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Feeding a Growing World: The Role of Speed Breeding in Improving Food Security

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SUMMARY

Speed breeding is a methodology that allows plant breeders to improve crop production by adjusting temperature, light duration, and intensity to boost plant development. It uses an artificial source of light, which is kept on continuously, to activate the photosynthetic process, which leads to growth and reproduction much earlier than normal. Speed breeding produces 3 to 9 generations per year against 1 to 2 generations per year with traditional selection methods. This will assist in meeting the demands of the future's rising population. This can be accomplished using a variety of technologies, including genotyping, marker-assisted selection, high throughput phenotyping; gene editing, genomic selection, and re-domestication, all of which can be combined with speed breeding to allow plant breeders to keep up with a changing climate and growing human population.

INTRODUCTION

Global food security is a major concern as the population grows and the environment changes. To feed the projected population of 10 billion by 2050, agricultural productivity must increase by 60%. Climate change leading to rising temperatures, floods and droughts can lead to new diseases and pests, requiring an effective plant breeding response. The current rate of crop improvement is inadequate to meet future demand. There is a need to increase the rate of genetic gain of critical food crops to ensure food security. Conventional breeding methods used in most crop improvement programs take more than 10 years to develop and release a new variety, delaying the process. To speed up this process, plant breeders have adopted different strategies like speed breeding to reduce the breeding cycle and shorten the time to develop, market and commercialize cultivars.

Speed breeding

Combining phenotyping with speed breeding for improving yield

Phenotyping is the assessment of complex plant traits related to growth, development, and all other features that serve as the foundation for complex trait assessment. Combining phenotyping with speed breeding allows multiple generations of plants to be grown in a shorter period of time, which accelerates the process of identifying and selecting plants of desired traits with accuracy. This approach can also help to save time and resources in crop improvement.

Integrated genomic selection with speed breeding for genetic gain enhancement

The fundamental benefit of using genomic selection is that it shortens the breeding cycle and creates higher-quality plant varieties in a shorter amount of time, improving genetic gain. combining genomic selection with speed breeding procedures has the potential to drastically speed up breeding efforts for many crops by increasing generation in a shorter time frame and can improve crop quality even more effectively.

Speed breeding for multiple disease resistance

Speed breeding is a powerful tool for developing crop varieties that are more resistant to diseases and pests. It allows multiple generations of plants to be screened in a shorter period of time. By using speed breeding in combination with techniques such as gene editing, researchers can quickly identify and introduce genetic variations that confer resistance to multiple diseases into a crop variety.

Combining gene editing with speed breeding for crop improvement

Gene editing is a technology that involves making changes to the genes of a crop species to improve its yield. One such tool is CRISPR/Cas system, which opens new possibilities for genetic diversity. It can change multiple targets at the same time. Employing this, a high-yielding variety can be produced; however, this

process takes a long time. Therefore, combining genome editing and speed breeding has the potential to overcome this crisis, and multiple generations can be produced in a single year.

Speed breeding for accelerating domestication

Speed breeding can be used to accelerate the domestication of wild plant species by producing multiple generations in a shorter period of time. This speeds up the selection for desirable traits and the evaluation of genetic variations for potential domestication. Speed breeding allows researchers to efficiently develop new domestic plant varieties that better suit human needs and environmental conditions.

Speed breeding in comparison with other breeding techniques

Speed breeding is a method used to accelerate the growth and development of plants. It allows for multiple generations of plants to be grown in a shorter period of time. Compared to traditional breeding methods, speed breeding offers the advantage of faster crop development and production. It can also help identify genetic variations with the most potential for domestication. It can be used in combination with other techniques such as gene editing to quickly develop new crop varieties with improved traits, such as disease resistance. However, traditional breeding methods such as hybridization, mutation breeding and selection are still important and provide a diverse range of genetic variation, and can be used to develop crop varieties adapted to specific environments. Speed breeding is more efficient for identifying the best genetic variations, and can be used in conjunction with traditional breeding methods.

CONCLUSION

The plant research community is working to improve plants at a large scale and quickly, to ensure food security for a growing population. Speed breeding accelerates the development of high-yielding, disease-resistant, and nutritious crop varieties. By reducing the time, space, and resources invested in the selection and genetic progression of superior crop varieties, speed breeding can hasten the production of high-performing cultivars with market-preferred features. Combining speed breeding with conventional, marker-assisted selection, and gene editing breeding procedures can help to improve crop breeding efficiency and ensure global food security for ever growing population.

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