SPECIAL SUBMISSIONS

Introduction

The papers in this section were presented at the symposium, "The Environmental Impact of Transgenic Crops on Soil Biological Processes and Functions," held during the 2002 ASA–CSSA–SSSA annual meetings. Among the objectives of the symposium were to review and discuss the effects of genetically modified (GM) crops on soil biological processes and functions in agroecosystems and stimulate discussion of research priorities.

A primary reason that the symposium was organized is that public concerns over the environmental effects of GM crops are widespread (Priest, 2000). The agricultural land area planted to GM crops has expanded rapidly since the first commercial introduction of these crops in the 1990s and, therefore, the potential risk of large-scale environmental impacts also may be increasing. In 2003, the global land area planted to GM crops was estimated at 68 million hectares (CropBiotech Net, 2004). The majority (99%) of these GM crops were grown in six countries (United States, Argentina, Canada, Brazil, China, and South Africa). The possible overall environmental hazards associated with the release of GM crops include the dispersal and invasiveness of GM plants into ecosystems; movement of transgenes in the environment through pollen dispersal to other nontransgenic plants or gene transfer to microorganisms; reductions in the biodiversity and activity of nontarget organisms, including both flora and fauna; and development of resistance in target organisms (National Research Council, 2002).

The potential of nontarget effects of GM plants on soil organisms, including microbial processes, nutrient cycling, and microbial diversity, is a cause of considerable concern in environmental risk assessment of these crops. Although a limited number of previous studies demonstrated that GM plants can affect soil and microbial communities, results must be interpreted with caution because the environmental impact of these plants may be subject to several factors, including variations in climate, soil chemical and physical properties, and plant growth rate, that occur under field conditions (Dunfield and Germida, 2003).

As the number and variety of GM crops increase and as land area devoted to production of GM crops continues to expand, it is important that a defined system is in place to screen for potential unwanted nontarget effects. Agricultural scientists will be challenged by producers and stakeholders to provide information for improving current environmental assessments of GM crops.

Most environmental assessment studies for GM crops have focused on potential aboveground effects. However, the belowground component may also be significantly affected by GM crops because soil-borne microbial communities are largely responsible for ecosystem functions such as nutrient cycling and decomposition. The complexity of the soil system and the inability to culture most soil microorganisms has contributed to the difficulty in studying soil microbial communities and often resulted in their omission in environmental assessments of GM crops. Recent methodological advances, including new molecular biological techniques, are aiding to better describe and understand soil microbial communities (Kowalchuk et al., 2003). Such advances in soil ecosystem research will improve the information available to determine environmental impacts of GM crop production.

The symposium highlighted concepts and state-of-the-art knowledge of the effects of crops genetically modified for insect and herbicide resistance on soil and rhizosphere microbial communities and processes. Also of interest were the impacts of genetic traits for improved nutrient uptake and the indirect effects of management practices associated with GM crops on soil microbial communities. Several gaps in our knowledge that impede our full understanding of GM-crop-induced effects were highlighted. In an attempt to overcome these knowledge gaps, several papers described technological advances that couple microbial identity and function and new techniques in microbial community analysis that should provide tools for more complete assessments of GM-induced effects on plant–soil systems.

We hope that the symposium articles presented in this issue serve as valuable information sources for those interested in improving assessment of the effects of GM crops on the soil ecosystem and that this information will be used to develop more effective environmental assessment strategies.

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