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*Mini Review*

# A Comprehensive Analysis of Mutation's Role in Plant Genetic Improvement

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**Abstract**

In vitro culture instability can lead to genetic and epigenetic changes in crops called somatic mutations. These changes can also have positive effects. For example, it can be used in breeding programs to create new breeds with desirable traits. This article presents a systematic review aimed at answering the following questions do somatic mutations contribute to genetic improvement in plants? Five electronic databases were searched for articles based on predetermined inclusion and exclusion criteria and standardized search strings. Somatic mutation techniques have been most commonly applied to ornamental plants, with 49 species cited in 48 articles, in various countries around the world, such as sugar cane, rice, banana, potato and wheat. Sixty-nine studies used the technique to assess genetic diversity generated among clones, and 63 studies assessed agricultural performance traits. Other studies relate to resistance to pathogens, ornamental properties, and resistance to abiotic stress. Application of the plant growth regulators (PGRs) benzylaminopurine (BAP) and dichlorophenoxyacetic acid (2,4-D) is the most common method for generating somaclones, and randomly amplified polymorphic DNA ( RAPD) molecular markers were the most commonly used markers for identification and characterized. Somatic mutations are used in genetic improvement programs in the world's most economically important crops to create genetic diversity and support the introduction of new genotypes resistant to disease, pests and abiotic stresses doing. However, much remains to be explored, such as the genetic and epigenetic mechanisms underlying somatic mutations.

**Keywords:** Genetic improvement, Tissue culture, Somaclonal variation, DNA markers

## INTRODUCTION

Plant diseases caused by plant pathogens cost the global economy more than $220 billion annually. Invasive pests cost the world at least $70 billion, not to mention biodiversity loss from pathogens. Additionally, abiotic factors such as water scarcity, salinity and temperature extremes are costing global agriculture around $30 billion [1]. This reality threatens the food security of some countries and hurts smallholder farmers and individuals living in areas where food security is not yet achieved.

Genetic improvement programs therefore look for ways to reduce the effects of diseases, pests, and abiotic stresses on agricultural crops by developing resistant or tolerant varieties [2-3]. Various strategies are used to achieve this goal. Plant cell and tissue cultures have traditionally been used for the production, maintenance, and enhancement of plant resources from asexual processes where clonal propagation is expected to produce genetically uniform plants. However, Braun made the first observation and the first report of cell- and tissue culture-derived mutations defined as somatic mutations. This was one of his biggest problems over the years. H. Maintaining Plant Genetic Fidelity from In Vitro Tissue Culture. However, in 1981 Larkin and Scowcroft identified somatic mutations as potential for crop improvement, which was later documented by other researchers [4].

Since then, new Somaclones in different cultures have been marketed with traits useful for breeding, such as pathogen resistance, abiotic stress tolerance and high productivity. Somatic mutations have been observed in which clones of genetically identical plants exhibit different

phenotypes after regeneration, with most explants undergoing microproliferation. It becomes more evident when cells are grown in culture for long periods of time and when explants/micropropagated plants suffer multiple subsequent subcultures. Initial studies focused on genetic and epigenetic variation, leading to the hypothesis that plant growth hormones such as auxins and cytokinins may be responsible for these observed genetic changes in plants. Other studies have explored the potential application of somatic mutations in horticultural crop improvement and described the current state of our understanding of genetic and epigenetic changes that occur during tissue culture [5]. To summarize the current state of knowledge on somatic mutation in plant breeding, this article presents a systematic review (SR) of research conducted over the past 16 years. The approach presented here uses the SR tool. The SR tool provides an overview of all available relevant evidence for the application of this tool in plant breeding. The main countries working on somaclonal mutations, the different cultures of somaclones produced worldwide, the purpose of the somaclones produced, the methods used to induce the somaclonal mutations, the number of subcultures, and the somaclonal mutations. Most commonly used PGRs to induce, and their dosages, preferred explants used, major phenotypic features observed in somaclones, commonly used in studies to detect somaclonal mutations Information on the molecular markers generated, and the gene expression of several generated somaclones is presented [6].

# RESULTS

## Screening of studies

Represents the PRISMA flowchart used to screen the articles analyzed in this review. Web of Science was the database that contributed most to this review, with 1,192 articles (27%). Eleven key articles were manually added to this review, reporting on the generation and study of somaclones with resistance to disease, abiotic stress, agricultural and molecular aspects. A total of 4351 articles were identified in the database, of which 882 were duplicates and 3725 were excluded during the selection process. In the extraction phase, all 629 articles were read and 410 were excluded because they did not meet the inclusion criteria. A total of 219 articles were selected for this SR [7].

## Bibliometric analysis

A literature map was constructed from the titles of the accepted articles (n=219). Between 2010 and 2015, the terms somaclonal variation, somaclonal variant and somaclonal variant predominated, suggesting trends in publications during this period. The term RAPD (Randomly Amplified Polymorphic DNA) is also common in studies published between 2005 and 2015, where this molecular technique has been used in previous studies and new approaches to molecular markers are now being explored indicates that you may be pursued. A second bibliographic map showed the five journals with the highest number of publications on somatic mutations. Plant Cell and Tissue and Organ Culture had the most publications, followed by African Journal of Science and Technology, In Vitro Cell and Developmental Biology – Plants, Plant Cell Report, and Euphytica [8].

# DISCUSSION

## Screening of studies

This SR comprises articles that aimed to generate somaclonal variants or study somaclones generated or marketed in the last 16 years. Therefore, many articles were eliminated in the extraction stage (410) because they dealt only with genetic variability without breeding purposes, where somaclonal variation is labelled in germplasm banks or in seedlings for field planting as an undesirable characteristic; in these cases, the objective is to ensure the genetic fidelity of plants. On the other hand, we included in our SR a set of 219 articles that deal specifically with the use of the technique for obtaining somaclonal variants with desirable characteristics to plant breeding programs. Although our study includes an extensively large number of articles, which makes it difficult to extract and discuss in detail all the data, we try to list the main data obtained in summary form to derive conclusions and tendencies regarding the proposed subject [9].

Began to be more frequent in the last two decades, when studies on the induction of somaclonal variation began to be developed for genetic breeding purposes. At this time, several journals focused on tissue culture and biotechnology publications began to publish articles using terms related to ``somatic mutation''. The modifications described in have been tested by in vitro culture to assess the genetic fidelity of plants to the original plant and were aimed at generating somaclones to be used for genetic improvement of crops. Not a thing. Therefore, the term "somacron" has been used more and more frequently for this purpose in recent years [10].

# CONCLUSIONS

A total of 219 articles published between 2007 and 2022 are included in this review, including numerous studies that generated somatic mutants from different cultures. In vitro-created genetic diversity in several plant species and crops has led to the emergence of traits associated with tolerance to biotic factors, improved agricultural performance, and tolerance to abiotic stresses. . Somatic clonal mutation has been used in genetic improvement programs in several crops around the world to generate genetic diversity and to produce major crops such as sugar cane, wheat, rice, potato, banana, ornamental plants and medicinal plants. New genotypes can be introduced into crops.

India, Pakistan, China, Egypt, Iran, and Brazil have the highest number of somatic mutation studies in the world. Studies on sugar cane, houseplants, and fruit trees were the most

common over the last 16 years. Studies on the induction of somatic mutations have focused on the identification of molecular genetic variants, selection of useful agronomic traits, pathogen tolerance, salinity tolerance, and water deprivation tolerance. Studies evaluating Somaclone for resistance to abiotic stresses such as lead tolerance, toxic metal tolerance and copper tolerance have also been cited. This indicates that the induction of somatic mutations has been studied from multiple perspectives in recent decades.

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