



**SUSTAINABLE FOOD SECURITY  
FOR ALL BY 2020**  
September 4–6, 2001 ! Bonn, Germany



SUMMARY NOTE

Panel Discussion: Complementary Technologies, One Goal: Approaches to Sustainable Food Production

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Title: Thoughts About the Future of Agriculture: Science and Fiction in the Risk Assessment Debate

***Many Different Roads to Success in Plant Breeding and Farming***

Instead of indulging into a fruitless debate about what strategy would be appropriate in agriculture, it would be much more rewarding in looking at the best way forward for a given country, a given ecology and economy. Looking for sustainable and equitable farming methods means in my eyes to refrain from any kind of ideological debate and concentrate on pragmatic decisions in order to find the best solution for a given region.

Roads to success in these areas are many, and we must pursue them all. In the first stage of fascination with the new technologies, a number of other pest-control strategies lost much — too much, in my view — of their appeal. We should have a closer look at mixed cropping and test critically its sustainability. Also, we will have to enforce research in biocontrol, which should also include a good package of risk assessment. Modern agriculture could benefit enormously from the knowledge and experience of organic farmers, whom I regard as visionaries of no less importance than the genome researchers who bring us important progress. We should apply our new knowledge about individual genes constructively to methods of cultivation that preserve or enhance soil fertility. On the basis of our new, sophisticated genomic knowledge it should be possible to develop transgenic plants capable of defending themselves against pests by producing their own organic pesticides, substances that remain active for a limited time only and, ideally, perform their functions only in specific endangered organs. Scientists are now looking for means of controlling genes in such a way as to prevent the formation of these effective ingredients in plant reproductive organs. In this way, the risks involved in crossing out undesirable genes could be elegantly avoided. There are several ways of preventing gene flow as such: Apomixis is a very promising one, where embryos develop spontaneously, not needing to be started by cross-fertilization — a strategy used by many wild species. Wise use of technology protection mechanisms could also help to prevent gene flow, at least for the strictly autogamous crops. We should also have a close look at the seemingly old-fashioned methods of breeding pollen sterile crops — in maize this has been achieved recently. Does this sound like a futuristic vision? Admittedly, it will take several years to accomplish many of these improvements, but thanks to the breakthrough in genome decoding, such dreams are now within reach.

We should take the unique opportunity to pursue this ecological approach to plant breeding. This will require active cooperation with those organic farmers who are at least willing to entertain the possibility of incorporating other genes in their crop plants. At present, the market has nothing to offer organic farmers as an encouragement to join this still modest faction. Although lower pesticide and herbicide consumption is often cited as an argument in favor of these first transgenic varieties, most organic farmers are hardly impressed, as they have long since cut back the use of chemical agents substantially (albeit in favor of organic pesticides, which are not without significant problems of their own). Yet organic farmers frequently fail to think far enough ahead. They should not be indifferent to the fact that the transgenic, herbicide-tolerant soy bean permits a form of crop cultivation in which

ploughing is virtually unnecessary — a giant leap forward in the battle against soil erosion. Like conventional farmers, organic farmers can ill afford to reject potential improvements out of hand on dogmatic principles. After all, yields in long-term organic field trials are still comparatively low, and it is in the best interest of those directly concerned to seek improvements.

On the other hand, we now know that soil organisms flourish considerably better in organically farmed fields, a fact that should give the defenders of conventional farming methods pause for thought. I have learned from my own personal contacts that dialogue is possible, although it is clear where at least one of the problems lies. With their heavily ideological point of view, many organic farmers tend to isolate themselves excessively from modern developments. All official advocates of organic farming categorically reject the introduction of other genes into crop plants, for example. They are quick to support the superficial fear-mongering arguments of nongovernment organizations that do not even hesitate to fuel resistance to transgenic livestock feed in the face of firmly established scientific knowledge. My own personal experience has shown me that dialogue is possible and that even the most dedicated organic farmers are capable of learning as well. My own surname can be traced back in a straight line to the Anabaptist founder of the Amish community in the US state of Pennsylvania — a certain Jakob Ammann, one of our families direct ancestors, who's name has been used to denominate the 'Amish.' This courageous emigrant, like so many others a victim of a broad and brutal campaign of religious "cleansing," established the Mennonite sect in 1693 and laid the cornerstone for the many Mennonite village communities now found throughout North America. These groups have preserved not only their religious beliefs but their traditional organic farming methods as well.

Those who see these Amish farmers as stubborn learn in their first personal encounter with them that such is not the case. One is amazed at how deeply curious the Amish are. I can confirm, at any rate, that the friends I have been privileged to meet do not fit the stereotype of narrow-minded fanatics. As organic farmers, they do not reject technology out of hand but instead examine every innovation closely in an effort to determine whether it might pose a danger to their religion or way of life. If they are convinced of the potential benefit, they have no reservations about introducing milk cooling systems and other modern technologies. I had a number of surprisingly amiable, objective discussions with Amish organic farmers about genetic technology, and to my amazement, they decided to test samples of genetically modified seeds soon afterwards. Transgenic potatoes are currently being grown on a trial basis on their farms. And there is no reason whatsoever to suspect that these genetically altered potatoes might disrupt their religious and social system in any way at all.

I have no way of knowing whether the Amish will actually begin cultivating these new varieties of potato in earnest, and that is ultimately their decision alone, the latest news hint to an adoption case by case. I was impressed by how quickly these very traditional Amish farmers, of all people, accepted the idea of testing the new varieties of potato. As I learned later, the laudable pragmatism that characterizes their approach to such difficult issues is a function of their unique spirituality and the strong sense of security they derive from their religion.

I have gained a very similar impression in conversations with practicing Buddhists. Their natural curiosity and their willingness to consider even genetic technology without prejudice has fascinated and impressed me time and time again. The most striking example of such a seminal conversation I have ever experienced took place in the Botanical Gardens at the University of Bern, where I had the good fortune to spend a half-hour discussing genetically engineered crop plants with a dignified yet quite cheerful teacher of the Dalai Lama. He, too, exhibited neither prejudice nor fear with regard to this visionary technology that is unfortunately much too often condemned without a thorough hearing process in this country.

### ***Science and Fiction in Risk Assessment Research Related to Transgenic Crops***

The new knowledge in molecular genetics will have a much more profound impact on food production than the "Green Revolution" of several decades ago, it could enable us at long last to achieve rapid progress in the breeding of the most common crop plants such as rice, corn and wheat. The growth of genetic knowledge will have consequences one never could have imagined before. The most

promising genes of crop plants will be an open book within only a few years from now. Significant progress has already been made with the genetic material of the rice plant, and major private agricultural corporations have made some of the fruits of their rapidly intensified research available — free of charge — on a worldwide scale.

The optimistic and visionary outlook is one side of the medal, the other side is the bitter debate about the risks we are taking with field releases of transgenic crops. Opponents of the new technology range from fundamentalists denying the new technology all benefits and fervent defenders who do not see the slightest problems. There is unfortunately a lot of partisan thinking on both sides and — as often, the truth lies in-between.

Lets take the well known example of the Bt-crops. Ever since the Nature paper of Losey appeared, people had to learn that the colorful larvae the beautiful and popular Monarch butterfly in the US can be killed by Bt Pollen within 4 days by 40 percent. Shockwaves of newspaper articles went around the globe and Monsanto lost some 5 percent of its shares within a few days. But even Losey himself warned about the interpretation of his lab results. Today we know that the Monarch larvae and the adults will nicely survive in vast fields of Bt crops. We know it from field tests, there are today lots of data available. Beneficial insects even have a better life in Bt corn fields, since they are not showered by pesticides. Roundup Ready crops can be grown with the new conservation tillage methods, in favorable conditions the soil microflora thrives under no tillage conditions much better than with crops treated with classic herbicides. It becomes now visible that transgenic crops, wisely designed and used, will add to the sustainability of agriculture.

Also it has become clear in the last years, that gene flow happens wherever possible, as it has done in the former days of agriculture. But today the transgenes act as marker genes and we can, for the first time in history, follow up with extreme precision what is going on in the fields. The present day transgenes do not pose any significant problems once they have escaped to their wild relatives through outcrossing. And outcrossing is only possible there where wild relatives are in the reach of viable pollen grains of crops, which produce after pollination viable hybrids. The latest long-term experiment of Crawley shows that, after 10 years, the four transgenic crops tested just vanish and have a considerably lower survival chance than their non-transgenic counterparts.

But one has also to realize that the early risk assessment data have been scanty and not at all convincing, and in the early days of the US approvals things looked a bit shaky in the hindsight. And also we should remain cautious about long-term effects and install some monitoring programs after commercialization. This would help us to avoid mistakes we have done earlier with the introduction of pesticides. We do not know enough today about the long-term effects in the highly-complex food web of insects.

It would also be wrong to dismiss the general anxiety of a large portion of the population about biotechnology, since it becomes clear now that biology as a science has lost its innocence and people have a very finely tuned sensitivity on what's going on. After all, the new molecular technologies will change the course of Evolution. But it is also true that we have started to strongly influence evolution a long time ago — with crops even several thousand years ago. In modern times we have without hesitation sped up mutational breeding with gamma radiation — with modern wheat we do still not know, what we have done to the genomes with those rather inconsiderate methods. But we all eat bread from wheat which has undergone such mutations. So the whole difference is that today we eat mutant food and in future we will eat gene food, where we know much better what we have done.

It would be a grave error to concentrate on the negative side of transgenic crops, since they offer important opportunities for modern farming. And it is modern farming we will have to install all over the world, since it is a fiction to believe that a trend back to traditional methods would solve the most urgent problems in feeding the world. But it would also be naïve to think that genetic engineering alone would save us all. Well-established global civil society organizations and also the United Nations Development Unit advocate a more intensive agriculture in order to save the last unharmed biotopes of this globe.

We learned extraordinarily quickly from the early years of genetic engineering through experiments involving the introduction of individual genes from other organisms into genetic material. Some of these first-generation transgenic plants have since been introduced in many different countries and are now producing good yields. Although the ecological and economic benefits vary from region to region, and have been only modest in some areas, most farmers who have been able to use these varieties effectively are thoroughly convinced of the advantages they offer.

The rapid expansion of genomic knowledge will soon make it possible to create resistances against parasitic fungi that are still causing disastrous crop damage today. We should be wary, however, of simply replacing the chemical "club" with the genetic club in the field of pest control. We would be far better off applying the elegance of breeding methodology to more meaningful goals, such as enhanced tolerance against drought, high salt concentration in soils and a better crop performance in cold climates. First successful developments in research labs will soon approach commercialization phase.

Efforts to realize romantic notions about nature in the fields with the aid of genetic technology surely make little sense today. It should be possible, however, to increase species diversity in the agricultural context and thus put an end to the dismal reign of monocultures. Our endless war against wave after wave of new pests on these vast, monotonous fields should prompt us to rethink our approach. We must win such battles in the future if we are to increase our food supply while alleviating ecological consequences at the same time. It should also be stated very clearly that farming with transgenic crops is not scale dependent: this is shown in China, where thousands of small cotton growers are very happy with the transgenic traits. Imagine a bag full of seeds where all seeds have a streamlined genome adapted to local ecological conditions and specific quality demands. On the other hand the seeds in the same bag offer a full variety of different resistance genes (whether transgenic or not), thus enhancing dramatically biodiversity again.

An excellent way to solve these complex problems on risk assessment and risk management in an open debate offers New Zealand. In a rigorously open, balanced and transparent debate, all accessible on the Internet under <http://www.gmcommission.govt.nz/>, thousands of submissions, testimonies and rebuttals have been published, and recently the Royal Commission of New Zealand has come out with a balanced report which you can download from the given Internet address. This tedious and lengthy debate process did not leave any room for cheap populist slogans and will eventually lead to balanced solutions, well adapted to the needs of New Zealand.

Another good source of information is <http://www.bio-scope.org>, a new website with a content database accessible over hundreds of keywords, daily news about biotechnology, and a daily clipping service for newspaper articles. Also you have access to a range of experts willing to answer individual questions.

*Note: The views expressed in this summary note are those of the author and are not necessarily endorsed by or representative of IFPRI or of the cosponsoring or supporting organizations.*