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Perspective

Enhancing Durum Wheat Biotic Stress Tolerance Using Mutation Breeding

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DESCRIPTION

Durum wheat is a major cereal crop that provides food and income for millions of people around the world. However, durum wheat production is threatened by various biotic stresses, such as diseases, pests, and weeds that reduce yield and quality. To cope with these challenges, durum wheat breeders need to develop new varieties that are resistant or tolerant to biotic stresses, while maintaining or improving other agronomic and quality traits.

One of the methods that can be used to improve biotic stress tolerance in durum wheat is mutation breeding. Mutation breeding is a technique that uses physical or chemical agents to induce random changes in the DNA (Deoxyribonucleic Acid) of plants, creating genetic variation that can be exploited for crop improvement. Mutation breeding can generate novel traits that are not present in the existing gene pool, or enhance the expression of existing traits that are desirable for biotic stress tolerance.

Mutation breeding has been successfully applied to durum wheat for enhancing resistance to several diseases, such as leaf rust, stem rust, stripe rust, septoria tritici blotch, tan spot, fusarium head blight, and karnal bunt. For example, a study by Hassine et al. screened 70 M4 and 37 M5 mutants of durum wheat derived from three levels of gamma irradiation (100 Gy, 150 Gy, and 250 Gy) for disease resistance and quality traits. They found that some of the mutants at 150 Gy showed higher resistance to septoria tritici blotch, tan spot, yellow rust, and leaf rust, as well as better grain quality parameters, such as thousand kernel weight, grain protein content, test weight, gluten content, and wet gluten content. They concluded that gamma irradiation was a potential tool for creating new elite genotypes resistant to multiple biotic stresses and improving grain quality in durum wheat.

Mutation breeding can also be combined with other conventional or molecular breeding techniques to increase the efficiency and effectiveness of durum wheat improvement. For instance, mutation breeding can be used to create mutant populations that can be screened for desirable traits using phenotypic or molecular markers. Alternatively, mutation breeding can be used to introduce specific genes or alleles into durum wheat cultivars using backcrossing or gene pyramiding strategies. Moreover, mutation breeding can be integrated with genomic selection or gene editing technologies to accelerate the development of biotic stress tolerant durum wheat varieties.

Advantages of mutation breeding over other methods

- It is cost effective and quick, as it can generate a large amount of genetic variation in a short time and with low cost.
- It is proven and robust, as it has been successfully applied to many crops and traits for over 80 years, resulting in more than 3,200 mutant varieties released for commercial use.
- It is transferrable and ubiquitously applicable, as it can be used for any crop species and any trait that is controlled by genes.
- It is non-hazardous and environmentally friendly, as it does not introduce any foreign DNA or chemicals into the plants, and the radiation does not persist in the mutant plants or their offspring.
- It can eliminate an undesirable character from a crop variety or improve the morphological and physiological characteristics of cultivated crops.
- It can enhance the disease resistance of crop plants, which is important for food security and quality.
- It can create novel traits that are not present in the existing gene pool, or increase the expression of existing traits that are desirable for biotic stress tolerance.

In conclusion, mutation breeding is a valuable method for enhancing biotic stress tolerance in durum wheat. It can generate new sources of genetic variation that can be exploited for selecting and transferring favorable genes or traits into durum wheat germplasm. It can also be combined with other breeding approaches to increase the genetic gain and speed of durum wheat improvement. Mutation breeding can help shape durum wheat for the future by creating resilient varieties that can cope with the changing biotic stress scenarios and meet the growing demand for food security and quality.

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