ADVANTAGES AND RISKS OF GENE MODIFIED CROPS FOR FARMERS

Prof. Dr. Jürgen SİMON*

INTRODUCTION

The cultivation of biotechnologically optimized useful plants is growing rapidly worldwide. But in the European Union its development is dropping. This is the result of an actual report of the non-governmental organization "International Service for the Acquisition of Agri-Biotech Applications" (ISAAA).[1] Following its survey the area under cultivation for trans gene plants has grown about 7% in 2009 to 134 Mill hectares. This is nearly the area of the whole agriculture in Western Europe. More than 14 Mill. Farmers in 25 countries used gene biotechnological optimized seeds in 2009. For example, every second cotton fiber comes from genetically modified organisms.[2]

But since 1998, in the EU no new genetically modified plant has got an admission to commercial cultivation.[3] Only the import of animal feed derived from genetically modified plants in the EU was approved. On the recommendations of the European Food Safety Authority to cultivation authorizations, based on scientific opinions of EU Member States and a specialized panel of experts with independent knowledge on genetic

* Leuphana University Lüneburg.

1 See www.bionity.com from 25.02.2010.

2 Ibid.

3 Jürgen Simon (2006), The impact of national and international debate in the European Union on the Moratorium on the Release of GMO into the environment: The Debate in Germany and the Moratorium, in: Journal International de Bioéthique, International Journal of Bioethics (Hrsg. Christian Byk), Paris, pp. 95-106, about the five years moratorium in Europe.

engineering it has not been decided since more than ten years. Between the EU Commission and the 27 member states of the EU it always came to a stalemate in the Council of EU Agriculture Ministers[4] in which neither for nor against an admission sufficient voices came together. So far, the procedure intends for such an event that the decision-making power will be delegated back to the EU Commission.

The chairman of the German Industry Association of Biotechnology (DIB), Dr. Stefan Marcinowski, appealed to the political decision-makers in Brussels, to fundamentally rethink the attitude of cultivation of genetically modified crops in Europe and to act. He stated[5]: "In 2008 alone, the EU imported 30 million tonnes feed from the cultivation of genetically modified plants, mainly to guarantee in this country a good, sufficient and internationally competitive protein supply. These are each year around 60 kilograms per EU citizen, which are used in the food chain.14 Mill. farmers in the world, who let the genetically modified plant to do so because they meet the economic and environmental benefits each year in person. These benefits should also be accessible to European farmers. We trust that the new EU Commission will end the already 12 years lasting admission blockade. Genetically modified plants not only allow higher and better quality crops in agriculture. They are also utilizing biomass as a renewable resource for the industry, as an energy source or as Bioreactors for the production of drugs. These opportunities for High-Tech Center Europe, we should not miss." Marcinowski pointed out that genetically modified plants in general are the most carefully studied plants. "For many years, scientific facts and worldwide experience in practical farming have been proven, that they are just as safe and tolerable as those of conventionally bred crops. There are few products that are more intensively tested than these."[6]

---

4 Ibid.

5 www.gentechnik-news.de/Anbau-gentechnisch-optimierter-Nutzpflanzen-waechst-weltweit.394.0.html v.23.02.2010 (25.02.2010).

6 Ibid.

So, now you see as the result of my introduction:

1. Genetically modified plants are growing rapidly worldwide.
2. They are strongly limited in Europe.
3. Therefore the question arises: What are the chances and risks of these plants, esp. from the economical point of view?

In this lecture I will focus on European and German farmers. This means that cultures as cotton will only be mentioned in the margin. But for a better foundation of my arguments I also will cite international studies. The reason is that we find a bigger pool of experiences concerning the farming of transgene plants outside the European member states.

I. CONSEQUENCES FOR THE AGRICULTURAL PRODUCTION

The agricultural characteristics of crops got through genetic engineering have manifold impact on agricultural production. For the producer this can have advantage but can also be detrimental. Farmers only make up use of genetically modified seeds, if the benefits - such as higher yields, savings inpesticides, higher labour flexibility - outweigh the disadvantages. A survey among farmers of the U.S. Department of Agriculture (U.S.DA) from 1997 shows that the main motivation for the cultivation of GMOs is to achieve higher yields[7] – same as in other fields of production.

In the following discussion of the pros and cons of growing of genetically modified plants it can distinguished between input and output

[7] www.ers.usda.gov./publications/arei/eib 16/Chapter 3/3./3/ from 25.2.2010; Duffy, Michael (2001), Who Benefits from Biotechnology?, American Seed Trade Meeting, Dec. 5-7, Chicago II. See also to those and further points Gerds, Marcel (2006), Vor- und Nachteile der Grünen Gentechnik für landwirtschaftliche Anwender, www.slideshow.net.

factors.[8] Input factors are those factors that influence the efficiency of agricultural production, e.g. expenses for seeds, plant protection, the cost of a possibly necessary separation of transgenic and conventional varieties, as well as indirect costs associated with the change of the production system that will be necessary. Output factors are the returns and prices for GMOs, and they also influence the viability of growing transgenic plants. Economic importance for commercial cultivation only have the input factors so far. High hopes, however, exist regarding the output factors, particularly as regards improving value-and thus the quality of ingredients.

A. Benefits of Growing

It is very likely that the costs for the use of pesticides in the farms sink through the cultivation of genetically modified plants.[9] This particularly applies to those crops whose properties have been improved with regard to the plants and disease protection. Here especially herbicide-resistant and Bt varieties play a role, especially since it is possible to save herbicide- or insecticide-measures.

Through the combination of genetically engineered herbicide-resistant plants and complementary fitting herbicides the extent of the spray treatments can be reduced. The basic idea is to modify plants genetically so that they can accordingly react with resistance to complementary herbicide. Therefore a single herbicide with broadband effect could contribute to the fight against weed rather than the current number of specific herbicides that are used now. Specifically, this economic advantage includes the reduction of costs for the plant protection product in itself, as well as labor and machinery use. Together with a not so often

---

8 Wenzel, Gerhard (2006), Molecular plant breeding: achievements in green biotechnology and future perspectives, in: Applied Microbiology and Biotechnology, pp. 642-650.

9 Philipps, R. H./ Park, J. R. (2002), Environmental Benefits of Genetically Modified Crops: Global and European Perspectives on Their Ability to Reduce Pesticide Use, in: Journal of Animal and Feed Sciences, Vol.11, pp.1-18.

necessary infection control one may speak from a reduction of work-completion costs. This involves, inter alia, a reduction in inspection costs - of the machines. Through this "convenience effect" the cultivation system will be well received by improving efficiency and simplicity of cultivation at all.

Besides the economic benefits clearly environmental benefits play a role.10 According to the USDA survey of farmers those aspects only play a small role, but it is also a general social interest, to reduce the amount of pesticides. Farmers had thus the chance to improve their image among the population by reducing the use of chemicals - corresponding markting measures provided. Besides the fact that the potential exists to do without high volumes of pesticides the fact plays a role that the pesticides to be applied may have less toxicity. The synthetic herbicides, that are required for the cultivation of non-herbicide-tolerant plants have been estimated by the Environmental Protection Agency (EPA) in the U.S. a higher toxicity from 3.4 to 16.8 with twice as long half-value time as glyphosate herbicides as for example Roundup. For the agricultural producers that would have the advantage that the organisms living in and on the soil were spared. For example, Earthworms react very sensitive to herbicides.

Another advantage is dependent on market conditions and affects also farmers who do not cultivate GMOs. Thus, the costs of pesticides for conventional varieties have been fallen since the introduction genetically modified varieties. In contrast to 1995 - the introduction of herbicide resistant varieties - the cost of herbicide measures amount to 1.8 to 2.4 € / ha less in the year 1999. An indirect consequence of reduced application of pesticides is a reduction of the soil crossings, and thus a lower soil compaction. Thus the yield of the soil increases.[11] In the following, I will focus more detailed on the yield.

---

[10] Ibid.

[11] Ibid.

1. Earning Expectations

The new properties obtained by the genetic characteristics of the commercially grown green crops are less aimed at a direct increase of the yield, rather than on an improvement of plants and disease protection. Thus, only the production - conditions are positively affected.

As a result of the new resistance the Bt corn for example is developed against the larvae of the European corn borer. And that could lead to a revenue stabilization. Thus, the yields of Bt maize are theoretically higher in the areas where the European corn borer is active compared to the conventional varieties. In the years in which the corn borer population is less active or in European corn borer-free regions, the yield is virtually but the same. In view of the fact that the distribution within this corn pest moves farther and farther to the north Germany, this scenario may be increasingly rare. In Germany regionally up to 20% of the harvest is destroyed.[12] Therefore in the future a higher yield of Bt corn compared with conventional varieties will be assumed.

Concerning other genetically modified crops, whose cultivation in our region were possible, there is little to say about the expected yield. In Germany long-term experiment carried out over four years brought no significant yield differences between conventional and herbicide-resistant canola (oilseed rape variety) rape.[13]

Also in Bt potato varieties only input characteristics could still be improved. An increase in earnings compared to the conventional varieties was not yet detectable.

---

[12] Menrad, Klaus/ Gaisser, Sibylle/ Hüsing, Bärbel/ Menrad, Martina (2003), Gentechnik in der Landwirtschaft, Pflanzenzucht und Lebensmittelprodution, Heidelberg; Kempken, Frank (2000), Lehrbuch: Chancen und Risiken der „Grünen Gentechnik“, Heidelberg

[13] Ibid.; Gerds, Ibid.

B. Disadvantages of the Crop

1. By-products

The main danger in the cultivation of GMOs is the development of resistant weeds and secondary pests and the changes in weed flora. Concerning the possibility for the saving of plant protection stuffs results from practice seem at first to put an end to these hopes. A study by the U.S. Cornell University - the first, which examined the long-term econometric consequences of the cultivation of genetically modified cotton - revealed that the cultivation of Bt cotton in China, leads to both ecologically and economically disadvantages for the local peasants.[14] So it came to an excessive occurrence of secondary pests, so that after seven years of cultivation, 20 times per season insecticide had to be used. In India the situation is similar, according to the study. There were previously unknown pests discovered, which caused widespread crop failures; but the actual goal - resistance to cotton worms - was achieved. In the professional world, this study is controversial. This is among other things, the fact that Cornell University conducted only interviews, but no field observations.[15] In addition, we find many other, sometimes logical, inaccuracies in this study.

But the cultivation of Bt potatoes in the United States brought sobering results, too. So the Bt toxin was effective in potatoes against the Colorado potato beetle, but not against the virus - aphid. Additional insecticide interventions were the result. Also in the U.S. a decrease in herbicide use on herbicide-cultures could only be observed in the first years of cultivation. Through years of use of genetically modified plants, the volume of pesticides has grown significantly. In the United States in fields with herbicide-resistant plants now 15 to 30 percent more herbicides are used than on conventionally farmed land. Overall, U.S. farmers must use today about 11.5 percent more pesticides than before the introduction of genetic engineering. But also genetically modified

---

14 Gerds, Ibid

15 Ibid.

herbicide-resistant oilseed rape is spreading as a weed. In turn, more or other herbicides must be used.

2. Seed costs

Clearly, the costs the farmers have to pay for seed of genetically modified plants are significantly higher than those for conventional varieties.[16] The reason for this mostly results of the high development costs. In addition, a so-called technology-fee is raised. Additional costs include those due to the contractual obligation to apply certain pesticides of the respective production. Thus, the prices of transgenic seeds are between 20% and 35% higher than the prices for conventional seed. For herbicide-resistant plants the higher seed costs can compensate the cost benefits in weed control, especially since they do not promise higher returns. For crops with insect or virus resistance, the savings certainly are much higher. So, this investment in the higher seed costs seems worthwhile for the farmer.

3. Prices

Crucial for the cultivation of GMOs is the price, which the agricultural producer can achieve. A difference in price for transgenic and conventional plant products can already be observed since 1999. Experiences from the U.S. confirm that the prices of genetically modified products are lower than those for conventional. So are the U.S. prices for GMO-free products 3% to 9% higher than the farmgate prices of transgenic varieties.[17]

4. Outlets (Absatzmöglichkeiten)

Due to the still strong skepticism about the products from GMOs in the population it will be more difficult for the farmer to sell his products.

---

[16] Genetically Modified Foods: Harmful or Helpful?, www.csa.com/discoveryguides/.../overview.php (18.02.2010).

[17] Menrad, ibid.

Thus, genetically modified corn is in Europe not deductible,[18] neither the starch nor the food producers buy it. The agriculture downstream industry has strong interest to avoid the printed words "genetically modified". Thus, for example, Kampffmeyer mill, a subsidiary of the large GermanMill Group VKMühlen, pays extras to producers of maize using genetic engineering impurities below 0.1% while delivering the goods with more than 0.1% GMO content is rejected.[19]

5. Identity Preservation

"Under Identity Preservation" refers to the identification- or separation costs. Through the labeling of products such as for example seed, feed and food additional costs occur in all stages of crop production. These contain especially the seed, growth, harvesting and marketing. Here mainly the costs of segregation of GMOs and GM-free plants or products are relevant. The concept of Identity Preservation, however, goes beyond the mere separation costs, as also the traceability and proof of origin / origins and nature of the products are allowed. At all stages of the agri-food chain additional costs are allowed. The additional costs move 5 to 25 €. That would be 6% to 17% of the account for the ex-farm price.[20] These additional costs are a disadvantage to farmers in the cultivation of transgenic plants. In addition to these monetary aspects also additional bureaucratic hurdles exist there too. The documentation requirement, distance control, and other legal regulations will be not further deepened at this point, but they also lead to costs. It should be noted, however, that by complying with these schemes additional work is necessary on the part of the manager, and the attractiveness of the cultivation of GMOs will be more reduced.

---

18 Deutsche Bank Research, Grüne Biotechnology: Weg aus der Sackgasse in Europa gesucht, 14. Januar 2004, www.db research.de (16.02.2010)

19 Gerds, ibid.

20 Menrad, ibid.

6. Indirect Costs

In contrast to the direct costs, indirect costs do not arise directly from the cultivation of transgenic crops. Examples are costs due to changes in the farming system and costs for the reduction of risks from the cultivation of GMOs.[21] Risks that are associated with the cultivation of GM crops are manifolds. These include for example their introduction into the wild or out-crossing, horizontal gene transfer, formation of new viruses, impacts on non-target plant or animal organisms, resistance to Bt toxins, or the blending or contamination with transgenic material.[22] To address these risks for the farmer many costs can arise and / or an increased workload. The necessary modification of crop rotation and production technique causes effort and requires some new investments. The planting of the crop "barriers" between transgenic and conventional populations is a further measure to mitigate the risks of farming. Again, this means additional costs and the binding of labor. As another non-monetary disadvantage of growing transgenic crops plays the need for more communication between farmers in a region. Here is co-operation in demand, especially if the owners of the surrounding land are skeptical towards plant genetic engineering. To what extent this is a disadvantage substantially depends on the farmer himself. The increased communication and perhaps even an awareness training can develop into an advantage, because they could contribute to an improvement of relations between the farmers.

7. Dependency

All genetically engineered characteristics in plants and thus the entire transgenic plant as such, have been patented by international seed companies. This will entail the payment of royalties for themselves. Among many farmers is, therefore, the anxiety prevalent,to get to the dependence on these groups. Especially considering the fact that in the herbicide-resistant varieties, only the corresponding herbicide of the

---

21 Ibid; Franks, (1999),

22 Menrad, ibid.

group is used these concerns are perfectly legitimate. So, the American company Monsanto now dominates 90 percent of the market for genetically modified seeds. Most plants of Monsanto are via gene manipulation resistant to the company's own herbicide "Round-up Ready". Who as a farmer uses Monsanto seed also has to use its pesticides. However, it is questionable whether the dependence on the biotech industry is another than the already existing or from seed-, fertilizer- or pesticides-industry.

II. CONCLUSION

At first glance, the sheer number of disadvantages of the use of green bio technology in agricultural practice seems to outweigh the benefits. In considering must be taken into account, however, that the various factors have a different weight. This is highly subjective. For example, for one farmer it could be one of the main reasons that no genetically modified plants grow, while for another farmer that hardly plays a role. Particularly difficult to assess is the aspect that in fact the main motivation for the Cultivation of GMOs is - the use of pesticides. As mentioned, theory and practice indicate a significant difference to each other. This will require the examination of various aspects. Firstly, the credibility of the scientific sources must always be questioned. It is a general impression looking at the phenomenon of plant genetic engineering, that there are few sources that entirely work without ideological blinkers - both the one as well as the other side. Furthermore, there are hardly any scientific studies that are scientifically correct carried out.[23] Many studies of this kind were carried out tendentious. Here the phenomenon of self-fulfilling prophecy is absolutely true: experts are so eager to come to a definite conclusion that they focus the investigation on it and then find exactly what they wanted. Straight therefore it is difficult to formulate a final consideration.

---

[23] See Wang, Shenghui (2006), Tarnishing Silver Bulletts: Bt Technology Adoption, Bounded Rationality and the Outbreak of Secondary Pest Infestations in China, Cornell University.

Furthermore, it is questionable whether the results from the different areas of the world are transferable to the conditions in Europe. The cultivation of GMOs in Europe is still too young to demonstrate meaningful test results. It remains to be seen whether it comes to similar developments in the U.S., China or India. But there is an opportunity, however, for the European, German and other farmers. You can learn from the mistakes of your international colleagues. So, it would be necessary for example to take actions to prevent the occurrence of secondary pest and weeds.

In general, it can do so under "resistance management". Specifically, it would mean for example, that in addition to the field with the GM Corn conventional maize is growing next in order to withdraw the pests there so that a resistance to the insecticide can develop slowly. Only when these and similar measures are taken, the cultivation of transgenic plants can be both economically and ecologically favorable. Thus also the disadvantages could be compensated for these aspects and promote the acceptance among the population. It remains the task of farmers through judicious application in the context of good professional practise, to use the opportunities that arise from the use of green gene technology, and to minimize the risks, and thus to increase the acceptance by colleagues and skeptics in the population.