Symposium Session IV : Plant Disease Resistance

SIV-1

Risk assessment of genetically modified organisms and its regulatory framework in Korea

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Since the development of the first transgenic plant, health and environmental issues concerning the safety of genetically modified crops have been raised. The main concerns regarding genetically modified (GM) crops include the production of toxins allergy-causing substances, changes in nutrient levels, and the development of antibiotic resistance. Gene flow, and the effect of GM crops on non-target organisms, are among the important environment issues. In an effort of manage globally-debated issues about genetically modified organisms (GMOs), Korea passed the Law on Transboundary Movement of Living Modified Organisms (LMOs) on March 2001 based on the adoption of Cartagena Protocol on Biosafety that adopted in January 2000. The said Law was established by the Ministry of Industry, Commerce, and Energy (MICE), as Presidential Decree No. 6448. New regulation of MICE include government approval procedures for commercialization of GMOs, the safety assessment procedures, identification of GMOs, operation of Biosafety Committee, Safety standards for the research facility involved with GMOs, and enforcement of regulation.

GMO approval procedure for research trial

Once GM crop has been developed within the confinements of the laboratory, it may become necessary to continue the research by conducting field experiments including greenhouse tests. According to the Enforcement Ordinance of MCIE's new Law on GMOs, those who want to carry out research trials involving rDNA to develop GMO in Korea not only by government research institutes but also by the universities and private companies must obtain permission from relevant government agency. For those crops that contain disease resistant gene, for example, the Ministry of Agriculture and Forestry is responsible for the approval of GMOs for research trial to be released into the environment in Korea.. Based on the Enforcement Ordinance of the Law on Transboundary Movement of Living Modified Organisms, MAF is now in the process of setting up related guidelines that deals with approval process for research trials involving rDNA.

Although, it is not applicable for the whole nation at this moment, Rural Development Administration, an affiliate of the MAF, which is responsible for the agricultural research and extension work in Korea, has been operating guidelines called "Guidelines of research involving recombinant DNA technology and handling of GMOs in Agricultural Application" since 1999. The purpose of setting up of this guideline is to secure the safety of researchers who conduct agricultural research involving rDNA technology in the laboratory, greenhouse and field conditions as well. According to the guidelines, applicants must submit relevant information on the GMO materials to be released into the greenhouse and field to the Institutional Biosafety Committee (IBC) consisting of internal or external experts in the areas of molecular biology, ecology, plant breeding, plant pathology, plant physiology, and entomology. Head of research institutes or experiment stations of RDA must designate the IBC to oversee the safety of GMOs to be handled in the laboratory or to be released into the greenhouse and field. The application has to include information on the nature of the GMO, how it has been modified, the precise nature of the research program proposed, where the GMO will be released and how the release will be monitored. The applicant must also supply information necessary for evaluating foreseeable risks, whether they are immediate or delayed, from the release of the GMO. Detailed information is reviewed by scientists in each research organization's IBC members whether planned release of GMOs might affect the surrounding environment. IBC members of each research organization assesses the potential implications of proposed GMO release very carefully, including possible toxic or allergenic effects, and the possible impact on soils and non-target organisms such as bees and other beneficial insects. If committees are satisfied that the release of GMO poses a very low risk then field trials are approved. Based on RDA's research guidelines, each institute or research station must operate the IBC and only those GMOs that got IBC's approval can continue research in greenhouse, or in the confined field. For example, IBC of National Institute of Agricultural Biotechnology, one of the 10 research institutes of RDA has approved the field research trials of 21 cases including gene flow studies of herbicide resistant rice and 35 cases of laboratory research under RDA guidelines in May, 2003.

Approval of GMO for marketing and production

Another new law on the movement of GMOs in Korea is the "Guidelines for Environment Risk Assessment of GMOs". A range of GM-derived agricultural products, including seed, grain, microbes, animal feed and feed additives, are target items for new guidelines in Korea. They require that bioengineered agricultural products, whether domestic or imported, must receive safety clearance from the Minister of Agriculture and Forestry before being distributed locally. According to the Guidelines, the Minister should authorize the Administrator of the Rural Development Administration (RDA), an affiliate of the Ministry of Agriculture and Forestry, to perform the review process. Therefore, those seeking to sell GMOs that are intended for direct use as food, feed or cultivation purposes, must submit an application to the RDA to verify that the products do not harm the

environment. Applications can be reviewed by the public for 30 days. This gives members of the public the opportunity to provide relevant information and express their opinions. RDA will give notice of the results of the inspection to applicants within 270 days of receiving the application. According to the guidelines, RDA established a special inspection committee. This committee consists of 15 members working in agriculture, plant breeding, entomology, molecular biology, ecology, and anti-GMO group.

As of June 2004, a total of 11 GMO events of 3 crops have been applied for the environmental safety approval. GMOs under being reviewed by the environment safety authority, the Rural Development Administration (RDA), are 1 herbicide tolerant soybean, 2 insect resistant maize, 3 herbicide tolerant maize, 1 herbicide/insect resistant maize, 1 herbicide tolerant cotton, and 3 insect resistant cotton. Among them, Roundup Ready Soybean(GTS-40-3-2) and insect resistant maize(Mon 810) of Monsanto have been officially cleared for their environmental safety on May 18, and on June 4, respectively by environmental safety authority. Besides the Monsanto Korea, Bayer Crop Science, and DuPont Korea are among the applicants for the environment safety approval. Information on approval status of GMO environment Risk Assessment is available at the RDA homepage of http://www2.rda.go.kr/gmo/english/e_index.asp.

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SIV-2

MAP kinase kinase kinase as a positive defense regulator in rice-blast fungus interactions

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Abstract

We have found the role of rice mitogen-activated protein kinase kinase kinase (MAPKKK), *OsEDR1*, as controlling hypersensitive response (HR) and increased disease resistance to rice blast fungus *Magnaporthe grisea*. Generation of transgenic rice plants through introduction of the over-expression construct of *OsEDR1* using *Agrobacterium*-mediated transformation results in lesion mimic phenotype. Up-regulation of defense mechanism was detected through detection of increased transcription level of rice *PBZ1* and *PR1a*. Inoculation of rice blast fungus on the lesion mimic transgenic lines displayed significantly increased resistance. The disease symptoms were arrested like HR responses which are commonly detected in the incompatible interactions. High accumulation of phenolic compounds around developing lesions was detected under UV light. There was variation among transgenic lines on the timing of lesion progression as well as the lesion numbers on the rice leaves. Transgenic lines with few lesions also show increased resistance as well as equal amount of grain yields compared to that of wild type rice cultivar Nipponbare. This is the first report of the MAPKKK as a positive regulator molecule on defense mechanism through inducing HR-like cell death lesion mimic phenotype. The application of *OsEDR1* is highly expected for the development of resistant cultivars against rice pathogens.

Introduction

Disease resistance mechanism of plant has been a major research area for many scientists in order to solve the yield loss problems by pathogens. Breeders have been trying to generate resistant cultivars through introgression of resistance genes which confer complete resistance into the customer most wanted, but susceptible cultivars. There have been many reports on cloning and functional analysis of *R*-genes for the purpose of using them for molecular breeding sources of various plants (*Dilbirligi* et al., 2004). But, as proved by the breeding programs so far, a simple introgression of *R*-genes into the susceptible cultivars for generating resistant one result in resistance breakdown through the appearance of new races infecting *R*-gene-mediated new resistant cultivars (Kiyosawa, 1982; Bonman et al., 1986). This unexpected disease occurrence brings the necessity of developing durable resistant cultivars.

There are two types of resistance which has different level of defense against disease. The one is field resistance which is manifested by synergistic effect of multi gene products having individual role in defense activities (Parlevliet, 1983). This has an advantage in durability, but unfortunately, it show partial resistance (Ezuka, 1972; Yeh and Bonman, 1986). The characteristics of partial resistance are slow disease development and less lesions, and that reduces the epidemic potential (Roumen, 1994). Because of the generic disadvantage of *R*-gene-mediated resistance, field resistance is regarded as an alternative method for