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STRESS BREEDING FOR CLIMATE CHANGE

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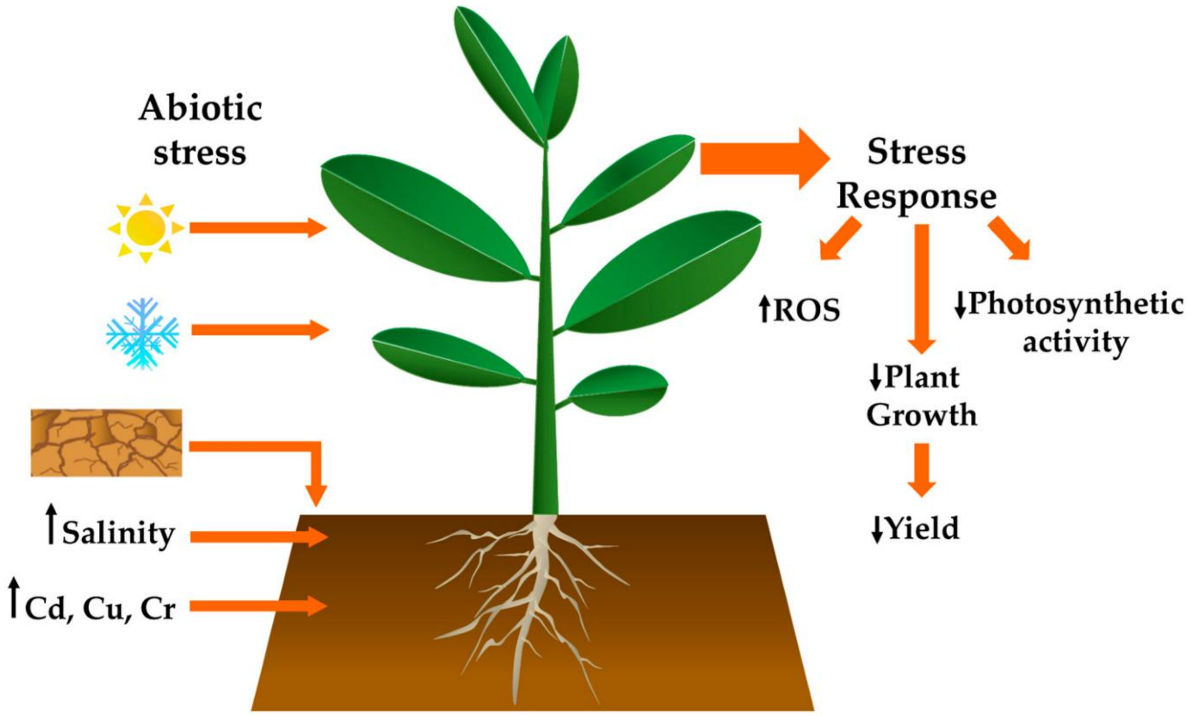
Stress Breeding is a term used to describe a process of plant breeding that involves exposing plants to stressful conditions in order to select for traits that enhance their ability to survive and thrive under those conditions. With climate change posing significant challenges to agricultural productivity and food security, stress breeding has become an increasingly important tool for developing crop varieties that can tolerate drought, extreme temperatures, and other environmental stresses.



(Source: Godoy *et al.*,2021)

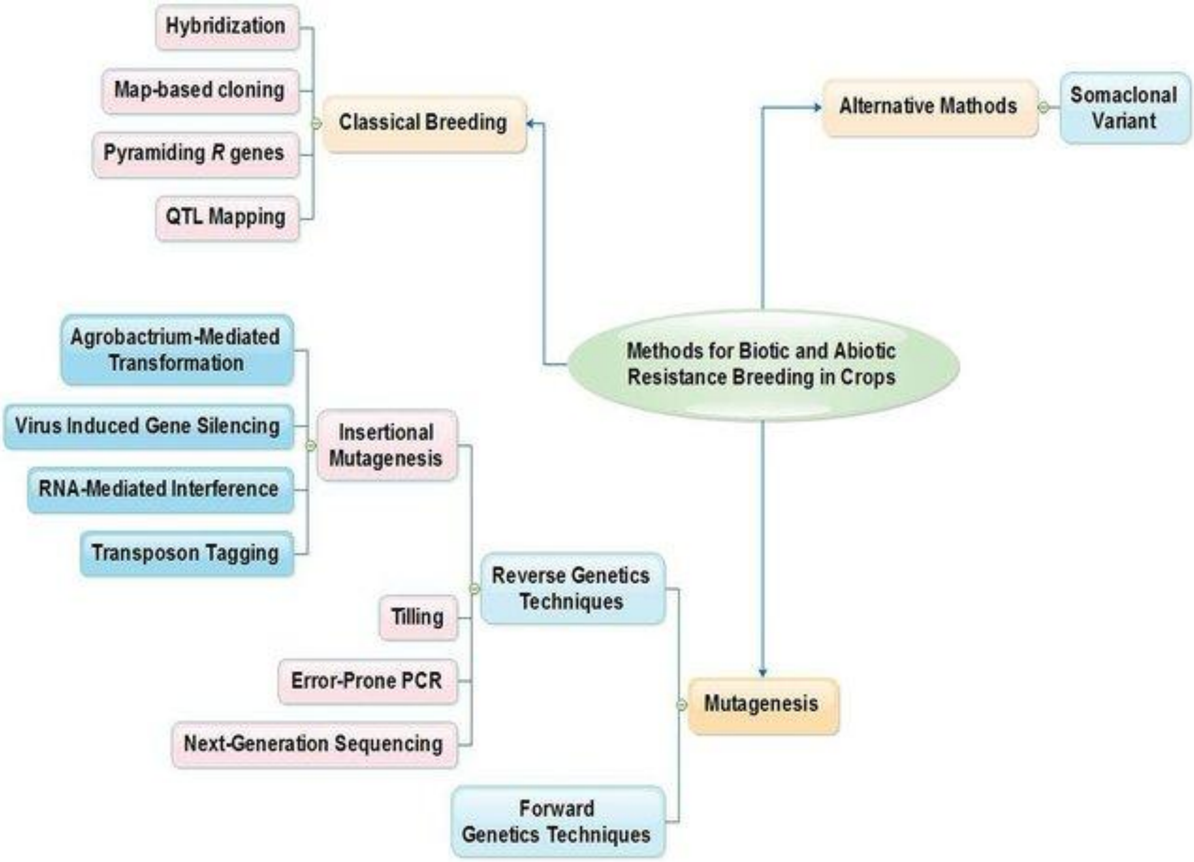
Stress breeding involves subjecting plants to different kinds of stress, such as drought, high temperature, or high salinity, and selecting the plants that perform best under those conditions. This process is repeated over several generations, with the goal of producing plants that have inherited the genetic traits that make them better adapted to those stresses.

Stress breeding can be done using traditional breeding methods, such as cross-breeding and selection, or through genetic engineering techniques that allow for more precise manipulation of plant genomes. In either case, the goal is to develop crops that can maintain high yields even in the face of challenging environmental conditions.

Some of the Commonly Used Breeding Methods for Abiotic Stress Include

1. **Conventional breeding:** This method involves crossing two or more plants with desirable traits to produce offspring that exhibit the desired traits. This method can be time-consuming and may require several generations to produce plants with the desired traits.
2. **Marker-assisted selection:** This method involves selecting plants based on specific genetic markers associated with the desired trait. This method allows for more precise selection and can reduce the time and resources needed for conventional breeding.
3. **Genomic selection:** This method involves using genomic data to predict the performance of offspring and select plants with the desired traits. This method can be useful for selecting plants with complex traits and can reduce the time needed for conventional breeding.
4. **Mutagenesis:** This method involves inducing mutations in the plant's genome using chemicals, radiation, or other methods. Mutagenesis can create novel genetic variation and can be used to select plants with improved abiotic stress tolerance.
5. **Genetic engineering:** This method involves introducing genes from other organisms into the plant's genome to confer desirable traits. Genetic engineering can be used to introduce genes that improve abiotic stress tolerance, such as genes for drought tolerance or salt tolerance.
6. **Recombinant DNA technology:** This method involves creating new combinations of genes by combining fragments of DNA from different sources. Recombinant DNA technology can be used to create new genetic variations that confer improved abiotic stress tolerance.
7. **Polyploidy breeding:** This method involves increasing the number of chromosomes in the plant's genome to create new genetic variation. Polyploidy breeding can be used

to select plants with improved abiotic stress tolerance, as polyploid plants often exhibit greater genetic diversity and higher tolerance to stress.



(Source: Ashkani *et al.*,2015)

Major Challenges Associated With Abiotic stress Breeding

Breeding for abiotic stress tolerance is a complex and challenging process that involves identifying, selecting, and developing plant varieties that can thrive under challenging environmental conditions, such as drought, salinity, extreme temperatures, and nutrient deficiency. Here are some of the major challenges associated with abiotic stress breeding:

- Complexity of abiotic stress: Abiotic stress is a complex phenomenon that can be caused by a range of environmental factors. Therefore, it is difficult to identify the specific genes or mechanisms that are responsible for conferring tolerance to a particular stress.
- Lack of genetic diversity: Many crops have narrow genetic diversity, which makes it difficult to breed for abiotic stress tolerance. This can limit the availability of useful traits to improve the crops' resilience to environmental stresses.

- Difficulty in phenotyping: Phenotyping plants for abiotic stress tolerance can be challenging, as it often requires growing plants under controlled conditions that mimic the environmental stress. This can be time-consuming and expensive, and it may also require specialized equipment and expertise.
- Time-consuming and costly: Developing abiotic stress-tolerant plant varieties is a time-consuming and expensive process. It can take many years to identify, select, and breed plants that are capable of withstanding challenging environmental conditions.
- Conflicting traits: Breeding for abiotic stress tolerance often requires trade-offs with other important traits, such as yield, quality, and disease resistance. This can make it difficult to balance the need for stress tolerance with the need for other desirable traits.
- Lack of effective screening methods: Screening large numbers of plants for abiotic stress tolerance can be a daunting task. There is a need for effective, high-throughput screening methods to identify plants with desirable traits quickly.
- Regulatory challenges: Developing new plant varieties can be challenging due to regulatory requirements for safety, efficacy, and environmental impact. These requirements can add time and cost to the development process.

Limitations

While stress breeding holds great promise for developing more resilient crops, there are also concerns about the potential negative impacts on biodiversity and ecological systems. Some experts have raised concerns that stress breeding could lead to the development of crop varieties that are highly specialized for specific environmental conditions, making them less adaptable to changing conditions in the future. Others worry that stress breeding could exacerbate existing inequalities by favouring large-scale agribusinesses that have the resources to invest in advanced breeding technologies.

Conclusion

Despite these concerns, stress breeding is likely to play an increasingly important role in the development of crops that can thrive in a changing climate. By selecting for traits that enhance stress tolerance and resilience, stress breeding offers a promising pathway for ensuring that food production can keep pace with growing demand while also mitigating the impacts of climate change.

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