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Q: What is Greenpeace's position on genetic engineering?

A: Greenpeace is opposed to the release of genetically engineered organisms (GMOs) into the environment and to the patenting of life. Genetically modified organisms have been released without adequate knowledge about their effects on the ecology, wildlife and human health. Greenpeace does not campaign against the contained use of genetically engineered organisms, such as for medical applications.

Q: What is genetic engineering? Are GMOs dangerous? Isn't it like conventional breeding?

A: Genetic engineering makes it possible to insert foreign genes into random positions in the DNA of a host, e.g. a plant or crop. These hosts are then subsequently screened for the desirable trait inserted, e.g. resistance to a chemical weed-killer.

Genetically Modified Organisms (GMOs) are new life forms which have never before occurred in nature, and which cross species barriers, unlike traditional plant breeding or traditional biotechnology. Genetic engineering breaks the natural boundaries that exist between species. A fish and a strawberry will not breed in nature, but in the laboratory, scientists can take a gene from a fish, insert it into a strawberry, and essentially create an entirely new organism. Genetic engineering can manipulate genes from animals, plants, and even humans.

Once these man-made organisms are released into the environment and the food chain, they reproduce and there is no way to recall them. No one knows what the long-term effects of GMOs on the environment will be as they had never been released in the environment on a large scale before the mid-90s.

Q: Do GE crops pose a health risk?

A: It cannot be excluded that genetically altered plants involve possible health risks. The random insertion of a foreign gene may disrupt the tightly controlled network of DNA in an organism. The gene could, for example, alter chemical reactions within the cell or disturb cell functions. This could lead to instability, the creation of new toxins or allergens, and changes in nutritional value.

Genetically engineered plants contain genes from bacteria, insects and viruses which have never been part of the human diet. No information exists about their allergenic properties. The allergenic potential of such exotic, introduced gene products are uncertain, unpredictable and untestable.

In addition many of the genetically engineered crops which are already grown on a commercial scale contain genes which are resistant to antibiotics used for the treatment of diseases in both humans and animals. These genes are unnecessary to the development of the GE plants themselves and could severely undermine the effective treatment of diseases if the antibiotic resistance is transferred to bacteria which are harmful to human and animal health.

Q: Isn't genetic engineering an accurate, predictable and fully understood technology?

A: The technology currently used to genetically engineer living organisms such as plants or animals is crude and imprecise. There is little or no understanding of the effects of genetic engineering (GE) on DNA and the organism as a whole, nor of how this might affect offspring in subsequent generations. Current genetic engineering technologies involve the insertion of novel gene(s) into the DNA of a host. Whilst the sequence and primary function of the genes in the insert are both usually well defined, current methods usually insert gene sequences into the host DNA at random positions.

There is no external control on the position at which the insert is incorporated into the host DNA.

DNA is a complex molecule whose detailed function is poorly understood. It is not yet understood exactly how DNA architecture affects gene expression. It is known, however, that the position of a gene within the DNA molecule influences the regulation of that gene - this is called the position effect. There is a large uncertainty regarding the position and number of the inserted genes until later examined using DNA sequencing techniques. Inserted genes can also cause unintended side effects.

In conclusion, the consequences of genetic engineering on the structure of DNA, the detailed functioning of genes and their effect on the organism as a whole cannot be accurately predicted. Proponents of GE technology would argue that much DNA is redundant and GMOs containing unviable insertions or those with serious biochemical abnormalities are screened out. However, some biochemical abnormalities may be latent, or may only transpire several generations later. Results may not be apparent for several generations and there is little data on how gene inserts behave in subsequent generations.

Q: Isn't it true that GE is a "green" technology which allows farmers to use less herbicides?

A: An analysis of more than 8,200 University field trials has shown that farmers who grow GMO soybeans use two to five times more herbicides than farmers who grow natural soy varieties.

70 percent of the genetically engineered crops in the field in 1999 were engineered to withstand high doses of farm poisons. Application of toxic chemicals is actually a necessity with these crops, while techniques that truly move farmers away from chemical use fall to the wayside.

Many of the biotechnology companies trying to convince the public that GMOs are good for the environment are actually concealing a much different agenda: an effort to increase sales of herbicides owned and marketed by the very same companies.

Q: Aren't genetically engineered crops needed to feed the world?

A: This is a fundamentally flawed claim based on the false assumption that hunger exists because of a gap between food production and human population. In fact, "The world produces enough food to feed all the people who inhabit it - and it could produce even more," according to United Nations Food and Agriculture Organisation (FAO) head, Jacques Diouf.

FAO's recent food security assessment "Agriculture: Towards 2015/30" excludes genetically modified organisms yet concludes that food production will continue to increase over the period to 2030 and will continue to exceed population growth. This report confirms that the real causes of hunger and malnutrition are poverty and lack of access to food.

At www.farmingsolutions.org Greenpeace, Oxfam and other groups concerned with real solutions to hunger have documented examples of socially and environmentally sustainable farming practices from all over the world that provide sufficient and healthy food.

Q: Aren't GE crops good for farmers?

A: In USA and Canada where GE crops have now been grown for over five years a coalition of 33 farm and agriculture groups recently issued a warning that "Genetic engineering in agriculture has significantly increased the economic uncertainty of family farmers throughout the U.S. and the world. "

The agrochemical companies that produce GE seeds require farmers to sign legal agreements specifying how to farm and promising not to save seed. They also expect farmers to pay royalties.

Companies such as Monsanto then aggressively sue farmers who they believe are using their seeds without signing such agreements. Unfortunately due to contamination many farmers are finding they have GE crops on their land whether they asked for it or not. In Canada Monsanto sued a canola grower called Percy Schmeiser because GE canola was growing on his land as a result of

contamination. Even though Schmeiser did not want the contamination Monsanto argued successfully that he owed them money anyway.

Conventional growers are discovering that GE crops from neighbouring fields have become weeds that cannot be sprayed off with herbicides because they have inbuilt resistance. In Canada the Royal Society has warned that the entire Canadian prairie is now contaminated with herbicide-resistant canola weeds, the removal of which raises farm costs.

At the end of harvest US and Canadian farmers are discovering a further problem of GE crops – that export markets won't buy them. Following the introduction of GE canola in Canada, sales of Canadian Canola to Europe dried up. The same is true of US corn which is no longer sold to Europe and has lost important markets in Asia.

Q: What are Bt crops? Are they dangerous?

A: GE BT crops are designed to be resistant to an Insect pest. Such crops are created by inserting a synthetic version of a gene from the naturally occurring soil bacterium, *Bacillus thuringiensis* (*Bt*), so that the plants produce their own *Bt* toxins to destroy pests. Insect resistant *Bt* maize, cotton and potatoes have already been grown extensively on a commercial scale, particularly in the USA, and many other *Bt* crops are under development (e.g. oilseed rape, rice and tomatoes).

Evidence suggests that the rush to commercialise Bt crops could have serious consequences on the environment and on human health. For instance, official scientists in several national administrations in Europe advised their governments that the genes contained in a transgenic maize produced by the multinational Novartis, in particular those conferring antibiotic resistance, will pose real threats to human and animal health and the environment.

Q: What is golden rice? Couldn't it prevent children from suffering from vitamin A deficiency and going blind?

A: Golden rice is a variety genetically engineered in a laboratory to produce pro-vitamin A. Its proponents say this GE rice would solve the problems of vitamin A deficiency (which can result for example in blindness) in developing countries.

According to Patrick Moore, the lead researcher, Dr Potrykus, this variety of golden rice is now ready for planting. "Ready" excludes the requirement for any understanding of the health or environmental impacts. The reality is that golden rice is a research project. It has not undergone safety tests and its claims to solving health problems are extremely optimistic, bordering on fantastic.

GE Golden rice is the most expensive, least developed, and most ecologically dangerous way to address VAD. In the long term, the single-crop approach of GE rice may be a serious threat to food security. GE rice does not address the underlying causes of VAD, which are mainly poverty and lack of access to a more diverse diet. This rice is an untested and superficial technological fix that may generate new problems.

Vitamin A rice could, if introduced on a large scale, exacerbate malnutrition and ultimately undermine food security because it encourages a diet based on one staple rather than the re-introduction of the many vitamin-rich food plants that were once cheap and readily available. These plants would address a wide variety of micronutrient deficiencies, not just VAD.

Q: Is Greenpeace opposed to the use of GE in medicine?

A: Greenpeace's expertise is on environmental issues and focuses on the ecological risks connected with the release of GMOs into the environment. We are no experts in the field of medical questions which often involve many social aspects.

The application of genetic engineering in medicine is different to the use of GE in agriculture or aquaculture. The use of GE in the latter ones involves massive release of genetically engineered organisms into the environment. In the medical sector, GE is used to develop new drugs or to develop new diagnostics kits with the majority of these applications not involving the use of GMOs or their release into the environment. The production of pharmaceuticals can be done by GE micro-organisms in contained facilities.

Scientific progress in molecular biology has great potential to increase our understanding of nature and to provide new medical tools. There might be beneficial applications in the diagnosis or treatment of serious diseases.

Greenpeace is not in general opposed to the use of GE in the medical sector, but research and application should only take place in truly contained systems. No GMOs producing e.g. drugs or hormones should escape into the environment because of the risks to human health, wildlife and ecosystems.