Impact of transgenic crops on fertility of soils with different management history

The technology to genetically modify crop plants may be useful to ameliorate farming systems with respect to economy, dependency on external inputs, and sustainability of food production. Potential risks of genetically modified (GM) crops need to be evaluated thoroughly in order to avoid effects on non-target organisms, the environment and the human integrity. The performance and effects of GM-crops in different environments has to be considered, demanding for a case specific risk assessment.

Objectives of the proposed research project are

- to review GM-crop effects in soils with different management history and soil quality,
- to assess Bt-maize effects on key indicators of biological soil fertility,
- to investigate the extent and length of GM-crop induced changes depending on the initial soil fertility level,
- to assess the time needed for recovery after Bt-maize cultivation (resilience), and
- to analyse the decomposition of Bt-maize in soils, with respect also to tissue quality.

Expected results

The uniqueness of the chosen approach is to use soils from the same area that developed different soil fertility as the result of management history:

- Organic field plots  DOK-trial  high soil fertility
- Conventional field plots  DOK-trial  medium soil fertility
- Maize monoculture field  On-farm  low soil fertility

To date, GM-crops are intended to be used in high input agriculture. Identical soil types with different fertility levels, as indicated by soil organic matter and microbial biomass, activity and diversity, were not yet investigated with respect to the risks caused by Bt-maize. We are expecting that soils low in microbial biomass and activity are more likely to show changes as induced by the Bt-maize, whereas high microbial biomass levels may render the soil better buffered towards disturbance. A soil rich in microorganisms may also decompose plant residues and the Bt-toxin faster and recovery times to reach initial levels may therefore be shorter than in soils with lower activity.

Methods

*Bt-maize* (Bt11 and Bt176) will be grown in a climatic growth chamber using soils from organic and conventional field plots of the DOK long-term field trial (Mäder et al. 2002) and monoculture fields. GM-crop effects on soil fertility will be evaluated in comparison to NK4640, the parental line of Bt11, in addition to abundantly grown maize varieties. Soil fertility will be measured by standard protocols of methods related to bio-geochemical cycles (microbial biomass, soil enzymes, respiration, soil nutrients, root symbioses like mycorrhiza, microbial community structure) (Fig. 1). These methods have been proven useful to detect subtle effects of an applied biocontrol inoculum *P. fluorescens* CHAO (Fließbach et al., in prep.).

![Figure 1: Methodological concept and methods applied (in red) to evaluate potential effects of Bt-maize on soil fertility.](image)

**Networks within NRP 59**

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**References**


Fließbach, A., Winkler, M., Lutz, M., Oberholzer, H.R., Mäder, P. (in prep.): Soil amendment with *Pseudomonas fluorescens* CHAO is more effective in soils low in microbial biomass and activity.