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Chapter 7 - Next-generation genetic engineering tools for abiotic stress tolerance in plants

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Abstract

Population growth is the increase in the number of individuals in a population. Growth of the human population globally is about 83 million annually and it is anticipated that the population is going to reach 7.774 billion in 2020. The Intergovernmental Panel on Climate Change has anticipated that food and environmental security will be a big challenge, due to the extreme events of abiotic stress under the changing climate. On the other hand, genetic improvement of crops through conventional breeding is a slow and difficult process, causes high heterozygosity, prolongs juvenile periods, and is also inconsistent. Besides conventional development of crop species to attain the food and nutritional security of the increasing population, next-generation new biotechnological tools (NBTs), namely genetic engineering (GE), may be a useful tool for the sustainability of crop production under the changing climate. Scientists revealed that NBTs/GE may be useful for the induction of desired agronomic and breeding traits through the inclusion of responsible genes into the genome. NBTs/GE has been practiced for more than three decades through direct transformation methods (biolistic) and indirect methods (*Agrobacterium tumefaciens*-mediated transformation) as primary strategies for the introduction of heterologous DNA into plants. All genetically modified crops generally use one of these methods, since NBTs/GE methods are able to maintain a high stability of the major traits of the clone. Breeding of genetically modified plants through the introduction of desirable agronomic and quality traits by utilizing NBTs/GE has been found to be apposite for many crops. The present chapter will discuss the concept, methods, and mechanism of NBTs/GE for improvement of crop species against abiotic stresses for meeting the food and nutritional security of the increasing population.