to rodenticide and bacteria have become resistant to antibiotics;
- The GE plants may transfer the 'foreign' genes for herbicide tolerance via pollen to other plants, encouraging the emergence of herbicide resistance, requiring new generations of herbicides. This will perpetuate the dependence on polluting agro-chemicals.

The latter point is already a reality. In 1997, a farmer in Alberta, Canada planted separate fields with oilseed rape that either resisted Monsanto's Roundup herbicide, Cyanamid's Pursuit or Aventis' Liberty. In 1999, he found weeds that resisted all three herbicides. Only more toxic herbicides, such as 2,4-D, will now be able to control the new superweeds.[153]

Clearly, the solution to weed control lies not in GE technologies, but in restoring more sustainable farming practices, such as crop rotation and smaller plots, which reduce the weed problem in the first place.

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[150] "*Glyphosate, RoundUp and Other Herbicides – An Annotated Bibliography*", Vermont Citizens' Forest Roundtable, January 1996.

[151] Charles Benbrook, Benbrook Consulting Service, July 1999, full text of the study at www.biotech-info.net

[152] Bob Hartzler, "*Are Roundup Ready Weeds in Your Future?*", November 3, 1998, full text at: http://www.weeds.iastate.edu/mgmt/qtr98-4/roundupfuture.htm

[153] New Scientist, 19 February 2000, p. 21.

11. Health Risks

The Notion of 'Substantial Equivalence'[154]

Consumers in Western Europe first became aware of GE food in 1996, when Monsanto's herbicide-tolerant soybeans grown in the US started to arrive in Europe. Over 40% of the US soybean harvest is exported, and the GE soybeans are mixed in with the conventional harvest. The American Soybean Association rejected calls to segregate the GE soy on the basis that it was 'substantially equivalent' to ordinary soybeans.[155]

The concept of 'substantial equivalence' has been at the root of the international safety assessment and testing of GE food. According to this principle, selected chemical characteristics are compared between a GE product and any variety within the same species. If the two are grossly similar, and if it is shown that the genetic engineering has not inadvertently led to the production of known toxins and allergens, the GE product does not need to be rigorously tested on the assumption that it is no more dangerous than the non-GE equivalent.

The use of 'substantial equivalence' as a basis for risk assessment is seriously flawed, and cannot be depended on as a criterion for food safety. It focuses on risks that can be anticipated on the basis of known characteristics, but ignores unintended effects that may arise.[156] Genetically engineered food may, for example, contain unexpected new molecules that could be toxic or cause allergic reactions. A product could not only be 'substantially equivalent', but even identical with its traditionally produced counterpart in all respects bar the presence of a single harmful compound. It has also been argued that substantial equivalence acts against rigorous scientific inquiry because it prevents testing of the assumption that GE does not cause changes that are more dangerous than traditional breeding.[157]

The Example of Tryptophan[158]

Food supplements such as amino acids, are often manufactured by fermentative processes, in which large quantities of bacteria are grown in vats, and the food supplement is extracted from the bacteria and purified. One amino acid, tryptophan has been produced in this way for many years. In the late 1980's the Japanese company Showa Denko K.K. decided to use genetic engineering to accelerate and increase the efficiency of tryptophan production. They genetically engineered bacteria and altered the cellular metabolism substantially, leading to greatly increased production of tryptophan. These genetically engineered bacteria were immediately used in commercial production of tryptophan, and the product placed on the market in the US in 1988.

Showa Denko was allowed to sell the tryptophan produced by genetically engineered bacteria without safety testing because they had been selling tryptophan produced in non-genetically engineered bacteria for years without ill effects. It was considered that the method of production (whether via natural or genetically engineered bacteria) was immaterial. In effect they considered it **substantially equivalent** to the tryptophan that had been sold for many years.

This product was placed on the market, and within a few months it caused the deaths of 37 people and caused 1500 more to be permanently disabled.[159] It took months to discover that the poisoning was due to toxin

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[154] Parts of this section are taken from: Luke Anderson, "Genetic engineering, Food and Our Environment - A Brief Guide", (Devon, UK: Green Books, July 1999) pp. 15-16.

[155] "*European Response to Genetically Modified Soybeans*" Press Release from American Soybean Association, November 1996 <www.oilseeds.org/asa/news.htm>

[156] J. Fagan, "*Importation of Ciba-Geigy's Bt maize is Scientifically Indefensible*", <www.netlink.de/gen/BTCorn.htm>

[157] E Millstone, E Brunner and S. Mayer, "*Beyond 'Substantial Equivalence*", Nature 401:525-526, 1999.

[158] This section is an extract of a briefing paper prepared by Dr. John B. Fagan from Genetic ID, USA, in November 1997.

[159] Mayeno, A.N. and Gleich, G.J., "*Eosinophilia-myalgia Syndrome and Tryptophan Production: A Cautionary Tale*," TIBTECH, 12, 346-352, 1994

present in the tryptophan produced using Showa Denko's genetically engineered bacteria. The disease caused by this toxic product is called Eosinophilia Myalgia Syndrome (EMS).

It was later shown that the tryptophan produced in genetically engineered bacteria contained one or more highly toxic contaminants. The most prominent of these, called EBT, was identified as a dimerization product of tryptophan. It comprised less than 0.1% of the total weight of the product, yet that was enough to kill people. This compound was probably generated when the concentration of tryptophan within the bacteria reached such high levels that tryptophan molecules began to react with each other. Thus, it appears that genetic manipulations led to an increase in tryptophan biosynthesis, which led to an increase in cellular levels of tryptophan. At these high levels, these compounds reacted with themselves, generating a deadly toxin. Being chemically quite similar to tryptophan, this toxin was not easily separated from tryptophan, and contaminated the final commercial product at levels that were lethal to some consumers.

The tryptophan case is complicated by the fact that the company had also cut corners in the purification procedure at the same time when they introduced the genetically engineered bacteria. Until now it is not definitively established whether toxicity resulted primarily from the use of genetically engineered bacteria or from cutting corners in the purification procedure. In any case, this example highlights that the concept of substantial equivalence is flawed. The product that resulted from the new production process (after introducing GE bacteria and altering the purification process) was considered substantially equivalent to the former product.

This example highlights the danger that a genetic alteration in an organism can shift the metabolic pathway and cause the production of toxins that might not be detected during some superficial safety tests.

Antibiotic resistance marker genes

Most of the currently marketed GE crops contain antibiotic resistance marker genes, in addition to the desired trait like insect or herbicide resistance.

There is the risk that the gene can be transferred from the plant to disease causing germs, whether the transgenic maize is used as animal fodder or as a food product for humans. These bacteria would then be immune to antibiotic treatment.

Research on if and to what extent such gene transfer can happen has only recently started, so the available scientific data is incomplete. A recent study published in La Recherche (309, May 1998) indicates that the preconditions for such transfer are now present. In this paper, Professor Patrice Courvalin of the French Pasteur Institute points to the likelihood that antibiotic resistance will transfer from transgenic plants in the environment, and to the potential for transfer in the digestive tract. Widespread cultivation of transgenic crops, warns this report, will significantly add to already problematic issues of resistant bacteria. There is sufficient scientific proof that:

- Genes can be relatively stable in the intestine;
- Bacteria can in principle take up genes in mammalian intestines;
- Horizontal gene-transfer from genetically modified micro-organisms to bacteria has been observed in the intestines of insects (e.g. spring-tails);
- Soil bacteria are known to take up genes in the soil.

Given the above, current scientific knowledge strongly supports the assumption that antibiotic resistance genes can be taken up from bacteria in the intestines of animals and humans. Experience in normal agricultural practice shows that antibiotic resistance can move from animal pathogens to bacteria that are also harmful to humans.

The risks of antibiotic resistance genes used in genetic engineering are often trivialised by the industry, with the argument that a large proportion of the bacteria in our environment is already resistant to antibiotics. In their opinion, occasional gene transfers from GM plants to pathogens is statistically insignificant. Several research results contradict this argument. Novartis often states that about 40-60% of intestinal bacteria are already resistant to Ampicillin and related antibiotics. But they present no scientific data for these figures. An analysis of scientific literature shows that the frequency of antibiotic resistance varies considerably. Depending on the variety of bacteria, and also depending on the country where the research has been carried out, the results are completely different. The percentage of antibiotic resistant germs in samples of one variety of bacteria (Bacteroides fragilis) varied between 3 and 30%, in samples of another bacteria (Shigella) between 5.9 and 80.7%. A general statement of 40-60% is completely unfounded. It also has to be assumed that not every human being carries antibiotic or Ampillicin resistant germs. Each antibiotic therapy is based on the bacteria being and staying sensitive to the chosen antibiotic. Ampicillin antibiotics are widely used in the treatment of human illness as well as on animals. In 1994, for example, 40 million courses of Ampicillin were prescribed in the US (that is, an average of 1 in 6 of the population). Furthermore, the resistance gene present in the transgenic maize confers resistance also against the antibiotics Ampicillin and Amoxycillin. To maintain the effectiveness of antibiotics for as long as possible, it is simply irresponsible to put further resistance genes into circulation.

It is an unnecessary, obsolete technology

Antibiotic resistance genes do not serve any purpose in transgenic crops. Such resistance genes are used as markers in the laboratory by genetic engineers, to distinguish cells where their engineering of other traits has been successful from those where they failed. If the cells are treated with antibiotics after the gene transfer, only those containing the resistance gene survive - those cells also will be the only ones containing the desired genes, like insect- or herbicide-resistance. Today, it is possible to use other markers instead. It is also possible to remove antibiotic resistance genes after the genetic engineering event.

Because they are unnecessary and dangerous to human health, many regulatory authorities in Europe oppose the use of antibiotic resistance markers. The German GE advisory commission (ZKBS) recommends the rejection of clinically important antibiotic resistance genes. The French Committee of Prevention and Precaution recommends a ban of all transgenic crops containing antibiotic resistance genes. The US Biosafety Advisory Committee says that antibiotic resistance should not be trivialised. Norway prohibits all transgenic plants with antibiotic resistance. The French government will not allow such plants (other than Novartis' already-approved maize). Several EU-member states such as the United Kingdom have announced their opposition to the approval of the Novartis maize in Europe.

ANNEX A: OECD/BINAS List of Deliberate Release Notifications

1. **Organism Common Name:** Sugar beet
Organism Scientific Name: *Beta vulgaris*
Cultivar: *Liberty*
Desired Trait: Herbicide resistance (Liberty)
Gene: Synthetic PAT gene
Organisation: AgrEvo GMBH
Purpose of release: Processing and consumption
Geographic location: Moscow region

2. **Organism Common Name:** Potato
Cultivar: *Var. Belorusskii3*
Desired Trait: Virus resistance (PVY)
Gene: CP VPY
Organisation: Centre Bioengineering, RAS
Start date: 1994-01-01
Finish date: 1998-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Moscow

3.**Organism Common Name:** Potato
Cultivar: *Var. Prigozhii-2*
Desired Trait: Herbicide resistance (Basta)
Gene: Bar-gene
Organisation: Centre Bioengineering, RAS
Start date: 1994-01-01
Finish date: 1998-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Moscow

4. **Organism Common Name:** Potato
Cultivar: *Var. Russet Burnbank New Leaf*
Desired Trait: Insecticide resistance (Colorado beetle)
Gene: Cry IIIa *B.Thuringienis*
Organisation: Monsanto
Start date: 1997-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Regions of Moscow, Tambov, Krasnodar, Far East

5. **Organism Common Name:** Potato
Cultivar: *Superior New Leaf*
Desired Trait: Insecticide resistance (Colorado beetle)
Gene: Cry IIIa *B.Thuringienis*
Organisation: Monsanto
Start date: 1997-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Regions of Moscow, Tambov, Krasnodar, Far East

6. **Organism Common Name:** Soybean
Cultivar: *line 40/3/2, Var. Asgrow*
Desired Trait: Herbicide resistance (Roundup)
Organisation: Monsanto
Start date: 1997-01-01
Purpose of release: not available. Restricted biosafety trials
Geographic location: Krasnodar region

7. **Organism Common Name:** Potato
Cultivar: *Var. Russet Burnbank New Leaf*
Desired Trait: Insecticide resistance (Colorado beetle)
Gene: Cry IIIa *B.Thuringienis*
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Variety trials
Geographic location: 18 regions

8. **Organism Common Name:** Potato
Cultivar: *Superior Newleaf*
Desired Trait: Insecticide resistance (Colorado beetle)
Gene: Cry IIIa *B.Thuringienis*
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Variety trials
Geographic location: 18 regions

9. **Organism Common Name:** Sugar beet
Desired Trait: Herbicide resistance (Roundup)
Gene: EPSPS Agrobacterium spCP4
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Restricted biosafety trials

Geographic location: Regions of Moscow, Tambov, Krasnodar, Far East

10. **Organism Common Name:** Maize
Desired Trait: Herbicide resistance
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Regions of Moscow, Tambov, Krasnodar, Far East

11. **Organism Common Name:** Soybean
Cultivar: *line40/3/2, Var. Asgrow*
Desired Trait: Herbicide resistance (Roundup)
Gene: EPSPS Agro-bacterium spCP4
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Restricted biosafety trials
Geographic location: Krasnodar region

12. **Organism Common Name:** Soybean
Cultivar: *line40/3/2, Var. Asgrow*
Desired Trait: Herbicide resistance (Roundup)
Gene: EPSPS Agro-bacterium spCP4
Organisation: Monsanto
Start date: 1998-01-01
Finish date: 1999-01-01
Purpose of release: Processing and consumption
Geographic location: Anywhere in the Russian Federation

13. **Organism Common Name:** Potato
Trait wanted: PVX, PVY resistance
Institution / Company: Centre "Bioengineering" RAS
Regulatory Authority: Inter-Agency Commission on Genetic Engineering Activity
Regulatory Contact: A. Golikov
Modification category: Virus resistance

14. **Organism Common Name:** Potato
Trait wanted: Human interferon production
Institution /Company: Institute of Potato Breeding[160]
Regulatory Authority: Inter-Agency Commission on Genetic Engineering Activity
Regulatory Contact: A. Golikov
Modification category:

15.**Organism Common Name:** Potato
Trait wanted: Colorado beetle resistance (two variants)
Year: 1997
Institution /Company: Monsanto (Europe)
Regulatory Authority: Inter-Agency Commission on Genetic Engineering Activity
Regulatory Contact: A. Golikov
Modification category: Pest resistance

16. **Organism Common Name:** Soybean
Trait wanted: Herbicide Resistance
Institution /Company: Monsanto (Europe)
Institution /Company Contact
Regulatory Authority: Inter-Agency Commission on Genetic Engineering Activity
Modification category: Herbicide tolerance

[160] "*Field Trials and Commercial Applications, Field Trials in Russia*", OECD/BINAS Web Page, http://www.oecd.org/about/member-countries.html; http://binas.unido.org/binas

ANNEX B: Contacts for People Interviewed for this Report

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ANNEX C: Contact Addresses

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Fax: 7-095-258-1734

Dupont
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SCIENTIFIC INSTITUTES DOING GE
Basic research in biology and biotech is carried out in such institutes as:
Russian Academy of Sciences (RAS)

- Institute of Bioorganic Chemistry, Moscow
- Centre of Bioengineering, Moscow
- Institute of Molecular Biology, Moscow
- Institute of Gene Biology, Moscow
- Institute of Molecular Genetics, Moscow
- Institute of Microbiology, Moscow
- Institute of Plant Physiology, Moscow
- Institute of Biochemistry and Physiology of Microorganisms, Pushchino
- Institute of Protein Research, Pushchino
- Institute of Cytology and Genetics, Novosibirsk
- Novosibirsk Institute of Bioorganic Chemistry, Novosibirst

Within the RAS, the Scientific Council for Biotech was set up in 1980 and the Inter-departmental Commission on rDNA in 1988.

Russian Academy of Agricultural Sciences

- Institute of Agricultural Biotech, Moscow
- Institute of Agricultural Microbiology, St. Petersburg
- Institute of Phytopathology, Odintsovo
- Scientific Industrial Biotech Centre in Animal Husbandry, Dubrovitsy

Russian Academy of Medical Sciences

- Institute of Biomedical Chemistry, Moscow
- Institute of Nutrition, Moscow
- Institute of Experimental Medicine, St. Petersburg

Ministry of Health Care

- State Research Centre of Virology and Biotech 'Vector', Koltsovo, Novosibirsk region
- State Research Centre of Genetics and Selection of Industrial Microorganisms, Moscow
- State Research Centre for Applied Microbiology, Obolensk

Ministry of Education
Etc, etc.[161]

[161] K.G. Skryabin and L.P. Matyash, Country profile: Russian Federation in "*Biotechnology in the Developing World and Countries in Economic Transition*", G.T. Tzotzos and K.G. Skryabin Ed., CABI Publishers, March 2000

GLOSSARY[162]

agrochemical: synthetic chemical used in agriculture to control pests (pesticides and insecticides) or weeds (herbicides), or to stimulate soil as in the case of fertilisers.

allergy: adverse sensitivity or pathological reaction to environmental factors or substances in amounts that do not affect most people.

antibiotic: pharmaceuticals produced from fungi, bacteria and other organisms that inhibit the growth of or destroy micro-organisms, and are widely used to prevent and treat diseases. Perhaps penicillin is the best known of this class of drugs.

biotechnology: a variety of techniques that involve the use and manipulation of living organisms to make commercial products. These techniques include cell culture, tissue culture, embryo transfer and recombinant DNA technology (genetic engineering).

biodiversity: All living organisms, their genetic material and the ecosystems of which they are a part. It is usually described at three levels: *genetic, species and ecosystem diversity*. *Genetic diversity* is the variation of genes between and within species. It is all the genetic information contained in all the genes of all plants, animals and micro-organisms on earth. Genetic diversity within a species allows it to adapt to new pests and diseases, and to changes in environment, climate and agricultural methods. *Species diversity* is the total number or variety of species in a given area. *Ecosystem diversity* is the total variety of ecosystems or interdependent communities of species and their physical environment. Ecosystems may cover very large or quite small areas. They include such natural systems as grasslands, mangroves, coral reefs, wetlands and tropical forests, as well as agricultural ecosystems that depend on human activity but have characteristic assemblages of plants and animals.

Bt**:** *Bacillus thuringiensis* CrylA(b) Delta-Endotoxin (BT) is a naturally-occurring soil bacterium approved as a natural insecticide for use by organic farmers.

CEE: Central and Eastern Europe.

cloning: the practice of artificially producing two or more genetically identical organisms from the cells of another organism.

CODEX Alimentarius: the UN body charged with developing international standards for food quality and safety, and comprised of 165 nations.

DNA (deoxyribonucleic acid): genetic material in all organisms (with the exception of a few viruses) in which the hereditary material is ribonucleic acid or RNA. It is contained in chromosomes. The information coded by DNA determines the structure and function of proteins that in turn define the structure and role of cells making up an organism.

enzyme: any of numerous proteins produced by living organisms and functioning as biochemical catalysts in living organisms.

[162] *Most definitions from* ***Enclosures of the Mind*** *(RAFI) and* ***The Ownership of Life*** *(IATP)*

gene: the functional unit of heredity. A gene is a section of DNA that codes for a specific biochemical function in a living being. Genes are physically located on chromosomes.

genetic engineering (GE): see genetically modified.

genetically modified (GM): the use of high technology processes to manipulate the genetic material of a living organism in order to affect the organism's biochemical characteristics and create new, different organisms in a laboratory.

genetically modified organism (GMO): organisms (plant, animal, micro-organisms, and parts thereof) created through genetic engineering/modification.

herbicide: a synthetic chemical used to destroy weeds or other undesirable vegetation amongst a crop.

multinational corporation (MNC): the original term used to describe companies present in more than one company, but with a strong national base. Also see transnational corporation.

organic agriculture: a type of agriculture which does not employ artificial chemical pesticides, herbicides, synthetic fertilisers, sewage slurry, GMOs, antibiotics or irradiation in the production of crops or livestock.

Organisation for Economic Co-operation and Development (OECD): The OECD was founded in 1961 to build strong economies in its member countries, improve efficiency, hone market systems, expand free trade and contribute to development in industrialised as well as developing countries. Membership consists of the 29 countries (including Europe, North America, Japan, Australia, New Zealand, Finland, Mexico, Czech Republic, Hungary, Poland and Korea), that produce two thirds of the world's goods and services.

patent: temporary legal monopoly on the commercial exploitation of an invention that covers a wide range of products and processes, which now includes life forms. In order to patent something, the invention must meet four criteria. A patent must be new, innovative, industrially applicable, and must necessitate an inventive step. Patents provide exclusive legal protection to patent holders for between 17-25 years. Anyone wishing to use a patented invention must receive permission from the patent holder and pay royalties. In exchange for this monopoly, the patent holder must disclose information about the invention.

pesticide/insecticide: a synthetic chemical used to destroy insects to prevent them from eating crops.

precautionary principle: The precautionary principle was first recognised as international law by the Rio Declaration in 1992, and reads: *"Principle 15: In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

protein: any of a group of complex organic compounds that contain amino acids as their basic structural units, occur in all living matter, and are essential for the growth and repair of animal and human tissue.

recombinant DNA: a hybrid DNA molecule which contains DNA from more than one source

toxicity: capable of causing poisoning when introduced into the body.

transnational corporation (TNC): a more recent term than MNC used to define companies that are present in many countries (hundreds of countries) thus having often less than 50% of their activity in their country of origin. Some of these companies are now moving their headquarters out of their country of origin. The spread of shareholders also means that the notion of country of origin becomes vague. TNC is more relevant now to the aspect of globalisation than MNC.

transgenetic animal: an animal into which new DNA sequences have been deliberately introduced.

US Department of Agriculture (USDA): The US equivalent of a Ministry of Agriculture.

US Environmental Protection Agency (US EPA): The US equivalent of a Ministry of Environment.

US Food and Drug Administration (US FDA): the US government agency responsible for new food, drug, and cosmetic approvals, as well as food safety issues.

World Bank: one of the largest multilateral banks, it lends to governments for financial restructuring, environmental and social projects, and infrastructure development. The bank has come under increasing fire for lending to projects which induce environmental devastation rather than protection as well as forced relocation of people - such as massive road-building projects, large dams, and timber harvesting in environmentally-sensitive areas through clear cutting.

xeno-transplantation: the cloning of animals for human transplants, and genetically modifying animals to produce pharmaceuticals in milk for example.