GMLS 2012

Programme

International Conference on

Implications of GM-Crop Cultivation at Large Spatial Scales

Bremen, June 14–15, 2012

www.gmls.eu

GMLS Conference 2012
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Contact:
Broder Breckling - bbreckling@iuw.uni-vechta.de
Richard Verhoeven - verhoeven@uni-bremen.de

Conference location
Haus der Wissenschaft, Sandstraße 4, Bremen
www.hausderwissenschaft.de

Phone numbers during the conference
Conference registration desk +49 175 9960651
Conference location: +49 421 218 695-00

Organising Committee:

Broder Breckling (University of Bremen; University of Vechta)

Richard Verhoeven (University of Bremen)

Christiane Eschenbach (University of Kiel)

Hartmut Meyer (European Network of Scientists for Social and Environmental Responsibility ENSSER, Braunschweig, Germany)

Gunther Schmidt (University of Vechta)

Winfried Schröder (University of Vechta)

Christoph Then (testbiotech, Munich)

Wiebke Züghart (Federal Agency for Nature Conservation, Bonn)

funded by STIFTUNG GEKKO

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GMLS III 2012 **Programme**

Wednesday, June 13th

19.00 Informal get together for participants and friends in the restaurant *Ständige Vertretung*, Böttcherstraße 3-5, Bremen

Thursday, June 14th

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9.30	Opening Address by the Organisers	
9.40	**Maike Schaefer** (Vice-chairman of the parliament group of Bündnis90/Die Grünen Bremen and speaker of environmental policy) Welcome to the GMLS III Participants	
Long-term experience and regulation aspects		
10.00	**Charles Benbrook** (Center for Sustaining Agriculture and Natural Resources, Washington State University, Pullman, Washington, USA) Impacts of genetically engineered crops on pesticide use in the U.S. – the first sixteen years	**14**
10.40	**Wiebke Zühart** (Federal Agency for Nature Conservation, Bonn, Germany) Establishment of an European data centre for Post Market Monitoring – what will be the best option?	**57**
11.00	**Hans-Georg Starck** (Ministry of Agriculture, Environment and Rural Areas of the Federal State of Schleswig-Holstein, Kiel, Germany) Official seed monitoring as a possible additional data source for GMO monitoring	**49**
11.20	**Sarah Stoppe-Ramadan & Gerd Winter** (Research Centre for European Environmental Law, University of Bremen, Germany) The admissibility of GMO free regions as coexistence measure	**50**
Lunch at 11.40		
13.00	**Hartmut Meyer** (European Network of Scientists for Social and Environmental Responsibility ENSSER, Braunschweig, Germany) EFSA's new guidance for environmental risk assessment of GM plants: The revival of obsolete concepts	**40**

Thursday, June 14th (continued)

Causes and Effects – starting points for large scale implications		
13.20	**Andres Carrasco** (University of Buenos Aires, School of Medicine, Argentina) Teratogenesis by glyphosate based herbicides and other pesticides. Relationship with the retinoic acid pathway	**24**
14.00	**Robin Messnage*, Emilie Clair, Steeve Gress et al.** (*CRIIGEN, Caen, France) Human cell toxicity of GMOs associated pesticides.	**39**
14.20	**Angelika Hilbeck** (EcoStrat GmbH, Zurich, Switzerland) Ladybeetles and Bt Toxins in GM plants – Differences in perception and approaches to biosafety testing for regulations	**35**
Poster presentation and coffee break at 14.40		
15.20	**András Székács** (Central Food Science Research Institute, Budapest, Hungary) Cry1Ab toxin quantification in MON 810 maize	**51**
16.00	**Miluse Trtikova, Matthias Meier & Angelika Hilbeck** (ETH Zurich, Plant Ecology, Zurich, Switzerland) Effect of extreme climatic conditions on Bt toxin concentration in transgenic maize	**55**
16.20	**Walter Haefeker** (European Professional Beekeepers Association, Seeshaupt, Germany) GMOs and their impact on the beekeeping sector: Still neglected in research, widely ignored in regulation, untapped potential for monitoring	**33**
16.40	**Broder Breckling** (University of Bremen, University of Vechta, Germany) Transgenic evolution and ecology on the way	**21**
17.00	End	
17.30	Sight-seeing in the Town Hall of Bremen (UNESCO world cultural heritage site, guided tour)	
19.30	Dinner in the restaurant *Becks am Markt* (not included in the conference fee)	

Friday, June 15th

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9.00	**Nicola Schoenenberger & Luigi D'Andrea** (InnovaBridge Foundation, Caslano & Biome, Delémomt; Switzerland) Subspontaneous glyphosate-tolerant genetically engineered *Brassica napus L.* along Swiss railways	**46**
9.40	**Frieder Hofmann*, Ulrich Schlechtriemen, Ulrike Kuhn et al.** (*TIEM Integrated Environmental Monitoring GbR, Bremen, Germany) Temporal and spatial variation of maize pollination in North Germany and its relevance for GMO-monitoring	**36**
10.00	**Elena Balducci*, Donatella Paffetti, Davide Travaglini et al.** (*Plant Genetics Institute – CNR, UOS FI, Fiorentino, FI, Italy) Pollen flow evaluation to implement a Quick Monitoring Index (QMI)	**12**
10.20	**Iwona Bartkowiak-Broda, Wiesława Popławska, Alina Liersch et al.** (Plant Breeding and Acclimatization Institute, Poznan, Poland) Investigation of oilseed rape gene flow using erucic acid as marker	**13**
Coffee break at 10.40		
Landscape effects and agro-ecological interferences		
11.00	**Cynthia Sagers, Meredith Schafer, Brett Murdoch et al.** (University of Arkansas, Department of Biological Sciences, USA) Domestication, feral species and the importance of industrial agriculture to the future of plant diversity	**43**
11.40	**Frieder Graef*, Anne Heyer, Sigrid Ehlert et al.** (*Leibniz Centre for Agricultural Landscape Research, Müncheberg, Germany) Assessing exposure of habitats and species neighbouring GMO cultivation	**32**
12.00	**Thomas Bøhn*, Denis W. Aheto, Felix S. Mwangala et al.** (*GenØk – Centre for Biosafety, Tromsø, Norway) Large-scale consequences in small-scale farming: Sharing and saving GMOs in subsistence agriculture?	**20**
12.20	**Raymond Arritt*, Brian Viner & Mark Westgate** (*Iowa State University, Ames, Iowa, USA) Predicting GM pollen dispersion at large spatial scales	**11**

Friday, June 15th (continued)

Lunch at 12.40

Consequences for research policy and society

13:40 **Rosa Binimelis*, Angelika Hilbeck, Tamara Lebrecht et al.** **16**
(Center for Agro-food Economy and Development-CREDA-UPC-IRTA, Castelldefels, Spain)
Farmer's choice of seeds in five regions under different levels of seed market concentration and GM crop adoption

14.20 **Denis W. Aheto*, Thomas Bøhn, Flora Tibazarw et al.** **9**
(*School of Biological Sciences, University of Cape Coast, Ghana)
Issues for strengthening biosafety decision-making in Africa

14.40 **Martha Mertens** **38**
(Institut für Biodiversität Netzwerk, Munich, Germany)
Deficits in research funding for analysis of GMO health and environmental risks – the example of Germany

15.00 **Christoph Then** **52**
(testbiotech, Munich, Germany)
Occupy Innovation – for a change in research policy

15.20 **Plenary Discussion**

End of the conference at 16.00

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Poster Session

Ibrahim Alaraidh*, Azura Amid, Abd-El Aziem Farouk et al. **10**
(*King Saud University, Riyadh, Saudi Arabia)
Detection of genetically modified rice: collaborative validation study of a PCR based detection of genetically modified rice *Oryza sativa* commercially available in Saudi Arabia

Natália C deAlmeida Silva*, Flaviane Malaquias Costa, Juliana B Ogliari et al. **30**
(*CCA/UFSC, Florianópolis, Brazil)
Spatiality of maize fields in Brazil: challenges for co-existence between GMs and local varieties

Rosa Binimelis **18**
(Center for Agro-food Economy and Development-CREDA-UPC-IRTA, Castelldefels, Spain)
Is there any room for alternatives? GMOs cultivation in Spain

Issues for strengthening biosafety decision-making in Africa

Denis W. Aheto[1], Thomas Bøhn[2], Flora Tibazarw[3] & Inger Louise Bones[4]

([1]School of Biological Sciences, University of Cape Coast, Ghana; [2]Genøk-Center for Biosafety, Norway; [3]Department of Botany, School of Applied and natural Sciences, University of Dar es Salaam, Tanzania; [4]National Scientific and Industrial Research, Zambia)

Biosafety decision-making in Africa is deeply hampered by two entrenched positions i.e. the pro- GMO and anti-GMO debates. While Africa is not a global exception to the contention of the use of GMO in agriculture, a greater number of African states generally have low capacity and minimal mechanisms for public awareness and information sharing, as well as relevant guidance for assessing the potential risks posed by GMOs. This situation has led to weak responses by policymakers to the wide range of emerging socio-economic, environmental, trade and regulatory issues related to use of GMOs in small-scale agriculture. For crop varieties, the argument in favour of GMO center on selective advantage for small farmers mainly in the form of insect pest resistance or herbicide tolerance with the promise of higher crop performance and better crop yields. Civil society groups, including small farmers with seed-saving culture advocate for broader agro-ecological and traditional crop improvement measures with potential for long-term food security, biodiversity and environmental sustainability. Concerns exist over farmers' seed-saving culture, systems of benefits sharing, biopiracy, and right to intellectual property as well as liability and redress issues. The review will draw on regional case studies from selected western, eastern and southern African countries as a basis to comment on some of the issues, gaps and challenges that confronts the development of effective biosafety standards on the continent, highlighting recommendations for a way forward.

Detection of genetically modified rice: collaborative validation study of a PCR based detection of genetically modified rice *Oryza sativa* commercially available in Saudi Arabia

Ibrahim Alaraidh[1], Azura Amid[2], Abd-El Aziem Farouk[3], Mohamed M. Ibrahim[4], Salih Bazaid[4], Ralf Greiner[5] & Abdullah Alghunaim[6]

([1]Department of Science, Teachers College, King Saud University, KSA; [2]Department of Biotechnology Engineering, Kulliyah of Engineering, International Islamic University Malaysia, Kuala Lumpur; [3]Department of Biotechnology, Faculty of science, Taif University, Al Hawayiah, KSA; [4]Recent address: King Saud University, Riyadh, KSA; Permanent address: Alexandria University, Faculty of Science, Botany and Microbiology department, Alexandria, EGYPT; [5]Max Rubner-Institute, Federal Research Institute of Nutrition and Food, Department of Food Technology and Bioprocess Engineering, Karlsruhe, Germany; [6]Riyadh, Saudi Arabia)

A collaborative trial study has been conducted for validation of an extraction method and a subsequent PCR for detection of transgenic rice sold in Saudi Arabia. The tests were carried out in Saudi Arabia using Real-Time PCR and the positive samples were validated in another lab in Malaysia using PCR and agarose gel visualization. The samples were tested for the existence of the NOS Terminator. A total of 150 samples were tested out of which three samples tested positive as GM-rice which were retested in Malaysia. The presence of GMO rice in Saudi Arabia supports the necessity of developing precise quantitative and qualitative ways for routine analyses and detection of GMO products in the Saudi Arabian market. With the discovery of GM products in the Saudi Arabian market it would be of no surprise that other Middle Eastern nations also knowingly or unknowingly import GM crops.

Predicting GM pollen dispersion at large spatial scales

Raymond Arritt[1], Brian Viner[2] & Mark Westgate[1]

([1]Iowa State University, Ames, Iowa USA; [2]Savannah River National Laboratory, Aiken, South Carolina, USA)

Risk assessment for large-scale gene flow from genetically modified (GM) crops requires knowledge of pollen transport over distances of tens of kilometres or more, but there are few measurements of pollen dispersion over such distances. A physically based modelling approach is a useful alternative for estimating pollen dispersion at these scales. We have created a physically-based dispersion model by combining a high-resolution version of a meteorological model with a Lagrangian particle dispersion model to predict pollen dispersion and viability. The meteorological model produces time-dependent fields of wind, turbulence, temperature, and humidity. These fields are input to the Lagrangian dispersion model which predicts movement of tracer particles that represent a statistical sample of a pollen cloud. We apply the combined models in two examples: a mountain-valley location where prior studies have detected gene flow over 20 km from a GM source, and the island of Kauai where major seed production operations are located. In the mountain-valley location the model successfully predicted dispersion of GM pollen to the sites where gene flow was observed. For the island, the model predicted complex patterns of pollen deposition affected both by daily sea-breeze winds and by inland terrain. Results show that pollen dispersion is controlled by a complex interplay of prevailing winds, terrain, and particle aerodynamics, so that a comprehensive modelling system is essential.

Pollen flow evaluation to implement a Quick Monitoring Index (QMI)

Elena Balducci[1], Donatella Paffetti[2], Davide Travaglini[2], Stefano Biricolti[3], Francesca Bottalico[2], Silvia Fiorentini[2], Anna Buonamici[1], Francesca Donnarumma[1], Alessandro Materassi[4], Gianni Fasano[4], Lorenzo Chelazzi[5], Filippo Cimò[1], Isabella Colombini[5], Laura Bartalucci[6], Antonio Perfetti[7], Olga Mastroianni[7], Valeria Tomaselli[8] & Cristina Vettori[1]

([1]Plant Genetics Institute – CNR, UOS FI, Sesto Fiorentino, FI; [2]Department of Agricultural and Forest Economics, Engineering, Sciences and Technologies - University of Florence, Firenze; [3]Department of Agronomy and Land Management, University of Florence, Firenze; [4]Institute for Biometeorology, CNR, UOS SS, Li Punti, Sassari; [5]Institute of Ecosystem Study - CNR, UOS FI, Sesto Fiorentino, FI; [6]Settore Promozione dell'innovazione e sistemi della conoscenza, Regional Government of Tuscany, Firenze; [7]Migliarino, San Rossore, Massaciuccoli Regional Park, Pisa; [8]Plant Genetics Institute, CNR, Bari; all Italy)

This work is part of LIFE08 NAT/IT/342 DEMETRA project with the aim of developing a Quick Monitoring Index (QMI) to rapidly assess the potential risk generated by a selected range of transgenic crops in well determined ecosystems or biotopes. Therefore, it is important to define pollen dispersal of some species (crops and trees) which could potentially be converted in transgenic in the near future, and cropped (or potentially cropped) in proximity of protected ecosystems. The species included in the project are maize, sunflower, canola and poplar cultivated in selected areas in the Migliarino – San Rossore – Massaciuccoli Regional Park (Tuscany, Italy). Some pollen traps were installed taking into account the distance from cropped area and the dominant wind during the period of pollen dispersal. The information achieved is needed in order to collect data concerning the possible distance covered by transgenic pollen that potentially could impact biodiversity and target species. This will be also necessary to individuate potential periods and conditions that increase the risk of pollen dispersal.

Investigation of oilseed rape gene flow using erucic acid as the marker

Iwona Bartkowiak-Broda, Wieslawa Poplawska, Alina Liersch, Tadeusz Walkowski & Maria Ogrodowczyk

(Plant Breeding and Acclimatization Institute, National Research Institute, Poznan, Poland)

Oilseed rape (*Brassica napus* L. *ssp. oleifera* Metzg.) is partly out-crossing. The gene flow between different type of oilseed rape cultivars as well as environment may have consequences such as effect on purity and quality of the harvest and abundance of wild relatives. The pollen is trasferred by insects and wind, seeds are spilled before and during harvest. Hybridization between different oilseed rape crops and volunteers will take place. Impurities from unintended mixture of seeds to yield of different cultivars can be the problem not only for coexistence of GM and non GM oilseed rape but also for coexistence of cultivars of different quality which are under development at present.

Erucic acid content in oil is determined by nucleus genes and is not influenced by environmental conditions, because of that it can be used as the marker of gene flow and marker of volunteers as well as progeny of volunteers hybrids with cultivated varieties.

In the presentation will be developed examples of investigations in different parts of Poland aiming at elaboration the principles of coexistence of different types of oilseed rape cultivars.

This project is partly supported by the Ministry of Science and Higher Education, project no. PBZ 06/1/2007 and 6FPEU SIGMEA

Impacts of genetically engineered crops on pesticide use in the U.S. – The first sixteen years

Charles Benbrook

(Center for Sustaining Agriculture and Natural Resources, Washington State University, Pullman, Washington USA)

Herbicide-tolerant (HT) corn, soybean, and cotton cultivars, and Bt-transgenic corn and cotton, have been remarkable commercial successes in the United States since their introduction in 1996. Claims are often made that these technologies have, and continue to reduce pesticide use. Annual corn, soybean, and cotton pesticide use data collected by the U.S. Department of Agriculture (USDA) constitutes the most complete public dataset with which to assess the impacts of GE crops on the kilograms of pesticides applied.

A model was developed to quantify by year the pesticide use impacts per hectare planted of the six major commercial GE pest-management traits: HT corn, soybeans, and cotton; Bt corn for control of the European corn borer (ECB), Bt corn for the corn rootworm (CRW); and Bt cotton for Lepidopteron (budworm/bollworm complex) insect control. Changes in pesticide applications brought about by the planting of a GE-trait hectare were estimated by crop, year and trait, and aggregated across all GE trait hectares planted over the 16 year period 1996-2011.

HT crop technology has led to ~239 million kilogram increase in herbicide use across the three major GE-HT crops, while Bt corn and cotton has reduced insecticide applications by 56 million kilograms. The reduction in insecticide use associated with Bt corn and cotton has, however, been accompanied by the biosynthesis of substantial volumes of Bt Cry endotoxins, ranging from 0.5 kgs/hectare to 4.2 kgs/hecatre in the case of SmartStax Bt corn. Overall, pesticide use increased by an estimated 183 million kilograms, or about 7%, between 1996 and 2011.

Looking ahead, the spread of glyphosate-resistant weeds in HT weed-management systems is bound to trigger further increases in the intensity of herbicide use. The volume of 2,4-D sprayed on corn, e.g., could increase 15-fold by 2019 from 2010 levels if the USDA approves unrestricted planting of 2,4-D HT corn, a technology that could add 2.1 kg additional herbicide/ha, about a 50% increase. Further increases are expected in the use of 2,4-D and dicamba on newly HT corn, soybean and cotton varieties, and the volume applied of other herbicides linked to newly-HT crop cultivars will surely rise. The increase in herbicides applied on HT hectares has dwarfed the reduction in insecticide use over the 16 years, and will continue to do so for the foreseeable future.

Farmer's choice of seeds in five regions under different levels of seed market concentration and GM crop adoption

Rosa Binimelis[1], Angelika Hilbeck[2,3], Tamara Lebrecht[2], Rapahela Vogel[2], & Jack A. Heinemann[3,4]

([1]Center for Agro-food Economy and Development-CREDA-UPC-IRTA, Castelldefels, Spain; [2]Swiss Federal Institute of Technology, Institute of Integrative Biology, Zurich, Switzerland; [3]GenØk-Centre for Biosafety, Tromsø, Norway; [4]Centre for Integrated Research and School of Biological Sciences, University of Canterbury, Christchurch, New Zealand)

The issue of seeds/cultivars –access, ownership and stewardship- is one of the most important issues to food security. However, market concentration of staple food seeds is occurring in all sectors of the food production chain "from farm to fork", and has been well documented. The application of different forms of intellectual property protection, most recently patent protection on genetically modified (GM) seeds, has accelerated the concentration of the seed market and the shift of breeding efforts from the public to the private/industrial domain. Here, we address the question of whether non-GM farmers have fewer choices of cultivars available to them in countries with restricted or no access to GM seeds than GM farmers in countries with no restriction to access, and whether the choices made by countries have had an impact on their productivity. We provide case studies as an approximation of real world choices faced by farmers, to evaluate impact of the seed market concentration on the availability of cultivars and varieties among maize farmers in five regions (Austria, Germany, Spain, Switzerland, USA) with different degrees of GM crop adoption.

We found no evidence that restrictions and regulations of GM crops in Europe have disadvantaged European farmers regarding farmers' seed options nor their productivity. In contrast, we confirmed that

farmers' choice in countries with high adoption of GM maize had highly concentrated seed markets with fewer choices between existing market certifications on offer. While choice of maize cultivars had increased significantly in GM-free countries Germany and Austria, in Spain, the only European country growing GM maize since 1998 at a commercial scale, overall numbers of maize cultivars declined, with an increasing number of non-GM cultivars being replaced by GM cultivars like in USA. The article maps also the technological and socio-ecological context of maize production in Spain, so as to contextualise the observed trends. As a consequence, along with increasing seed market concentration came a decline in farmers' choices both among desired GM-cultivars and non-GM cultivars along with an increasing dis-acknowledgment of farmers' needs.

Is there any room for alternatives? GMOs cultivation in Spain

Rosa Binimelis

(Center for Agro-food Economy and Development-CREDA-UPC-IRTA, Castelldefels, Spain)

The introduction of GMOs into the food chain has caused a public controversy over its socio-economic (SE) impacts. In this context, the European approval process for the marketing of GMOs has been heavily criticized because it only focuses on the risk assessment of environmental and health aspects rather than also contemplating SE implications, hence isolating GMO cultivation from its geographical, and SE context (Binimelis, 2008; Pavone et al., 2011).

Little empirical knowledge exists on the ethical, legal and SE aspects of GMOs commercial production, despite European and international commitments to broadening regulatory assessment to incorporate these dimensions. Moreover, a recent hearing of the EC on SE aspects of GMOs made clear the urgent need for facts and statistics relevant to the European context (particularly for the production steps beyond the farm gate and for the social aspects) (Dalli, 2011).

In this frame, the paper maps the technological and SE context of GM maize production, using the empirical case of Spain (where 97.000 ha of Bt maize were grown in 2011). It aims to understand what set of relations (social, legal, ecological, technical) the GM technology requires, creates, blocks and/or performs. Under the light of the newly proposed reforms for GM cultivation and coexistence in Europe and the recent ruling of the European Court of Justice on hive products contaminated with GMOs (ECJ, 2011), the paper analyses how different social actors affect and are being affected by Bt maize and concludes that existing intensive models are being reinforced over alternative productions while stakeholders' options (e.g. seed choices) are reduced.

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ECJ (2011) Judgement of the Court (Grand Chamber) of 6 September 2011. Case C-442/09

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Large-scale consequences in small-scale farming: Sharing and saving GMOs in subsistence agriculture?

Thomas Bøhn[1], Denis W. Aheto[2], Felix S. Mwangala[3], Inger Louise Bones[1], Christopher Simoloka[3], Ireen Mbeule[3] & Odd-Gunnar Wikmark[1]

([1]GenØk – Centre for Biosafety, Tromsø, Norway; [2]School of Biological Sciences, University of Cape Coast; [3]National Institute for Scientific and Industrial Research, Zambia)

Gene flow in maize has important consequences for local, regional and global maize biodiversity. Many developing countries have informal seed systems in addition to formal ones. Particularly in poor communities, seed saving and sharing often co-occur with fields of very small size, scattered around where possible, next to houses and close to neighboring fields.

In this study we use preliminary data from a small-scale maize farming community, Chongwe, in Zambia, to illustrate and develop a concept model for the significance of seed saving and sharing for patterns of gene flow.

The production of genetically modified (GM) plants bring in new dimensions for farmers, such as potential violation of property rights for seeds and regulatory consequences for the end product, e.g. in trans-boundary movement to countries that do not accept GM products. Small-scale farming is vulnerable to cross-contamination due to scale issues. If transgenes are introduced into small-scale agricultural contexts, uncontrolled diffusion and further spread seems unavoidable. Removal of transgenes as well as their legal and regulatory consequences would require control with small informal seed-stores made by farmers.

Transgenic evolution and ecology on the way

Broder Beckling

(University of Bremen & University of Vechta; Germany)

From the beginning of GM crop cultivation it was obvious that transgenes would not remain restricted to agricultural areas. After almost two decades of handling transgenic plants in environmentally open cultivation systems, an investigation of probable starting areas of evolutionary processes basing on transgenes becomes more and more important. It can be expected to gain relevance in ecological research also. The following topics are likely to bring new insight in interaction of social, agronomic and ecological dynamics of transgenic crops on the larger scales:

Gene escape in Africa – unintended dispersal of GM maize varieties across African subsistence crops is highly likely to proceed already today - regardless of national admission policies. Systematic molecular and ecological investigations are widely lacking.

Mexican maize evolution – Traditional maize cultivation in Mexico gives room for a self-organized genetic exchange and environmental adaptation of traditional varieties. This permanently ongoing process today involves also introgression dynamics of transgenic traits.

Transgenic oilseed rape disperses in Europe and Asia, interacting with native relatives – Transgenic oilseed rape survives in the wild and can hybridise with a large variety of related other species, some of them weedy or feral, others are cultivated.

Evolutionary news that we will likely see in the future are failing of GM pest resistances and the insight that on a global scale resistances based on transgenic traits are not likely to hold much longer than the time span of patent protection. In case of a commercialization of herbicide resistant bent grass (e.g. for golf courses) it could well be that we might witness the collapse of certain GM production forms based on direct seeding and an increase of resistant weedy GM grasses.

Herbicide tolerance and GM crops

Lasse Bruun

(Greenpeace International, Amsterdam, The Netherlands)

The widespread and increasingly intensive use of glyphosate in association with the use of GM crops poses further risks to the environment and human health. The use of glyphosate on GM RR crops such as soy, maize and cotton has increased dramatically in North and South America, where they are predominantly grown. GM RR crops are marketed by the US agrochemical giant Monsanto, and are associated with its own formulation of glyphosate herbicide, Roundup. Monsanto's sales pitch to farmers promised, and still does, reduced labour and financial savings by simplifying and reducing the costs of weed control. The reality is turning out to be different, with increasing health, biodiversity and environmental concerns and the development of weed resistance.

Given the problems that are now evident, no new GM glyphosate-tolerant crops should be authorised. In broader terms, GM herbicide-tolerant crops have been developed for an industrial farming model. They are therefore intrinsically linked to unsustainable farming practices that damage the basic natural resources food production is based upon, and their cultivation should be banned.

PlantScouts – Identification of biodiversity in plants

Frank Buschermöhle, Sabine Zachgo & Walter Bleeker

(University of Osnabrueck, Germany)

The aim of our project is to establish a company that offers services related to wild plant biodiversity like the molecular characterization of intraspecific variability. We want to deliver data that contribute to the aim to preserve the regional gene pool. These services comprise analyses of hybridisation and differentiation of plant species, determination of the origin of plant species based on molecular markers and ploidy analysis. The methods we are developing are DNA fingerprinting (e.g. RAPD), DNA sequencing and flowcytometry.

We work closely with the wild plant gene bank at the Botanical garden of the University of Osnabrück as well as with seed companies.

This project is funded by the Europäischer Fond für regionale Entwicklung (EFRE).

Teratogenesis by glyphosate based herbicides and other pesticides. Relationship with the retinoic acid pathway

Andrés Carrasco

(Lab. Molecular Embryology, School of Medicine UBA, Conicet, Argentina)

In South America, the incorporation of genetically modified organisms (GMO) engineered to be resistant to pesticides changed the agricultural model into one dependent on the massive use of agrochemicals. (1, 2) Different pesticides are used in response to the demands of the global consuming market to control weeds, herbivorous arthropods, and crop diseases.

A recent study using a commercial formulation of glyphosate based herbicides (GBH) showed that treatments with a 1/5000 dilution (430 µM of glyphosate) were sufficient to induce reproducible malformations in embryos of the South African clawed frog Xenopus laevis, a widely used vertebrate model for embryological studies (3). The phenotypes observed include shortening of the trunk, cephalic reduction, microphthalmy, cyclopia, reduction of the neural crest territory at neurula stages and craniofacial malformations at tadpole stages. In addition GBH inhibits the anterior expression domain of the morphogen Sonic Hedgehog (shh) and reduces the domain of the cephalic marker otx2, prevents the subdivision of the eye field and impairs craniofacial development. Moreover, in recent experiments with another commercial formulation of GBH, the malformations observed before were reproduced in a dose-dependent manner, even at dilutions of 1/500000, which produced developmental abnormalities in 17% of the embryos, without lethality (unpublished results).

It is known that glyphosate penetration through the cell membrane and subsequent intracellular action is greatly facilitated by adjuvants such as surfactants. For this reason, the active principle was also tested by injecting frog embryos with glyphosate alone (between 8 and 12 µM per injected cell). The calculated intracellular concentration for glyphosate injected into embryos was 60 times lower that the glyphosate concentration present in the 1/5000 dilution of the GBH which was used to culture whole embryos. The injection of glyphosate produced similar phenotypes and changes

in gene expression, suggesting that the effects are attributable to the active principle of the herbicide.

It is very well known that acute or chronic increase of retinoic acid (RA) levels leads to teratogenic effects during human pregnancy and in experimental models. The characteristic features displayed by RA embryopathy in humans include brain abnormalities such us microcephaly, microphtalmia and impairment of hindbrain development; abnormal external and middle ears (microtia or anotia), mandibular and midfacial underdevelopment, and clefts palate. These craniofacial malformations can be attributed to defects in cranial neural crest cells. An excessive cell death in regions where apoptosis normally takes place may underlie a general mechanism for craniofacial malformations associated to teratogens (4, 5).

In fact, an excess of RA signaling is able to down-regulate the expression of shh in the embryonic dorsal midline in Xenopus (6, 7). Shh deficiency is associated to the holoprosencephaly syndrome (HPE), a CNS malformation with a frequency of 1/250 of pregnancies and 1/10000 of live births. The HPE is a defect generated by the deficiency of the embryonic dorsal midline, which results in a failure in the division of the brain hemispheres, leading to different grades of craniofacial malformations. Moreover, Shh signaling is also necessary for the development of the cranial neural crest derivatives. In mouse, specific removal of the Shh responsiveness in the neural crest cells that give rise to skeleton and connective tissue in the head, increases apoptosis and decreases proliferation in the branchial arches, leading to facial truncations. In addition Shh signaling from the ventral midline is necessary, as an anti-apoptotic agent, for the survival of the neural epithelium and it is also essential for the rapid and extensive expansion of the early vesicles of the developing midbrain and forebrain (9)

An excess of RA signaling also down-regulates otx2 expression in Xenopus, chicken and mouse embryos (5). Knock-out mice for otx2 lack all the brain structures anterior to rhombomere 3. Interestingly, heterozygous mutants showed craniofacial malformations including loss of the eyes and lower jaw (agnathia). These phenotypes are reminiscent of otocephaly reported in humans and other animals and suggest that otx2 plays an essential role in the development of cranial skeletons of mesencephalic neural crest origin (10, 11, 12).

All this evidence indicates that RA, otx2 and shh are part of a genetic cascade critical for the development of the brain and craniofacial skeleton of neural crest origin. Glyphosate inhibits the anterior expression of shh, reduces the domain of otx2, prevents the subdivision of the eye field and impairs craniofacial development, resembling aspects of the holoprensecephalic and otocephalic syndromes (13). Indeed, assays using a RA-dependent gene reporter revealed that GBH treatment increases the endogenous RA activity in Xenopus embryos. Moreover, an antagonist of RA rescued the morphological phenotype produced by GBH. This lead to the conclusion that at least some of the teratogenic effects of GBH were mediated by increased endogenous RA activity in the embryos (3). This is consistent with the very well known syndrome produced by excess of RA, as described by the epidemiological study of Lammer et al. in humans (14) and in vertebrate embryos (15,16,17,18).

In Xenopus embryos, the endogenous activity of retinoids gradually increases during early embryogenesis and is finely regulated in space. Therefore maintaining a normal endogenous distribution of RA is important for axial patterning and organogenesis in vertebrates (17,19)

It has been reported that triadimefon, a systemic fungicide with teratogenic effects in rodent models, produces craniofacial malformations in Xenopus laevis by altering endogenous RA signalling (20). Arsenic, another endocrine disruptor, also increases RA signaling at low, non-cytotoxic doses, in human embryonic NT2 cells (21). In addition, atrazine produces teratogenic effects and decreases the levels of cyp26 transcripts in Xenopus tadpoles, suggesting that this herbicide also disrupts the RA signaling pathway (22, 23). RA signaling is one of the finest pathways to tune up gene regulation during development, and all this evidence raises the possibility that disturbances in RA distribution may be a more general mechanism underlying the teratogenic effects of xenobiotics in vertebrates. Since mechanisms of development are highly conserved in evolution among vertebrates, we would like to stress that they could be useful as very sensitive biosensors to detect undesirable effects of new molecules.

The evidence that links GBH (and potentially other chemicals) to increased activity of the RA signaling pathway might explain the higher incidence of embryonic malformations and spontaneous abortions observed in populations exposed to pesticides.

An important evidence came from the epidemiological study carried out by Benitez-Leite et al. in Paraguay identified 52 cases of malformations in the offspring of women exposed during pregnancy to agrochemicals. The congenital malformations observed include anencephaly, microcephaly, facial defects, myelomeningocele, cleft palate, ear malformations, polydactily, syndactily (24). These defects are indeed consistent with the well-known and expected syndrome caused by misregulation of the RA pathway.

These conclusions should be taken into account together with the incidence of malformations and cancer in Chaco, an Argentine province with soybean harvest and massive use of glyphosate. Official records reveal a 4-fold increase in developmental malformations in the province and a 3-fold increase of cancer in the locality of La Leonesa in the last decade (25).

All this information is extremely worrying because the risk of environmental-induced disruptions in human development is highest during the critical period of gestation (2 to 8 weeks). Moreover, the mature human placenta has been shown to be permeable to glyphosate. After 2.5 hr of perfusion, 15% of administered glyphosate is transferred to the fetal compartment (26). Indeed, a two-compartment model study suggested that a considerable diffusion of glyphosate into the tissue is reached after intravenous administration in rats. These authors conclude that direct blood concentration is only an average indicator of the presence of the chemical and does not provide evidence about its tissue distribution (27). It is necessary to consider the possibility that very low concentrations (pg/cell and not necessarily evenly distributed to all cells) may be sufficient to cause embryonic lethality (which is consistent with increased frequency of embryonic death and spontaneous abortions) or to modify normal embryonic pattern formation (28).

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Spatiality of maize fields in Brazil: challenges for co-existence between GMs and local varieties

Natália C. de Almeida Silva[1]; Flaviane Malaquias Costa[1]
Juliana B. Ogliari[1] & Angela Cordeiro[2]

([1]CCA/UFSC, Florianópolis; [2]DMPC Consultancy, Florianópolis, Brazil)

Maize is the second most important crop cultivated in Brazil, occupying an area of 15.3 million ha. Small-scale farming is responsible for around 44% of maize production, playing an important role in *on farm* conservation of maize genetic diversity. In Santa Catarina State, local farming communities still maintain a great diversity of local varieties for different purposes. In 2008, the Brazilian biosafety authority approved the commercial release of GM maize. From that, GM varieties for herbicide resistance and Bt maize have been cultivated widely. The norm of 100 m as the minimal distance between GM and non-GM maize fields raised concern among those involved in ecological agriculture and agrobiodiversity conservation. The Western region of Santa Catarina State has a sloping topography and it is densely occupied by small farms. Therefore, avoiding gene flow between neighbouring fields seems almost impossible. This paper presents the preliminary results of a research project on the spatiality of maize fields and seed flows in rural communities of SC State, and the implications for co-existence of GM and Non-GM varieties.

Maize gene flow simulation in areas of intensive agriculture, Lower Saxony, Germany

Markus Ernsing[1], Broder Breckling[1] & Hauke Reuter[2]

([1]UFT, University of Bremen, [2]ZMT – Leibniz Center for Tropical Marine Ecology, Bremen; Germany)

Maize is a wind-pollinated crop with a significant potential of gene flow. In particular for areas of intensive agriculture it is important to assess whether the segregation distances between conventional and genetically modified fields are likely to be efficient in avoiding unintended impurities. In Germany, a segregation distance of 150 m to conventional and 300 m to organic fields was implemented in the regulations of good agricultural practice. Conventional harvests with GM impurities above 0.9%, if occurring unintended and technically unavoidable, must be labelled and marketed as containing GM and cannot go into conventional food production lines.

We used the MAMO model to simulate different scenarios of GM cultivation in two counties of Lower Saxony (Germany) with a high percentage of maize cultivation. It turned out that there is a non-neglectable probability of gene flow above 0.9 % for various scenario assumptions. In particular the contribution of lage-distance gene flow was identified to be important. Empirical data for lage-distance gene flow are comparatively scarce and had to be extrapolated. It was demonstrated that not only the percentage of maizen cultivation and the field distances in a region is important to assess the gene flow potential but also the field size distribution. The presentation encompasses typical field distribution maps and presents different scenario simulations.

Assessing exposure of habitats and species neighbouring GMO cultivation

Frieder Graef[1], Anne Heyer[1], Sigrid Ehlert[1], Ulrich Stachow[1], Sarah Effertz[2], Klaus Henle[2] & Birgit Winkel[3]

([1]ZALF, Leibniz Centre for Agricultural Landscape Research, Institute of Land Use Systems, Müncheberg, Germany; [2]UFZ; Helmholtz Centre for Environmental Research; Department of Conservation Biology, Leipzig, Germany; [3]BfN; Federal Agency for Nature Conservation, Bonn, Germany)

Possible environment risks of genetically modified plants (GMP) according to European legislation have to be assessed prior to their release and marketing. This assessment refers to both cultivation areas and neighboring habitats. For large cultivation regions a differentiated risk analysis is necessary to detect site-specific and/or regional differences.

Our aim is to determine the frequency and probability of habitats, typical species and protected habitats as well as rare, endangered and protected species in the vicinity (50 m, 200 m, 1000 m) of arable land in German agricultural landscapes. To account for regional ecological differences we random sampled 5x5 km squares among ecoregion maps of Germany. For our GIS analysis we use ATKIS data (Authoritative Topographic Cartographic Information System), biotope and land use maps, maps of protected biotopes and species, NATURA 2000 information, species occurrence maps, and regional crop species statistics.

We present the overall analytical approach and preliminary results.

GMOs and their impact on the beekeeping sector: Still neglected in research, widely ignored in regulation, untapped potential for monitoring

Walter Haefeker

(European Professional Beekeepers Association, Seeshaupt, Germany)

Beekeepers around the world have pointed out considerable deficits in assessing the implications of GMO cultivation for beekeeping and in maintaining the possibilities of GMO-free honey production. This is particularly true for beekeepers in the EU and beekeepers outside of the EU trying to export to Europe, where the customers are sensitive to the GMO issue and have been promised freedom of choice, coexistence and zero-tolerance for all food by the European Commission.

Since the foraging range of bees encompasses several kilometres, bees and bee products are uniquely susceptible to exposure from GMO crops. Currently there are very few member states with coexistence measures designed to protect the production of honey which is free of GMO impurities when GMOs are approved for cultivation.

The presentation will outline regulatory requirements to assure the possibility to produce GMO free honey as well as the need for GMO registers and monitoring.

It also shows the potential of bee keeping to contribute to GMO monitoring. Since the bee's activity range can be the same order of magnitude as pollen transport by wind for many wind-pollinated crops and bees collect pollen independent from nectar, the presence of GMO crops can be detected on the regional scale. This holds even if the crops are not directly visited by bees, because wind carried pollen attaches to sticky honey dew, which is released by aphids and frequently collected by bees. Adequate honey sampling could be established as an excellent tool for large-

scale monitoring for GMO presence-absence assessment. A global database of gene flow could be established and maintained in partnership between the scientific community and the honey sector, which already analyzes honey on a regular basis for GMO content and has a vested interest in maps indicating high or low risk of contamination.

The presentation points to neglected issues in research and management and highlights the perspective of beekeepers and formulates demands to fill research gaps, improve regulation and realize the potential of bees for global GMO monitoring.

Ladybeetles and Bt toxins in GM plants - Differences in perception and approaches to biosafety testing for regulations

Angelika Hilbeck

(ETH Zurich, Plant Ecology, Zurich, Switzerland)

Decade-long controversy exists over adverse effects of Bt toxins expressed in genetically modified plants on beneficial, nontarget organisms. Inconsistent evaluation standards and asymmetrical levels of scrutiny applied to studies that report adverse effects fuel the debate over appropriate testing methodologies for regulatory risk assessment. In this presentation different approaches to ecotoxicity testing will be presented and compared with the goal to engage in an overdue discussion regarding what an accepted level of sensitivity could be. These issues will be discussed along a two case examples of documented adverse effects of Bt toxins on the beneficial predatory insects, the two-spotted ladybird species *Adalia bipunctata*.

Temporal and spatial variation of maize pollination in North Germany and its relevance for GMO-monitoring

Frieder Hofmann[1], Ulrich Schlechtriemen[1], Ulrike Kuhn[1], Reinhard Wachter[2], Steffi Ober[3], Rudolf Vögel[4] & Mathias Otto[5]

([1]TIEM Integrated Environmental Monitoring, Nörten-Hardenberg/ Bremen; [2]Aeropalynology, Ganderkesee; [3]NABU, Berlin; [4]LUGV Brandenburg, Eberswalde; [5]Federal Agency for Nature Conservation (BfFN), Bonn; Germany)

Temporal and spatial variation of maize pollination has been studied in a case study in Brandenburg on a regional level in 2010 and 2011. All maize fields in an area of about 25 km² have been classified by phenological observations in respect to onset of pollination. Variation of maize pollen concentration in canopy height has been measured with high temporal resolution using active volumetric pollen monitors in and outside of maize fields and between maize fields of different flowering behavior. The results show a high temporal and spatial variation of pollination and pollen concentration. Onset of pollination varied between fields in the same region and same year from beginning of July to beginning of August and end of pollen shedding lasted until end of August. Whereas the late flowering fields tend to pollinate more compact over 2-3 weeks, pollination of the early flowering field has been interrupted several times due to unfavorable weather conditions, leading to a pollination period extending to over 6 weeks in the region and 4 weeks even in the same field. Similar patterns are shown by long-term measurements of maize pollen concentration in the air at a reference station for rural areas at Ganderkesee, Lower Saxony, from 1994-2011. The duration of the pollen flowering season varied from beginning of July up to beginning of September with high variety of patterns from year to year indicating the same effect of interruptions in pollen release leading to longer periods of pollination for regions with partially unfavorable weather conditions like in northern Germany than the commonly assumed 10-14 days.

The influence of volunteers and soil seed bank on the quality of oilseed rape seeds – monitoring and molecular analyses

Alina Liersch, Joanna Wolko, Wieslawa Poplawska, Krystyna Krotka & Iwona Bartkowiak-Broda

(Plant Breeding and Acclimatization Institute, National Research Institute, Poznan, Poland)

Oilseed rape (OSR)(*Brassica napus* L. *ssp. oleifera* Metzg.) is characterized by high frequency of seed shattering before and during harvest. The amount of seeds spilled to soil is between 5% and 10% of the total seed set, but in unfavourable weather conditions the spillage can be more important. These seeds incorporated in the soil seed bank may survive for several and even more years. They are the source of volunteers contaminating the harvest of subsequent oilseed rape plantations through seeds as well as pollen. This is the most important problem concerning the coexistence of different quality oilseed rape cultivars as well as GM and non-GM cultivars. The objective of the study was the monitoring of volunteers and soil seed bank in the field after the harvest of high erucic acid (about 57%) cultivar Maplus. Investigation has been carried out at two locations in Poland (Dlon, Zielecin). In seeds harvested from volunteers and collected from soil seed bank erucic acid and glucosinolates content were evaluated. All individual samples with erucic acid content higher than 2,0% were described using molecular marker system RAPD. The obtained results show that only single samples originated from cultivar Maplus can be attributed to the traditional OSR cultivars and/or hybrids of the double low OSR with traditional cultivars.

This project is supported by the Ministry of Science and Higher Education, project no. PBZ 06/1/2007

Deficits in research funding for analysis of GMO health and environmental risks – the example of Germany

Martha Mertens

(Institut für Biodiversität Netzwerk, Munich, Germany)

Public funding of research is essential to guarantee that the public interest in safe application of new technologies, in product safety and maintenance of human health and intact environments is not overrun by private economic interests. To achieve this, industry-independent research and expertise has to be on the same technological level as industrial research. In addition, research topics have to extend to different and additional fields, in particular to the identification of health and environmental effects, which is not the major focus of product development.

The presentation will deal with the observation, that in German public funding of GMO risk research there is still a striking imbalance: public resources go to a large extent into support of product development instead of enabling research into the consequences of GMO use. Deficits in experimental risk research and monitoring of large-scale implications are identified and a list of open topics is presented where additional research in the public interest is urgently required.

Human cell toxicity of GMOs associated pesticides

Robin Mesnage[1], Emilie Clair[1], Steeve Gress[1],
Christoph Then[2], András Székács[3] & Gilles-Eric Séralini

([1]University of Caen, CRIIGEN and Risk Pole, Caen Cedex, France; [2]Testbiotech e.V., Munich, Germany; [3]Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary)

Agricultural genetically modified (GM) plants are pesticides containing plants, designed to tolerate/produce pesticides. In the new growing generation with stacked traits, glyphosate-based herbicides (like Roundup) residues are present in the Roundup-tolerant edible plants and mixed with modified *Bt* insecticidal toxins that are produced by the GM plants themselves. We characterized their cellular side effects on human non-target cells. Roundup was highly toxic on human cells, from 10-20 ppm, far below agricultural dilutions. Roundup was also an endocrine disruptor from 0.5 ppm, in the range of concentrations relevant for human exposure. It caused estrogen and androgen receptor disruptions, and inhibited the aromatase enzyme. Modified *Bt* toxins are claimed and believed to be inert on non-target species. Surprisingly, Cry1Ab caused human cell death by membrane disruption from 100 ppm. For Cry1Ac, under our conditions, no effects were detected. Combined with Roundup, they reduced Roundup induced apoptosis. All together, our results raise new questions in the risk assessment of food and feed derived from genetically engineered plants.

EFSA's new guidance for environmental risk assessment of GM plants: The revival of obsolete concepts

Hartmut Meyer

(European Network of Scientists for Social and Environmental Responsibility ENSSER, Braunschweig, Germany)

In its 2010 “Guidance on the environmental risk assessment of genetically modified plants” EFSA has introduced a "comparative safety assessment" as a new and upstream decision making step in environmental risk assessment (e.r.a.) that will be used by its GMO Panel to decide on how to deal with documented, statistically significant differences in unintended effects prior to e.r.a. The Panel will be empowered to take decisions on the interpretation of scientific date at three points:

- determination of the consistency of the observed differences;
- determination of the non-transient nature of the observed differences; and
- determination of the biological relevance of the observed differences;

based on the data generated by the applicants. EU legislation does not foresee such a procedure as introduced by EFSA. EU legislation in addition rejects the concept that tests on substantial equivalence could serve as safety assessment in itself - as it would be the case if the new EFSA concept should be applied in future. It remains doubtful whether EFSA has the authority to govern normative issues as e.g. deciding on biological relevance without public debates and policy decisions.

Pollen dispersal of oilseed rape – estimation of the dispersal using pollen traps

Wieslawa Poplawska[1], Alina Liersch[1], Malgorzata Jedryczka[2], Joanna Kaczmarek[2], Joanna Wolko[1], Maria Ogrodowczyk[1] & Iwona Bartkowiak-Broda[1]

([1]Plant Breeding and Acclimatization Institute, National Research Institute Poznan; [2]Institute of Plant Genetics of the Polish Academy of Sciences Poznan; Poland)

Oilseed rape (*Brassica napus* L. ssp. *oleifera* Metzg.) is both self- and cross-pollinated. The frequency of outcrossing is dependent on the genotype of the cultivar and environmental conditions of the culture. Cross pollination is estimated to be between several and 90% depending on cultivar. Outcrossing mainly occurs between fields in the neighborhood but also pollen dispersal occurs in long distance.

The objective of this research project was to investigate the frequency and distance of pollen dispersal in Polish environmental conditions using passive and active pollen traps. The experimental field (acreage about 0,6 ha) was isolated by at least 5 km from other oilseed rape plantations. Passive traps were placed at five compass directions around the field at the distance of 90m in increments of 5m. Hirst-type volumetric pollen traps (Burkard Manufacturing UK) were positioned on a linear transect in the direction of the prevailing wind (S-E) at the distance of 90 and 180m from the edge of the field. Calculation of pollen concentrations was based on pollen number visualized on Vaseline-covered and stained Melinex tapes that were mounted on microscope slides and quantified with light microscopic techniques. The most important quantity of pollen has been found in the distance 0 to 40m from the edge of plantation. However, in the peak of flowering the pollen flow up to 180m of the investigated distance.

This project was supported by the Ministry of Science and Higher Education, project no. PBZ 06/1/2007

Coexistence in maize: Efficacy of non-GM maize border rows for the reduction of pollen-mediated gene flow

Gerhard Rühl & Maren Langhof

(Institute of Crop and Soil Science, Julius Kühn-Institut, Braunschweig, Germany)

A non-GM maize border directly at the edge of the field grown with GM maize has been considered as coexistence measure and already found its way into national coexistence regulations of several EU member states. In large scale field experiments we tested the effectiveness of 9 and 18 m wide maize border rows in combination with different isolation distances. In 2008, we combined non-GM maize borders with an isolation distance of 51 m at three sites in Germany. We could not observe any effect of non-GM maize border rows on pollen-mediated gene flow. In a modified field trial conducted in 2010 and 2011 the isolation distance between donor and recipient field was reduced to 6 and 12 m, respectively, to assess the efficacy of border rows as coexistence measure for small structured agricultural landscapes. In these trials maize gene flow was investigated using a GM-free test system based on the trait kernel color. Results obtained point out that both, 9 and 18 m wide border rows, can significantly reduce outcrossing in the first 5 to 10 meters of the recipient field but do not reliably reduce the GM percentage of the whole field`s harvest.

Domestication, feral species and the importance of industrial agriculture to the future of plant diversity

Cynthia Sagers, Meredith Schafer, Brett Murdoch, Jason Londo, Steven Travers & Peter Van de Water

(University of Arkansas, Fayetteville, Arkansas, USA)

> *"The evolutionary lines most likely to take advantage of a changing environment are those in which recombination is raised to a maximum. This is accomplished most effectively by mass hybridization between populations having different adaptive norms."* (Stebbins, 1959)

Stebbins's review of hybridization, evolution and the origins of organic diversity foreshadowed the current era in which cultivated crops commonly grow in the presence of sexually compatible relatives. Co-localization and subsequent hybridization between populations of domesticated and native plant species are increasingly likely as natural landscapes are converted to managed ones. As a consequence, the interface of agricultural and natural systems has tremendous potential for the rapid evolution of new plant forms. Marginal habitats are becoming important repositories of genetic diversity and their study at large spatial scales is increasingly relevant. In this talk I examine ecological and evolutionary processes that shape patterns of biological diversity at the interface of cultivated and natural systems. I will address a series of topics related to the migration of crop alleles including the movement of transgenes out of agricultural fields, the effects of hybridization on populations of native species, and the preservation of existing diversity in marginal areas that border on managed landscapes.

Large-scale analysis of the risks of crop escape

We are using geospatial tools to more clearly identify risks linked to the dispersal of transgenes into marginal habitats. Geospatial approaches that combine the occurrence of escapees, plant physiological status and environmental parameters will provide a predictive model of the likelihood of persistence of plants escaped from cultivation. In one project we are adopting stable isotope analyses to assess plant stress across a range of environmental variables. In a further effort, we will use wind vector modelling to design survey routes for the detection of GM plants throughout midwestern U.S. A geospatial perspective allows us to evaluate conditions that favor GM crop escape and to gauge the risks of long-term persistence at a scale comparable to Wilkinson et al. (2003).

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The GeneRisk project: Social ecology research applied to GMO risk assessment

Gunther Schmidt, Broder Breckling & Winfried Schröder

(University of Vechta, Germany)

The GeneRisk project was funded by the German ministry of education and research to assess systemic risks of GMO cultivation and to develop management strategies to cope with potential unintended and undesirable environmental and socio-economic impacts. Accordingly, the GeneRisk project consortium evaluated systemic implications of the introduction of GM crops in agriculture by bringing together disciplinary knowledge of ecologicsts, economists, agronomists, and legal experts.

The synthesis-report of the project encompasses, amongst others,

- a level-specific structuring of BT maize risk assessment,
- a model of regional cross-pollination for maize, and
- a Web-GIS information access approach.

Furthermore, welfare-economic and legal regulatory considerations together with stakeholder studies and perspectives were addressed.

The project results illustrate that GMO impact assessment is not possible from a purely scientific perspective but requires a multi- and transdisciplinary approach involving ecological or agronomic as well as social science aspects. While the molecular and farm-scale effects of GMO are comparatively well investigated, large-scale effects of GMO are considerably less researched. In this regard, the project contributed the first regional-scale estimation of maize gene flows for Northern German federal states. The contribution summarises the synthesis report which is available in German. Additionally, key articles were published in a special series which was launched in the international journal Environmental Sciences Europe edited by Springer.

Subspontaneous glyphosate-tolerant genetically engineered *Brassica napus* L. along Swiss railways

Nicola Schoenenberger[1] & Luigi D'Andrea[2]

([1]InnovaBridge Foundation, Caslano, Switzerland.
[2]Biome, Delémomt, Switzerland)

Railway tracks represent a highly interlinked habitat with numerous possibilities for accidental entry of oilseed rape due to seed spill during transportation. Moreover, glyphosate is regularly employed to control the vegetation, increasing the possibility of establishment for plants resistant to it. We surveyed the presence of genetically engineered glyphosate tolerant oilseed rape (*Brassica napus*) in Swiss railway stations. Our objective was to detect accidental establishment of transgenic plants, since Switzerland does not import nor cultivate transgenic oilseed rape (Swiss Federal Office for Agriculture 2011; Swiss Federal Office of Public Health 2011).

Materials and methods

Leaves from distinct individuals growing in railway stations throughout Switzerland and the Principality of Liechtenstein were analysed using commercially available immunologic test kits, detecting the CP4 EPSPS enzyme, which confers glyphosate tolerance. Positive results were confirmed by a partner organisation by the use of time PCRs of the *gox* and *cp4epsps* transgenes and an event specific PCR of GT73 glyphosate tolerant oilseed rape.

Results

A total of 1242 oilseed rape individuals were tested for genetic modification in 31 railway stations. At the Railway station of Lugano, 21 plants expressing the CP4 EPSPS protein and surviving glyphosate application were detected. This population was probably introduced through contaminated seed spills from freight trains.

Conclusions

Railways are an ideal system for herbicide resistant GM-plants to establish and spread as a result of high selective pressure in favour of herbicide resistance with consequent difficulties to keep the infrastructure free of weeds. Crop-to-wild gene flow can occur as several sexually compatible species which are congeneric or in allied genera to oilseed rape were found growing sympatrically (Schoenenberger & Giorgetti-Franscini 2004). Moreover, the capillary presence of railways in the agricultural landscape provides a putative source of contamination of GE-free agriculture. Carefully adapted monitoring designs may be set in order to detect introduction events that can lead to rapid establishment and growing populations as the accepted contamination thresholds are likely to be biologically insufficient to prevent further environmental contamination.

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Can dwarfed OSR (*Brassica napus* L.) measure up to tall cultivars?

Jana Seeger, Broder Breckling & Juliane Filser

(University of Bremen, UFT Centre of Environmental Research and Sustainable Technology, Bremen, Germany)

Dwarfing has been proposed as a method of transgenic mitigation to reduce fitness of GM OSR under competitive conditions, thereby limiting unintended gene flow. We addressed the question whether dwarfing may, in contrast, confer a fitness advantage to feral plants on disturbed ruderal sites. The effects of simulated mowing and reduced soil quality on relative fitness of the semi-dwarf hybrid PR45D03 compared to the tall cultivar Artus were tested in two separate experiments on a former dump site.

PR45D03 produced significantly less seeds than Artus on all soils in the substrate comparison, but matched the reproductive output of Artus on unmown control plots with humous soil. Artus plants lost significantly more dry plant biomass and % leaf area through mowing than PR45D03. Yet, the tall cultivar produced a similar number of seeds as PR45D03 in fall-mown and significantly more seeds in spring-mown plots, indicating a higher compensatory ability. Our results suggest that dwarfing may reduce the success of feral plants in some but not all situations, indicating that dwarfing may mitigate but not prevent transgene escape. Further studies need to test the likely possibility that dwarfing may be advantageous at lower mowing heights, higher soil quality and for different cultivars.

Official seed monitoring as a possible additional data source for GMO monitoring

Hans-Georg Starck

(Ministry of Agriculture, Environment and Rural Areas of the Federal State of Schleswig-Holstein, Kiel, Germany)

There are clear obligations for the genetic engineering agencies in the member states to enforce inspections and - in case of an unapproved deliberate release or placing on the market - to take counteractions. Legal basis is article 4, paragraph 5 of the directive 2001/18/EC. In 2000 Europe got a clutch of GMO findings in maize, oil seed rape and cotton seeds. Since that time some (not all) member states have started with a continuously analysis of seeds to detect GMO contaminations. Data of the last years in Germany but also from other member states will be presented. The findings show that seeds from some crops from particular origins have a permanent risk to be contaminated. Thus risk orientated seed monitoring is a strong approach to optimize the monitoring. These additional data may be of interest for the determination of a "baseline" before the deliberate release of genetically modified plants due to possible background sounds (low level contamination of the environment).

The admissibility of GMO free regions as coexistence measure

Sarah Stoppe-Ramadan & Gerd Winter

(FEU, University of Bremen)

The debate on risks from the introduction of GMOs into the environment for agroecology and biological diversity is vigorous as ever before. Accompanied with this debate is the question whether coexistence measures and in particular GMO free regions may be a solution. “GMO free region” means a region which can clearly be defined and where the use of GMO is prohibited or limited. Usage includes sowing, planting, breeding or any other systematic release. The prohibition or limitation in a GMO fee region can aim at any GMO or one specific kind and respectively at any kind of usage or a specific usage.

The presentation will look at the legal problems involved here. In particular it will discuss the following topics: What are the existing measures to ensure coexistence, and why would they be improved by GMO-free regions? Does German law encompass rules which allow GMO free regions? If so, can GMO free regions be achieved by existing national legal instruments or is there a need for reform? Do such national instruments contradict EU or international law?

Cry1Ab toxin quantification in MON 810 maize

András Székács

(Central Food Science Research Institute, Budapest, Hungary)

Quantification of the expressed transgenic Cry1Ab toxin in MON 810 maize reveals information on several crucial aspects regarding the agrotechnological application of this genetic event. Although resulting in the same trypsine-cleaved toxin form (activated Cry1Ab toxin, 65 kDa) in the insect midgut, the plant-expressed toxin protein (preactivated Cry1Ab toxin, 91 kDa) is a truncated version of the corresponding bacterial toxin (Cry1Ab protoxin, 131 kDa). This difference has both analytical and regulatory consequences. As commercial enzyme-linked immunosorbent assays, widely used for toxin quantification, are devised against the bacterial protoxin, they reportedly underestimate Cry1Ab toxin content in MON 810 maize. Moreover, the Cry1Ab preactivated toxin produced by MON 810 maize is not a registered *Bacillus thuringiensis* based bioinsecticide ingredient; its authorization would require complete toxicological evaluation. As for their environmental fate, in contrast to the rapid breakdown of the bacterial Cry1Ab protoxin, the plant-expressed preactivated Cry1Ab toxin protein shows persistence in the stubble, being protected from decomposition within the plant cells. And finally, although MON 810 maize has been advocated to be included in integrated pest management (IPM) practices, it cannot fulfil the main ecological principle of IPM, e.g. that protection measures should be timed only to the period when pest damage exceeds the critical level. Therefore, in spite of the environmentally mild characteristics of its active ingredient is, MON 810 maize does not formally comply with IPM.

Occupy Innovation – for a change in research policy

Christoph Then

(testbiotech, Munich, Germany)

Current European and German research policy is criticised by many civil society organisations. Drastic problems such as climate change, decreasing resources and global food supply are fueling the discussion. Uneasiness about a research policy that is mostly driven by economic interests is increasing.

It's time for a change: In 2011 about 100 civil society organisations published a call for a substantial change of the common strategic framework for the funding of European research and innovation programmes. In its 2001 annual report, the German Advisory Council on Global Change (WBGU) called for a "social contract for sustainability". Most recently, in February 2012, the German organisation, Friends of the Earth (FOE / BUND) published a report titled "Sustainable Science", which summarises several aspects of the current discussions on this subject.

One of the most important demands of organisations such as FOE (Germany) or the Nature and Biodiversity Conservation Union (NABU) is a multimillion sustainability programme, the so called "Nachhaltigkeitsmilliarde", an annual fund to drive the necessary transformation of science to secure a real change of policy in the fields of energy, agriculture, mobility and sustainable urban development. Furthermore, calls are being made for new structural instruments to enable more participation, transparency and democratic control by society and thereby put an end to the current fixation on technology, competitiveness and economic growth.

Similar demands are raised in a letter to EU Commissioner, Barroso, which was signed by about 100 civil society organisations in 2011:

- Research that will make Europe (and the world) an environmentally sustainable, healthy and peaceful place to live must now be prioritised over and above research that delivers marketable technologies. We, the undersigned civil society and scientific organisations, think that another research and innovation policy is not only possible but urgently necessary in order to respond to

the challenges our societies are facing. We call on the EU Institutions to take steps to.

- Overcome the myth that only highly complex and cost intensive technologies can create sustainability, employment and well-being, and focus on tangible solutions to environmental, economic and societal challenges instead;
- Ensure that the concept of innovation includes locally adapted and social forms of innovation as well as technological development, and facilitate cooperation and knowledge exchange between civil society organisations and academia in order to realise the innovative potential of the non-profit sector;
- Establish a democratic, participatory and accountable decision-making process for research funding allocation, free from conflicts of interest and industry dominance, and enable civil society to play a full part in both setting the EU research agenda and participating in all EU research programmes;
- Ensure that all experts advising EU research policy-makers are appointed in a transparent manner to provide impartial and independent expertise, free from conflicts of interests; replace industry-dominated advisory groups and technology platforms with bodies that provide a balanced representation of views and stakeholders;
- Ensure that publicly funded research benefits wider society by systematically requiring equitable access licensing and encouraging open source access policies in the next Common Strategic Framework."

The aim of the signatories of this letter is the initiation of a much more sustainable research policy in Germany and the European Union, beginning with the German parliamentary elections in 2013. To foster public debate, we support these "electoral benchmarks", directed at all the participating parties of the 2013 German parliamentary elections.

In addition to the demands presented above, we also see the need to build up more expertise in the fields of new, risky and high tech technologies, which is independent from the interests of industry. Similarly, as was the case prior to the recent financial crisis, only a few experts are investigating the long-term implications in great detail that may be associated with new developments in the fields of nanotechnology and biotechnology as well as areas such as energy, mobility and IT technologies. Many of the relevant experts

have close ties with industry (for example via funding of their research projects) or are working for government authorities, which in many cases are more interested in enhancing economic growth and competitiveness than fostering a broader public debate. The establishment of a broad and well-founded counter expertise in the field of risky technologies, which is also represented on an institutional level is essential.

General political goals:

- "Public money for public goods", the priority for publicly funded research policy should be the benefit of general society;
- More participation by civil society organisations in planning and implementing research policy;
- Much more transparent research policy frameworks should be developed, which are not| predominantly driven by economical interests;
- Enhancing independent counter expertise, especially in technological areas associated with higher risks for the environment and health;
- More scope for new, unconventional and controversial debates and views within the scientific community;
- Innovations in the fields of social and cultural sciences should be regarded as being equally important as technological innovations.

Effect of extreme climatic conditions on Bt toxin concentration in transgenic maize

Miluse Trtikova, Matthias Meier & Angelika Hilbeck

(ETH Zurich, Plant Ecology, Zurich, Switzerland)

Recently, it was shown that transgenic Bt maize plants do not produce Bt toxin at a uniform level. It was suggested that the toxin synthesis might be affected by the plant genetic background and various environmental factors. In our study, we investigated how is Bt toxin production influenced by sudden extreme climatic events such as drought in combination with high temperatures or waterlogging in combination with low temperatures. First, we grew two MON810 varieties for six weeks under optimal conditions (20-25°C, watered regularly), and then we exposed the plants for two weeks to two different treatments simulating either hot/dry (21-30°C, watered only sparsely) or cold/ wet (13-16°C, waterlogged) conditions. Leaf samples for Bt toxin quantification by ELISA were collected before and after the extreme climatic conditions were applied. The preliminary results indicate that waterlogging in combination with low temperatures may lead to a decrease in Bt toxin concentration in the leaves of transgenic Bt maize. This might have direct consequences for both target and non-target insects, especially in terms of insect resistance development and environmental risk assessment.

The potential impact of glyphosate-based herbicides on amphibians

Norman Wagner[1], Wolfram Reichenbecher[2],
Hanka Teichmann[2], Beatrix Tappeser[2] & Stefan Lötters[1]

([1]Biogeography, Trier University,
[2]Federal Agency for Nature Conservation, Bonn; Germany)

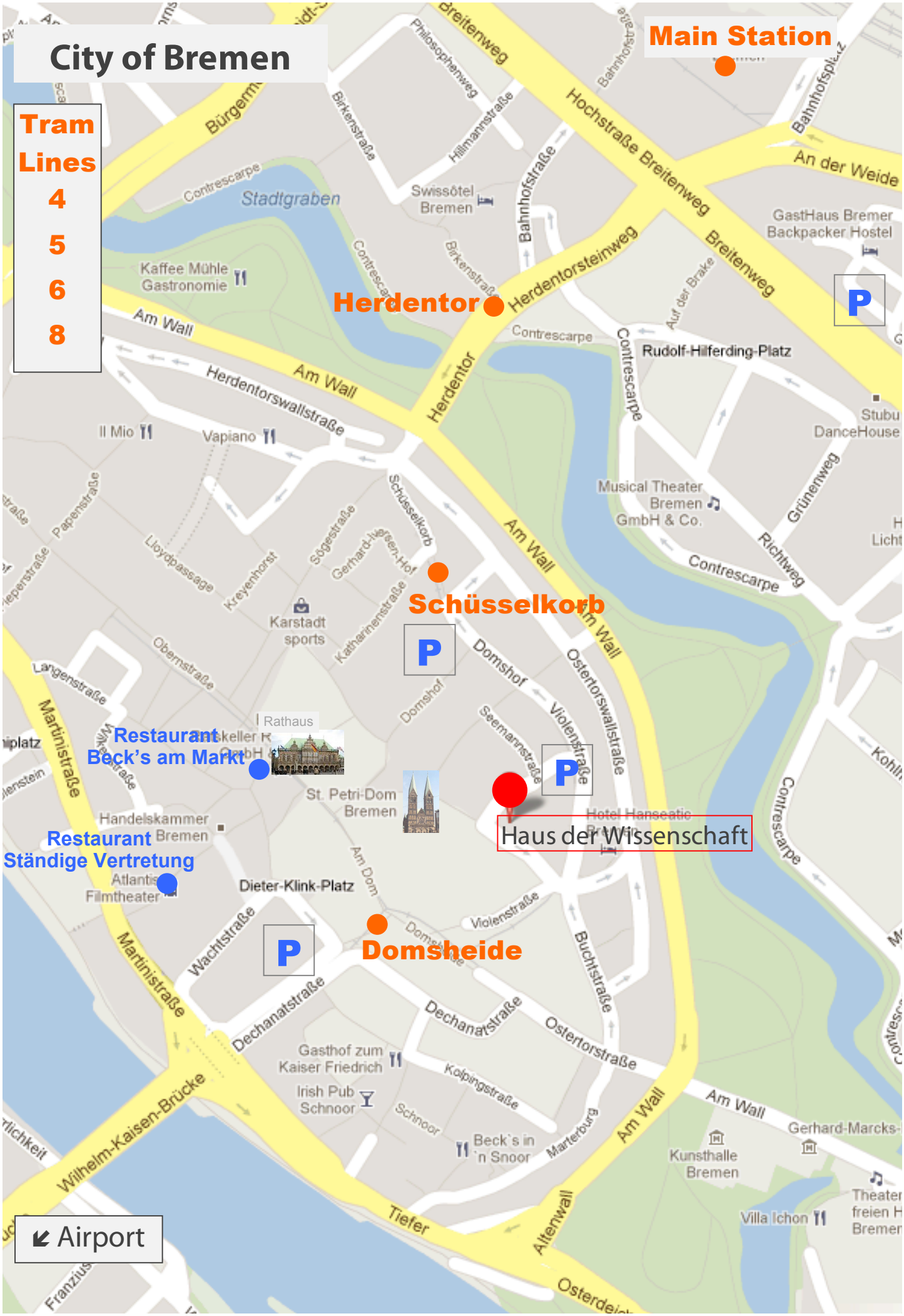
Since the introduction of genetically modified herbicide-resistant crops in 1996 the use of glyphosate-based herbicides (GBH) continues to grow on a global scale. By reviewing relevant literature from the past 13 years we here try to link potential impacts of GBH to amphibians, following five questions: (1) What is currently known about the impact of GBH on amphibians from laboratory, mesocosms, and field studies? (2) What are the concentrations amphibians could be exposed to? (3) What is known about interactions of GBH with other stressors? (4) Does the increased use of GBH contribute to amphibian decline? (5) What are important issues for future research? In short, the impact of GBH on amphibians depends on the herbicide formulation and significantly differs with respect to the taxa. Only little is known about the glyphosate (GLY) concentrations prevailing in amphibian habitats and virtually nothing about further substances contained in herbicide formulations. Therefore, GLY levels deduced from limited measurements can only be seen as approximations for contamination of amphibian habitats with GBH. Co-stressors mostly increase negative effects of GBH to amphibians and can render apparently harmless GBH concentrations harmful. Despite the fact that amphibian populations are usually declining due to multiple stressors, GBH may become a crucial stressor for previously affected populations, for species with limited distribution and those which do not build meta-populations. Compared to other herbicides, GBH use could affect more amphibians in some regions and during their entire life-cycle. We recommend for performing at least one amphibian test mandatory with each GBH formulation for pesticide registration and a better monitoring of both amphibian populations and contamination with GBH.

Establishment of an European data centre for Post Market Monitoring – what will be the best option?

Wiebke Züghart

(Federal Agency for Nature Conservation, Bonn, Germany)

The need for a focal data centre for Post Market Monitoring (PMM) of genetically modified organisms is expressed widely by Member States and the European Commission. The aim is to manage data from different sources using a common structure. Provided that comparable environmental data are available across Europe, aggregated analysis and evaluation can be made for the purposes of PMM. Different options on how to initiate an European data centre circulate among stakeholders, for instance the use of institutions such as EFSA, JRC or EEA or alternatively the development of a new information platform. We present the pros and cons of different approaches and deduce recommendations for future proceeding.


City of Bremen
Tram Lines
4
5
6
8
Main Station
Herdentor
Schüsselkorb
Haus der Wissenschaft
Domsheide
Restaurant Beck's am Markt
Restaurant Ständige Vertretung
Stadtgraben
Contrescarpe
Am Wall
Herdentorswallstraße
Herdentorsteinweg
Hochstraße Breitenweg
Breitenweg
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