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Genetically modified crops and their importance for Swiss agriculture

Swiss agriculture needs to increase production, while maintaining the same quality and at the same time reducing environmental impact. New agricultural methods and technologies are important for the attainment of these agricultural policy targets. The development and cultivation of genetically modified crops can contribute towards achieving these goals. The utilisation of such plants in research and food production is currently hampered by legal constraints.

Challenges

In line with its long-term agricultural strategy and its 2014 – 2017 agricultural policy, Switzerland wants to promote secure and competitive food production that is both sustainable and of high quality, while maintaining a degree of self-sufficiency of around 55 percent. The intention is to increase production, and use land, water, fertilisers and non-renewable energies in a more environmentally friendly manner. All this, while also maintaining the fertility of the soil, as well as preserving biodiversity.[1] These are ambitious aims: the world's population is growing, and even in Switzerland the number of people is steadily increasing – in the year 2060, the population is expected to reach nine million. This makes it more difficult to implement the agricultural strategy. Innovation is therefore indispensable, and this includes developing crops using genetic engineering.

Current state of the science

Breeding of sustainable crops

The way in which agriculture is carried out has a significant impact on the environment. The selection of particular crop varieties plays a crucial role in this. High-yielding plants that are suited to the climate and resistant to pests and diseases help in achieving robust and environmentally friendly production. Genetic engineering supplements classical breeding methods and enables the development of new varieties in a shorter period of time. Where more recent genetically modified plants (GM plants) are concerned, the changes to the DNA are often so small, that there is little or no foreign genetic material present.

GM crops which are resistant to specific pests are grown abroad on a large scale. By utilising such plants, yields can be increased and the amounts of insecticides used, as well as the number of treatments, can be reduced (Box 1). This saves operational time and money, protects beneficial organisms and minimises pollution of the soil and groundwater. Of course, the sustainable use of GM plants requires the same ground rules to be followed as with conventionally bred plants: specific measures, such as crop rotation, reduce the development of resistance in the target pests.

In Switzerland too, GM plants could help to contribute towards environmentally friendly and high-yielding agriculture. GM varieties of potatoes, apples and sugar beet are already available today, or will be in the near future (Box 2). Abroad, for example, GM potatoes are being tested that are resistant to the organisms which cause late blight. In Switzerland, this plant disease is combatted primarily with synthetic plant protection agents, or, in organic farming, with copper. It is expected that the resistant varieties will enable the number of sprayings to be halved, thus reducing pollution of the environment, and in particular, of the soil.[2]

Swiss plant research plays a crucial role in the development of improved varieties. However, the regulatory conditions impose inordinately high barriers on applied plant biotechnology and hinder research (Box 3).

Risk assessments of GM plants

GM plants have been commercially cultivated since 1996, the risks to humans and the environment associated with their cultivation have been researched for over 20 years. Numerous international studies verify that GM varieties that have passed testing and approval procedures are just as safe for humans and the environment as conventionally bred plants. The same conclusion is also reached by the National Research Programme on the Benefits and Risks of GM plants (NRP 59)[3] carried out in Switzerland between 2007 and 2012, as well as by the Swiss Expert Committee for Biosafety (SECB)[4].

Coexistence of agriculture with and without genetic engineering

In recent years, the global cultivation of GM plants has increased significantly, and currently accounts for more than 10 percent of arable land world-wide. Up until now, Switzerland has avoided the use of GM animal feed, and foods contain, at the most, the odd product made from GM soya or maize. However, it is becoming increasingly difficult for Switzerland to obtain raw ingredients that are free from GM organisms, and our country is becoming ever more dependent on certain nations such as Brazil and China. The importation of GM-free animal feed, together with food controls, increase the price of food in Switzerland.

BOX 1: SUCCESSFUL CONTROL OF THE EUROPEAN CORN BORER IN THE USA

The caterpillars of the European corn borer are among the most damaging pests to maize. In the USA, Bt maize accounts for over 60 percent of the total maize crop area. Bt maize is genetically modified in such a way that it produces a protein which is poisonous to the corn borer. Farms which plant Bt maize benefit from increased incomes: between 1996 and 2009, these amounted to an estimated 2.6 billion dollars. At the same time, it was also possible to reduce the amount of insecticides used by eight percent. The large-scale planting of resistant varieties over a number of years has led to a significant reduction in the European corn borer population. This has also contributed to increased income for farmers who do not plant GM maize. Their profits of around 4.3 billion were even higher than those of farmers who had planted Bt maize. The large-scale reduction of the pest population has probably also benefitted other crops, as the European corn borer also attacks potatoes, beans and peppers.[8, 9]

So far, the European corn borer has not developed a resistance to Bt maize, although insects which are resistant to the Bt protein have been identified in other pest populations, for instance in the corn rootworm. Resistance development such as this is a common problem in plant protection, and can be reduced by a variety of measures. In the USA, buffer zones around maize plantations are, for example, planted with non-Bt maize. Pests living in the buffer zones reduce the populations of resistant pests as a result of interbreeding, with their offspring no longer having resistance to the Bt proteins.

		Insecticides	Yield
Cotton	Argentina	–47 %	+33 %
	Australia	–48 %	0 %
	China	–65 %	+24 %
	India	–41 %	+37 %
	Mexico	–77 %	+9 %
	South Africa	–33 %	+22 %
	USA	–36 %	+10 %
Maize	Argentina	0 %	+9 %
	Philippines	–5 %	+34 %
	South Africa	–10 %	+11 %
	Spain	–63 %	+6 %
	USA	–8 %	+5 %

Insect-resistant Bt cotton and Bt maize are estimated to increase yields worldwide – by over a third, depending on the plant variety and the location in which it is planted. At the same time, the amount of insecticides used can also be reduced. As cotton is treated more intensively with insecticides than maize, the savings are generally significantly higher with Bt cotton.[9]

BOX 2: FEWER ANTIBIOTICS THANKS TO FIREBLIGHT-RESISTANT APPLE VARIETIES

An apple tree affected by fireblight.

The bacterial disease of fireblight causes significant losses for the apple growers in Switzerland if the affected orchards are not protected. In years where fireblight is rife, considerable amounts of antibiotics are sprayed in order to control the disease. Wild apple varieties possess genes that make them resistant to fireblight. Using genetic engineering, these resistance genes can be introduced into existing apple varieties without consumer-valued qualities such as taste, size and skin thickness being altered. Genetic engineering shortens the breeding time of 20 to 30 years down to around 10 years. Resistant apples do not have to be treated as often with crop protection agents, so there is less pollution of the environment. The use of this technology could also prevent the contamination of honey with antibiotics.

Swiss consumers are highly sceptical of GM plants. The overwhelming majority do, however, wish to be able to choose freely between foods with GM ingredients and those without. Studies have shown that around a quarter of the population is prepared to buy foods containing GM ingredients.[5] Moreover, there is also the issue of respecting the freedom of farmers to make their own business decisions.

Scientific studies show that the coexistence of GM and conventional crops is possible in Switzerland, even with its small-scale agricultural structures.[6] Alongside regional and operational factors, it is primarily the legal regulations that determine the costs. In comparison to the other cultivation costs, they are actually estimated to be quite low (less than 10 percent of total costs).[7]

Possible courses of action

Further strengthening of public plant research

Strong public agricultural research is necessary in order to make sustainably usable crops available for agriculture. With rights to new varieties remaining in the public domain, this strengthens farmers' independence from large global corporations. In order to facilitate applied research and breeding, dependable conditions for field trials of GM plants must be set up (Box 3).

Basing the approval procedure of GM plants on the product

Experience with GM plants since the 1990s has demonstrated that plant breeding using genetic engineering does not entail any specific risks. For this reason, the approval process for new varieties should fundamentally be looking first and foremost at the product itself and its characteristics, and not the breeding methods (with or without genetic engineering). A further aim should also be the mutual recognition of GM varieties between Switzerland and the EU, as is already the case with conventionally bred varieties.

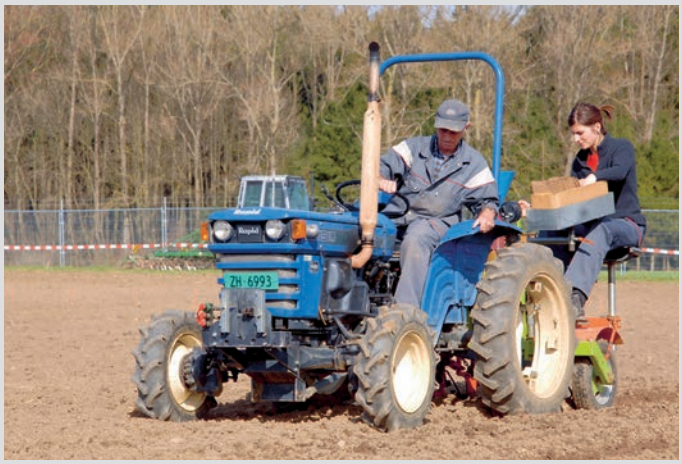
Enabling and scientifically supporting coexistence

In order to guarantee freedom of choice for consumers and for agriculture, it should be made possible in the future for cultivation systems that use genetic engineering and conventional methods to exist side by side. Experience has been gained in Switzerland from different systems (e.g. in organic farming) as to how to obtain a specific degree of purity in a seed and in the end product. This knowledge can be transferred to the production of GM products.

The mixing of GM products with conventional products can be traced back to out-crossing and the appearance of volunteer plants. Mixing can also occur in harvested crops at the harvesting, transport and processing stages. The risk of mixing at the various stages of production as well as the risk of out-crossings to related wild varieties differs according to each crop. It is therefore essential that different measures are set out for individual crop types. These should be scientifically based, and adaptable to the specific circumstances of each farm. For example, the minimum isolation distances between GM and conventionally planted areas could be reduced by means of buffer zones or the use of natural barriers. The aim should be to achieve pragmatic coexistence for as little extra effort as possible and at affordable cost.

BOX 3: IMPROVING CONDITIONS SURROUNDING FIELD TRIALS OF GM PLANTS

Field trials are essential for assessing the interactions of plants with the environment, their contribution to sustainable agriculture and any possible environmental risks. In Switzerland, there are significant obstacles to field trials of GM plants; the few trials which have been carried out to date have been hampered by objections, disruptive action and even vandalism, which has also considerably increased the cost. Most Swiss researchers therefore either resort to going abroad to carry out field testing of the plants they have successfully developed in laboratories, or turn away from GM varieties altogether. These developments make it very difficult to train students in plant biotechnology, and result in a decrease in practical scientific knowledge.



Field trial with GM wheat for NRP 59.

So-called 'protected sites' should be set up for future field trials of GM plants: protected areas which are equipped with everything that is necessary for biosafety, as well as being protected against disruptive action.[10] This would make approval procedures easier and generally lower the costs of field trials considerably.

A further obstacle to research with GM plants is the world-wide singular ban on field trials of plants which possess an antibiotic-resistant gene. This makes it next to impossible to use GM plants for research purposes which have been developed in laboratories outside of Switzerland. Since it is extremely rare for bacteria to take up plant DNA, the transfer of antibiotic resistance to animal or human pathogens in the context of field trialling can be practically ruled out.

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Further Literature

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