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# Green Gene Technology

## Research in an Area of Social Conflict

Springer

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## Research in an Area of Social Conflict

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# Preface

Green gene technology (GGT), understood as a part of modern biotechnology, has been on a steady, triumphal progression over the last ten years (ISAAA 2007, see the contribution by Einsele in this issue). This volume, jointly edited by Prof. Fiechter and me, deals with some actual scientific and socio-economic aspects with regard to genetically modified plants (GMP). Worldwide more than 100 million hectares of agronomical land are covered by GMP. This includes some prominent industrialised Western countries like the USA and Canada, a series of threshold countries like Argentina, Brazil, India and China, and a number of developing countries. Clearly, some of these countries have to deal with crop plant production and human nutrition in a very pragmatic way since, for example, India has to feed about a 1/5 of the world population on about 3% of the arable land. In contrast, the situation in Europe appears very different. Food supply is more than sufficient and comparably inexpensive. This surplus of food is on one hand convenient, since starvation has been largely unknown in Europe for about 50 years, with only comparatively few exceptions of socially peripheral individuals. On the other hand it makes the population careless about the future food supply. Even beyond mere food supply, Europe gained its cultural values from its agricultural success over the centuries. A single farmer became able to feed more and more people making them free to work outside of agriculture as a craftsman, artist, poet, scientist, engineer, mayor, administrative official, priest, philosopher, or soldier – to give only a few examples. In the public perception this connection between agronomy and cultural welfare is not sufficiently appreciated in Europe. Switzerland, geographically in the centre of Europe (although not a member of the political union) has the same cultural tradition, only somewhat shifted towards the more conservative mood common to mountain populations. In summary, a majority of Europeans, and the Swiss population in particular, are reluctant to new methods in agronomy.

Switzerland is probably the only country worldwide that has a moratorium on the commercial growth of genetically modified plants in its constitution. In contrast, the moratorium for GMP in the European Union between 1999 and 2004 was not legally binding. In Switzerland it was the population itself that established this moratorium into fundamental law by means of a referendum. Moreover, all Swiss legislation about gene technology, the so-called "Genlex",

is probably the strongest law in place that attempts to prevent the abuse of gene technology worldwide. This includes, for example, protecting the dignity of organisms. We are not aware of any other country in the world that has extended the term dignity of organisms to plants at the level of making it law or that has included this extension in its release ordinance, which also regulates field experiments with GMP. Dignity of plants is particularly difficult to determine, since most of the categories known from dignity of animals, like natural behaviour or sexual propagation, are not applicable to crop plants, which have been bred to exhibit very unnatural behaviour. Potatoes, for example, are mostly pollen sterile, often seed sterile, and have been artificially selected for loss of their alkaloids in the tuber, which makes them an easy victim to many predators or pathogens. This exposure to its enemies would be a clear contradiction to animal dignity. However since we have little imagination about a plant's "well being", even ethical experts publicly convey a somewhat helpless impression with this issue.

This particularly strong position of the gene technology legislation, guided by the public mood against gene technology is remarkable in Switzerland, since this country owes a considerable part of its wealth to the chemical and pharmaceutical industries, which depend largely on biotechnology in their modern development. Industry research and developments dealing with GGT has consequently moved out. The research at the famous industry-owned Friedrich Miescher Institute in Basel is no longer engaged in plant research and the large rice genome project of Syngenta in Stein was first moved to England and then to the US. High regulation hurdles for a small country make it very unattractive to invest in deregulation for an agronomic area that is too small to get back the investment by selling seeds. With less than 100 000 ha, the largest crop area in Switzerland is maize, of which only a small proportion could be GM maize. Only a non-profit institution would be able to deregulate a GM crop plant. But the only biotechnology group at a federal research station that could have brought a GM line to market was closed down in 2005.

In contrast to this barren land with regard to the application of GGT, more than 80 basic research projects with GGT are ongoing in Swiss public research institutions, the universities and the federal research institutes (Farinata-Kramer 2005, http://www.forschung-leben.ch/download/BioFokus70.pdf). This is a remarkable number for such a small country. Swiss plant scientists are prominent authors in top-ranking international research journals. The projects range from very basic research like chromatin structure and function to fields with an apparent application perspective like disease resistance in crop plants. A small-scale field test should always be made as the last step for proof of concept at the end of such basic research projects with application perspective. Field tests in Switzerland are officially possible in spite of the moratorium, which concerns only commercial application. However the hurdle to get a permit is very high. There have only ever been three field tests with GMP in Switzerland and only one since 1992. It took an unaffordable 4 years to get

permission for this harmless test performed in 2004, and financial expenses went beyond any relation to the scientific project costs. This money had to be spent on scientifically dispensable safety measures, attorney fees to support appeals in court, for professional guards and so on. Public research can not afford this time and expense a second time (see: Schlaich et al., in this issue). As a consequence, colleagues tend to do field tests in collaboration with colleagues abroad. The same experiment for which researchers in Switzerland were required to wait 4 years, submit 500 pages of applications and legal papers, and answer additional requests before permission was granted (in addition to the cost of all this), required US researchers to fill in a three-page form and agree to six weeks of evaluation by the authorities. This is apparently a very imbalanced situation for competition in research. As long as research stays in the lab, i.e. as long as it has no consequences, it is welcome in Europe. However, as soon as any application perspective becomes apparent, the resistance is extremely high because the final step for proof of concept needs an outdoors experiment. The legal situation, administrative officials, NGOs and the public mood collaborate very efficiently against research.

The huge mental discrepancy in society between research and application highlights that Switzerland in this sense is part of the European culture. Moreover by its size and the vehemence in the arguments of the opponent combatants in the public debate, Switzerland might even be a small core model for what happens in Europe on a larger scale. Therefore, when Prof. Fiechter asked me to join him in editing an issue of *Advances in Biochemical Engineering and Biotechnology* about green biotechnology, we immediately had the idea to focus on the Swiss situation: promotion must start at the centre of resistance otherwise it will be difficult to move anything. This is probably also true for changing the public mood on GGT. Promotion is necessary from the viewpoint of science, not in the sense that scientists should make political decisions – this is the field of the sovereign – but in the sense of insisting on dissemination of their knowledge and their rational conclusions also against a public majority. In contrast to industry, which has to sell products and thus has to please their customers, scientists working in public research institutions are not useful to society if they *only* prove experimentally what the public believes anyway. Who else if not public scientists should be the advocate of nature? GGT has huge potential for sustainable agriculture, for example, by reducing our dependence on agrochemicals and thus helping to preserve the environment, which shows that research in this area is more than justified.

How necessary scientists are who publicly communicate about the benefits and risks of GGT can be measured by how the public opinion is influenced by media in collaboration with a variety of NGOs, such as consumers, organic farmers and some groups that use concern about the environment for their own promotion. Usually, industry in the context of GGT is presented as a thoughtless, profit-hunting business – not considering that only industry has the capacity to develop a product from a scientific idea or a prototype to a useful

and reliable product and bring it to market. Making profit with a product is not only permitted in our society, but also a driving force and a control instrument. Without profit, no expenses can be paid for the development and stakeholders would move their money away. The public on the other hand hardly recognizes that NGOs are as well enterprises, just hunting for members and donations. Often, the struggle for life leads such NGOs to argue against their own basic environment-protection ideas. In spite of this paradoxical situation there is a lot of public trust in these NGOs, which under these circumstances is not justified. Frequently, the media publish press releases from NGOs without even mentioning this fact, thus giving the impression that it is an editorial contribution. The Swiss TV Program SR1 has broadcasted Greenpeace's own video spots in the official evening news several times without designating these spots as Greenpeace-made. And whenever a contribution makes the impression to be too positive about GGT – even if it is fact-based – a second contribution must be broadcast that is sceptical of GGT, although this might just be fact-less scare mongering. "Well balanced" is the political term for this kind of misinformation. How should a non-expert TV watcher recognize the difference? Hence, the area of public information is dominated by a coalition of consumer protection agencies, organic and small-scale farmers' unions and environmental protection groups, which follow their own interest with mostly non-scientifically reasonable argumentation. The public and the voters can hardly get to an independent opinion about GGT under these conditions.

A small group of scientists realized some years ago that research should be engaged in public education and that more locally produced results are required for trust building with the public. These scientists asked the Swiss National Research Foundation SNF to establish a national research program about the benefits and risks of genetically modified plants. One of the ideas behind that project was to collect biosafety and benefit-research data from Switzerland in order to be able to argue with results from inside the country and to distribute the knowledge among the stakeholders of the GGT debate. Since then, this program (NFP59) has been granted and the project applications are under review. Although the program was not designed for this purpose, the hope of the politicians is that the program will deliver arguments about the moratorium in two years. At that time it will be discussed whether the moratorium will expire or if it will be prolonged. It is obviously convenient for the current government not to be under pressure for a decision about a coexistence regulation between GMP application and conventional or organic farming.

This political background and the public perception primarily supports organic farming with its roughly 10% of the agronomic production in Switzerland. This would be fine if this public debate would not at the same time discourage young people to engage themselves in the area of modern methods in agriculture and explore their putative benefits. Over the years, we have had fewer and fewer agro-biotechnology students since young people look not only

for interesting fields for their studies, they also search for a topic which provides a perspective for their life to work on in the future. Switzerland has experience with moratoria and education: the moratorium in Swiss nuclear power plant production led to a draining of experts in this field in recent decades. It has to be assumed that the same will happen with GGT experts in the near future. Due to the small number of agro-biotechnology students, this topic has completely disappeared from the lectures on offer at ETH Zurich. In the view of the putative contribution of gene technology for sustainable agriculture, a lack of experts in the field is threatening the economic development of the whole country.

The application potential of GMP is broad. Up to now only herbicide tolerance and insect resistance have been the bulk traits. Their contribution to sustainability is already considerable, although these GMPs have not been designed for this purpose (Nillesen et al. 2005, see also Sanvido et al. in this volume). Currently the first crop plants with improved nutritional qualities like pro-vitamin A improved Golden Rice (a Swiss development) are under safety check for deregulation in several countries. Iron content is the next step in nutritional quality improvement. These nutritional traits are important for sustainability in the Western world but absolutely vital for developing countries. More complicated but under intensive study are traits for pathogen resistance, drought tolerance, and post-harvesting decay. A potato resistant to late blight (caused by *Phythophtora infestans*) is under development and could reduce the use of fungicides. Wheat resistant to *Fusarium* head blight would reduce the myco-toxin content of flour. In addition, the discussion of higher energy prices makes the production of renewable energy by GMP attractive again. Pharmaceuticals like antibodies or vaccines could be produced in GMP relatively inexpensively and without any risk of accompanying infections with human diseases. More putative applications will come up in the future. To miss all of these developments is a risk in its own.

The present volume of *Advances in Biochemical Engineering and Biotechnology* presents some of the few research topics that are currently under study in Switzerland. The socio-economic studies in this volume cover public perception, patenting, ethics, a comparison with the US, and the economy. Science contributions deal with fungal resistance (including field testing under Swiss conditions), biopolymer production, plastids and their compartments as target location for foreign products, biosafety with regard to out-crossing into wild relatives, putative impact of GMP to soil microflora and ecological impact of GMP over the last ten years of application.

In order to complete the picture, we have to admit that for various reasons many colleagues could not participate in this volume. The work and reviews of those groups can easily be found in the literature. Examples of topics are membrane ion transport, wheat genomics, transcription of plastids, transcriptional silencing, starch structure and biogenesis, apomixis, cell cycle regulation, genomic imprinting. Examples of applications with a focus on developing

countries include the nutritional bio-fortification of rice and cassava of which Golden Rice and virus resistant cassava are the most advanced projects.

This volume should provide an idea of what is going on in Swiss GMP research and give an impression of the social and political environment in which this happens. Hopefully, it will create some understanding outside of Switzerland for the GMP research situation, their application in this country, and stimulate some readers to actively engage themselves in this research or its public communication. I thank Prof. Armin Fiechter for the opportunity to co-edit this special volume with him. It was his wish to publish this volume on this timely and controversial topic.

Zurich, March 2007 Christof Sautter

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