Editorial Overview

Innovative technologies in flower breeding

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Induced mutations and genetic engineering are highly effective techniques to enhance genetic variation and have successfully assisted in the development of improved and new cultivars among ornamental plants and crops. To give a perspective for transgenic plant-based breeding in the near future, this issue presents a portion of the results and technical advances of two individual research projects, "Establishment of Efficient Molecular Breeding System and Production of Novel Flowers using Chimeric Repressor Silencing Technology (CRES-T, grant no. 1782)" and "Mutation Breeding using Heavy-Ion beam on Transgenic Flowers (1783)" in the funding program named "Research Project for Utilizing Advanced Technologies in Agriculture, Forestry, and Fisheries" from the Research Council, Ministry of Agriculture, Forestry and Fisheries of Japan. Researchers working under these projects contributed their recent advances that may facilitate the improvement of flower traits.

These two projects are categorized under the subprogram "Interministry Liaisoning Research" started in 2005, which facilitates the utilization of seeds from other research fields for agricultural purposes. Our projects seemed to have great prospects to achieve public acceptance of genetically modified organisms (GMOs), because half of the four projects adopted in 2005 were flower-oriented projects. Therefore, the studies in this issue focused not only on the advances in transgenic technologies, methods for efficient production of varieties, and basic research for facilitating them, but also in the recent movement of environmental assessment to adapt the domestic law for the implementation of the Cartagena Protocol on Biosafety (Kikuchi et al.) as well as their applications in chrysanthemum (Shinoyama et al.). In addition, the importance of transgenic plants in future breeding was reviewed (Shibata).

Plant breeding is now approaching a new step to facilitate the production of GMOs with valuable traits by combining molecular breeding with novel technologies and/or traditional breeding methods. In order to do so, we have to discover appropriate procedures for each material as well as for desired phenotypes. In this study, for example, we describe the ability of the CRES-T to achieve gene silencing against the redundancy of transcription factors or the multiploidy of plant materials. We also describe the advantages of heavy-ion beam irradiation, one of the most remarkable mutation technologies which have been developed in Japan. Atomic ions accelerated by particle accelerators have high energy and induce mutations at high efficiency and wide variation even under low exposure doses and short irradiation times. Heavy-ion beam irradiation on transgenic flowers with modified petal colors yielded a number of new color traits exceeding our expectations, and provided new findings to contribute to academic advances.

Transgenic technologies enabled valuable traits to be conferred on many important crops, and some of them are indispensable to our lives. However, most of these genetically modified plants make high profits due to the great demand from consumers, and were produced against enormous costs and risks for clearing many kinds of regulations. Our studies may provide a key to change such a situation and facilitate the commercialization of GMOs. Standardization of assessment procedures might be required to make it reliable and cost-effective, not only for horticultural flowers but for all crops. In addition, centralization and corporatization of affairs, attaining public acceptance, and educational/cultural proposition would be required.

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