Global Science Research Journals

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International Review of The Agricultural World

Opinion Article Open Access

ISSN:2705-1447 Vol. 1 (2), pp. 2, August, 2022

Improving agronomic traits through plant breeding techniques

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Received: 11-Jul-2022, Manuscript No. IRAW-22-73169; **Editor assigned:**13-Jul-2022, Pre QC No. IRAW-22-73169(PQ); **Reviewed:** 28-Jul-2022, QC No. IRAW-22-73169; **Revised:** 04-Aug-2022, Manuscript No. IRAW-22-73169(R); **Published:** 11-Aug-2022, DOI: 10.15651/2705-1447.22.1.007.

DESCRIPTION

Plant breeding is broadly defined as the process of identifying and selecting desirable traits in plants and combining them into a single plant. Plant breeding based on observed variation involves selecting plants based on natural variants found in nature or within traditional varieties; plant breeding based on controlled mating involves selecting plants with recombination of desirable genes from different parents; and plant breeding based on monitored recombination involves selecting specific genes or marker profiles. Traditional breeding is one of the most common methods for improving agronomic traits. The continuous application of traditional breeding methods in a given species could lead to the narrowing of the gene pool from which cultivars are drawn, rendering crops vulnerable to biotic and abiotic stresses and hampering future progress. Several methods have been devised for introducing exotic variation into elite germplasm without undesirable effects. Cases in rice are given to illustrate the potential and limitations of different breeding approaches.

Plant cell culture *in vitro* and plant regeneration from cultured cells certain isolated somatic plant cells can be cultured *in vitro* (in a test tube) and can proliferate and organize into tissues, eventually becoming complete plants. *In vitro* regeneration refers to the process of regenerating whole plants from plant cells. Plant regeneration is influenced by three factors: genotype, explant source, and culture conditions, which include culture medium and environment. To regenerate plants from cultured cells and tissues, various mixtures of plant hormones and other compounds in varying concentrations are used. Because plant hormonal mechanisms are still incompletely understood, the development of *in vitro* cultivation and regeneration systems is still heavily reliant on empirically testing variations of the three factors mentioned above.

Selection *in vitro* and somaclonal variation plants regenerated from cell cultures may have phenotypes that differ from those of their parent plants, and this can happen quite frequently. If such "somaclonal variation" is heritable and affects desirable agronomic traits, it can be incorporated into breeding programmes. Finding specific valuable traits, on the other hand, is largely left to chance and thus inefficient selection *in vitro*, as opposed to this undirected process, targets specific traits by subjecting large populations of cultured cells to the action of a selective agent in a petri dish. Photoperiods (light and dark cycles), temperature, carbon source, plant growth regulators, macro and micronutrients, vitamins, and water are all *in vitro* parameters that affect plant growth. A number of new plant breeding techniques have been developed and classified as NPBTs. Zinc finger nuclease technology, oligonucleotide-directed mutagenesis, cisgenesis, intragenesis, RNA-dependent DNA methylation, grafting on genetically modified rootstock, reverse breeding, agro-infiltration, and synthetic genomics are examples of these.

CONCLUSION

The advent of scientific plant breeding has accelerated the rate of varietal improvement, and it is difficult to predict the limits of this approach at this point. Molecular tools now allow for the monitoring of the dynamics of genomic recombination, allowing for a gene-by-gene breeding approach. Advances in *in vitro* culture, genome sequencing, and functional studies have aided in improving the application of molecular breeding techniques in many crops, as have many of the methodologies and protocols that employ NPBTs. NPBTs are powerful tools used to improve quality traits without modifying the characteristics of elites in citrus, and to protect the world citriculture from the most aggressive and devastating disease.