

REVIEW

Technology Development for Stable Agricultural Production under Adverse Environments and Changing Climate Conditions

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Abstract

The second of the United Nations' 17 Sustainable Development Goals aims to end hunger, achieve food security and improve nutrition, and promote sustainable agriculture. However, it is well known that the agricultural potential in developing regions including Africa has not been fully realized because adverse environments and changing climate conditions impose abiotic (e.g., low soil fertility, droughts) and biotic (e.g., pests, diseases) stresses on plant growth and development. To ensure food and nutrition security in such regions, the Environmental Stress-tolerant Crops project, the High-yielding Biomass Crops project and the Pest and Disease Control project in the Program for Stable Agricultural Production at the Japan International Research Center for Agricultural Sciences aimed to develop technologies and crops with high productivity and adaptability to adverse environments and changing climate conditions. In order to develop crops with environmental stress tolerance and disease resistance, we have clarified and used the genes and loci involved in these traits toward the development of breeding materials. And in order to develop technology for effectively controlling transboundary pests, we have elucidated the ecology of their occurrence and developed pest management technology based on that information. We hope that these materials and technologies will contribute to achieving food and nutrition security in developing regions.

Discipline: Crop Science

Additional key words: biomass, breeding, rice, soybean, sugarcane

Introduction

There are concerns that global strains on the supply and demand for food may occur in the medium to long term, owing to the increase in global population, chronic malnutrition in developing countries, projected economic growth in emerging countries, and increasingly abnormal weather (United Nations 2019, World Food Programme 2020). The second of the 17 Sustainable Development Goals (SDGs) developed by the UN calls on all nations to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture." In developing regions such as the tropics, many agricultural lands face such adverse environmental conditions as low fertility, high temperature, drought, and salinity, and are

particularly vulnerable to the adverse effects of climate change. For instance, droughts occur frequently around the world. In the past, crops such as rice and soybean have been severely damaged due to drought stress, and there are rising concerns about the adverse effects of climate change (Kim et al. 2019). It is thus necessary to promote sustainable agricultural production activities in developing regions where the potential for agricultural production has not been fully realized.

Recent estimates indicate that damage to crops due to plant pests accounts for 20%-40% of losses in global food production (FAO 2019a). Climate change, global warming, and the globalized movement of people and goods contribute to the spread of transboundary plant pests and diseases, worsening the damage that is creating

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Received 8 July 2020; accepted 3 December 2020.