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Genetically Engineered Crops: Solution for Biotic and Abiotic Stresses in Crop Production

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Abstract : Production and productivity of several crops in the country continue to be adversely affected by biotic (e.g., Insect-pests and diseases) and abiotic (e.g., water temperature and salinity) stresses. Over-dependence on pesticides and other chemicals is economically non-viable for the resource-poor farmers of our country. Further, pesticides can potentially affect human and environmental safety. While traditional breeding techniques and proper- management strategies continue to play a vital role in crop improvement, we need to judiciously use biotechnology approaches for the development of genetically modified crops addressing critical problems in the improvement of crop plants for sustainable agriculture. Modern biotechnology can help to increase crop production, reduce farming costs, and improve food quality and the safety of the environment. Genetic engineering is a new technology which allows plant breeders to produce plants with new gene combinations by genetic transformation of crop plants for improvement of agronomic traits. Advances in recombinant DNA technology have made it possible to have genes between widely divergent species to develop genetically modified or genetically engineered plants. Plant genetic engineering provides the strength to harness useful genes and alleles from indigenous microorganisms to enrich the gene pool for developing genetically modified (GM) crops that will have inbuilt (inherent) resistance to insect pests, diseases, and abiotic stresses. Plant biotechnology has made significant contributions in the past 20 years in the development of genetically engineered or genetically modified crops with multiple benefits. A variety of traits have been introduced in genetically engineered crops which include (i) herbicide resistance. (ii) pest resistance, (iii) viral resistance, (iv) slow ripening of fruits and vegetables, (v) fungal and bacterial resistance, (vi) abiotic stress tolerance (drought, salinity, temperature, flooding, etc.). (vii) quality improvement (starch, protein, and oil), (viii) value addition (vitamins, micro, and macro elements), (ix) pharmaceutical and therapeutic proteins, and (x) edible vaccines, etc. Multiple genes in transgenic crops can be useful in developing durable disease resistance and a broad insect-control spectrum and could lead to potential cost-saving advantages for farmers. The development of transgenic to produce high-value pharmaceuticals and the edible vaccine is also under progress, which requires much more research and development work before commercially viable products will be available. In addition, molecular-aided selection (MAS) is now routinely used to enhance the speed and precision of plant breeding. Newer technologies need to be developed and deployed for enhancing and sustaining agricultural productivity. There is a need to optimize the use of biotechnology in conjunction with conventional technologies to achieve higher productivity with fewer resources. Therefore, genetic modification/ engineering of crop plants assumes greater importance, which demands the development and adoption of newer technology for the genetic improvement of crops for increasing crop productivity.

Keywords : biotechnology, plant genetic engineering, genetically modified, biotic, abiotic, disease resistance
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