1. Database and Evaluation of Risk Assessments for GMOs

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Introduction

In 1994 first plans were drafted at BIOGUM to monitor and evaluate the research on possible risks resulting from the release of transgenic organisms in agriculture. The project is commissioned and partly funded by the Federal Office for the Environment (in German Umweltbundesamt, short UBA). The project started in early 1995 and will last two and a half years. Presently, three scientists are engaged in it.

Methods

We are collecting publications on field tests, biosafety research (Begleitforschung) and risk assessments. Besides the database on releases and risk assessments of selected GMOs, the project will provide a detailed report on biosafety. This report will consist of several critical reviews regarding traits, organisms and biosafety issues mentioned in the risk assessments.

Reviews on the most crucial issues will be supplemented by comments of experts within the report.

Reviews on the following issues will be presented in the report:

- Virus-Resistant Transgenic Plants
- Gene Flow to Relatives
- Invasiveness of Plants
- Invasiveness of Microorganisms
- Horizontal Gene Transfer
- Genetic Instability and Position Effects
- Toxicity of Transgenic Plants
- Allergenicity of Transgenic Plants
- Resistance Management with Herbicide Resistance
- Monitoring of Genetically Modified Microorganisms
- Changes of Nitrogen Cycle
- Genetic Diversity of Transgenic Varieties
- Implications with the *Bacillus thuringiensis* approach
- Risks of Modified Baculoviruses

Results

The first two reviews have almost been completed and the main conclusions are as follows :

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1 Virus-Resistant Transgenic Plants

The USDA risk assessment research program commissioned projects of nine different categories (Anonymous, 1995a). Most of the money was spent for the category "transgenic virus-resistant crops"(33% of the 6.4 million US-$ spent from 1992 to 1995). Until May 1996, we reviewed about 55 articles, 34 of them dealing wilh special research ; 2l articles consisted of reviews or theoretical studies. The results of this work are summarized as follows :

- Heterologous encapsidation is well documented in connection with potyviruses and luteoviruses. It should be studied in connection with other virus groups too (Maiss *et al.,* 1995).
- It is not easy to predict whether the frequency of interactions (encapsidation or recombination) between different viruses or between viruses and genetic constructs of transgenic plants is higher. The possibility for a virus to meet a heterologous coat protein may be higher in transgenic plants.
- A wide gap of knowledge is obvious concerning the frequency of recombinations, especially heterologous ones (Anonymous, 1995b).
- An interesting and maybe safer method than the coat protein approach is the use of mutated replicase genes in transgenic plants. This is also true for the use of non-coding coat protein genes and of antisense DNA with or without ribozymes. Ribozymes are used to cut essential virus sequences.

2 Gene Flow to Relatives

Evaluation of the importance of risk issues based on the amount of money spent by the USDA risk assessment research funding showed that the category "transgene movement to wild relatives" was the second of the 9 top issues (20% of the money spent).

The movement of transgenes is not a risk itself, but it could - depending on the gene - cause a risk. The empirical assessments we reviewed more or less all dealt with the problem of frequency and isolation distance for different plants. The compilation of about 40 articles, 9 of them reviews themselves, led to the following conclusions.

- The isolation distances varied considerably depending on the experimental design. Some working groups examined outcrossing rates using small numbers of donor organisms (McPartlan and Dale, 1994) and others large donor fields and small numbers of receptor plants. The latter found very long distances and higher outcrossing rates (Ellstrand, 1988; Timmons *et al.,* 1996).
- The size of donor populations strongly influences hybridization rates besides other environmental factors such as pollinating insects, distances between donor and receptor populations and climate.
- Amounts of pollen of wind pollinators decrease with the distance from the donor field but only to a certain rate of about 5 %(100% in the center of field). This value

remains stable at distances between 300 and 1,000 meters, and maybe beyond.

- The dispersal of pollen by insects can lead to very surprising rates of hybridization. Rates of 38% were found in one plot of a tested area. In this special case a route heading to small ponds influenced flight and pollination by insects (Hokanson *et al.*, 1996).
- Movement of transgenes to wild plants will happen and has happened yet. One should focus on the possible consequences of such events (Kareiva *et al.*, 1994 among others).

Discussion

So far only two of the prospective 14 issues have been reviewed. In autumn 1997, all the reviews will be available and we hope that some of them will be translated into English.

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