Biotech-Crops and their Utilization in Plant Protection against Diseases and Pests

Introduction

Domestication of cultivated plants and development of a new cultivars are long-lasting human-directed processes. All domesticated crops have been developed from wild ancestors. Early farmers and gatherers modified wild and weedy plant species into crops through a complex process of a selection. Many of the products of selection have become crop species sufficiently altered from their ancestors that they can be considered to be domesticated (Brown & Caligari 2008). After initial domestication events, further human activities lead to the selection of landraces, i.e. populations of crop species adapted to local conditions and community needs. However, until about a century ago, all these processes and activities were very gradual and generally long-lasting, but not based on systematic scientific research (Hancock 2012). At the end of 19th century, the foundation of modern plant breeding was laid. It was based on the ideas of Charles Darwin regarding the differential survival and reproduction of better adapted types and on the discoveries of Gregor Mendel regarding the genetic control and inheritance of various plant characteristics. These two crucial concepts still provide the scientific foundation of modern plant breeding. Modern day crops have shown significant yield and quality increases over the past century. However, this substantial progress is a result of a combination of plant breeding and simultaneous improvements in crop husbandry (Brown & Caligari 2008). And we have gradually learned that the classical plant-breeding methods developed at the turn of the 20th century do have some limitations.

During the last few decades, significant progress has been made in the development and application of new biotechnological approaches to agriculture and plant breeding (Altman & Hasegawa 2012) that can exceed the limitations of earlier approaches. Biotechnology can be considered as a series of enabling technologies, which each involve the manipulation of living organisms or their subcellular components to develop useful products, processes and services. Biotechnology encompasses a wide range of fields, including the life sciences, chemistry, agriculture, environmental science, human and veterinary medicine, engineering, and informatics. Plant biotechnology encompasses applications of a wide range of scientific discoveries involving the elucidation and manipulation of genetic and developmental systems in plants (Murphy 2011). This umbrella covers a broad spectrum of technologies, including plant tissue and cell cultures, monoclonal antibody production, recombinant DNA technology and/or genetic engineering, bioprocess engineering, and bioinformatics (Newel-McGloughlin & Re 2007; Altman & Hasegawa 2012). Recent biotechnologies are among the most exciting, cutting-edge applications of contemporary biological science. According to Murphy (2011), modern biotechnology can be separated into several different categories depending on the type of organisms being manipulated and/or the market sector of the end product. He pointed out that by no means do all modern biotechnologies involve transgenic methods or the creation of GM (genetically modified) organisms. The terms of plant biotechnology and GM crops are clearly not synonymous. Transgenesis is only one of several sophisticated biotechnological tools available to the modern plant breeding (Murphy 2011). From that perspective, the reader will understand why we used the term Biotech-crops in the present volume in this broader sense, and not only for GM plants.

One of the most significant impacts of recent plant biotechnologies is seen in breeding of crops with improved pest and disease resistance and in the production of disease-free plants (Walters 2009). Those key developments motivated the Czech Society for Plant Pathology to organise the workshop *Biotech-crops and their utilization in plant protection against diseases and pests*, as a part of the XIXth Slovak and Czech Plant Protection Conference, held in Nitra (Slovak Republic) on 6th September 2012. The main purpose of this workshop was to bring together Czech and Slovak plant pathologists and breeders for the first time who could contribute to this general topic, as well as address emerging concepts and recent findings from pertinent international research. In total, eight lectures were presented at this workshop and six of these form the core of this special issue of Plant Protection Science.

L. Horváth *et al*. (Central Control and Testing Institute in Agriculture and Slovak Inspectorate of Environment, Bratislava, Slovak Republic) summarised information about the cultivation of biotech-crops, the control of coexistence, and the environmental monitoring of GM plants in Slovakia. The cultivation of GM crops for commercial use in Slovakia began in 2006, with cultivated GM maize hybrids based on the MON 810. P. Mihalčík *et al.* (Plant Production Research Center, Piešťany, Slovak Republic, Monsanto Czech Republic, and Monsanto Slovakia) focused on the efficiency of border rows to prevent the adventitious presence of GM maize in non-GM maize plots, as well as the response of the MON 810 at three locations across Slovakia. J. Nedělník *et al.* (Agricultural Research, Troubsko and Mendel University in Brno, Brno, Czech Republic) presented an overview of literature reports related to Bt maize versus non-Bt maize, emphasising changes in fungal microflora spectra and mycotoxin content. The main focus was given to *Fusarium* spp. mycotoxins, including fumonisins (FUM), deoxynivalenol (DON), and zearalenone (ZEA). F. Kocourek and J. Stará (Crop Research Institute, Prague, Czech Republic) shared the results of field trias conducted between 2002 and 2008, designed to evaluate the efficacy of Bt maize MON 810 and *Trichogramma* wasp against European corn borer (ECB) (*Ostrinia nubilalis*). Ľ. Cagáň and I. Rosca (Slovak Agricultural Universityin Nitra, Nitra, Slovak Republic, and University of Agronomic Science and Veterinary Medicine, Bucharest, Romania) showed the results of a field trial of eight maize hybrids, including coleopteran-protected MON 88017, the lepidopteran-protected MON 89034, the stacked product, MON 89034 × MON 88017, and five conventional and commercial controls. Bt maize hybrids containing MON 88017 strongly reduced levels of the *Western corn rootworm* (WCR), *Diabrotica virgifera virgifera*. J. Polák *et al.* (Crop Research Institute, Prague, Mendel University in Brno, Brno, Czech Republic, and INRA-Bordeaux, France) began by reviewing the history of Biotech/GM crops, including horticultural crops, and their commercialisation. The second part of their paper focused on the development of the transgenic HoneySweet plum with resistance to *Plum pox virus* (PPV). All six contributions are presented as full papers in this special issue of Plant Protection Science.

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