



**Biotica
Research
Today**
Vol 3:12 ¹¹⁷²
2021 ¹¹⁷³

Speed Breeding: A Contemporary Era of Revolution

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Open Access

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Keywords

Commercialization, Genetic advancement, Pre-breeding, Resource utilization

Article History

Received in 26th December 2021

Received in revised form 29th December 2021

Accepted in final form 30th December 2021

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How to cite this article?

Dwivedi *et al.*, 2021. Speed Breeding: A Contemporary Era of Revolution. *Biotica Research Today* 3(12): 1172-1173.

Abstract

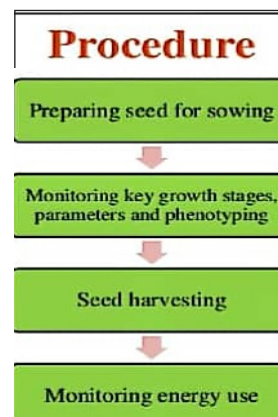
In the absence of an integrated pre-breeding programme, it takes more than ten (10) years for obtaining a new and high yield performing cultivar having desired characters with great market demand. So far, in the early phase of breeding a significant amount of space, time and resources invested in the selection and genetic advancement in crop improvement. Speed breeding has the potential to reduce the time required for cultivar development, release and commercialization. The objective of this article is to present key opportunities and challenges of speed breeding to guide pre-breeding and breeding programmes. Key challenges of speed breeding includes: access to suitable facilities, staff trained in the protocol, adopting major changes to breeding programme design and operations. The current article highlights the potential advantages of speed breeding for the successful development and release of cultivars in 5 years versus 10-12 years when using conventional breeding methods.

Introduction

The contemporary world has increases the gear with more work in least time from a quick solution to quick communication; everything is increasing its rate. This depicted that in future FASTNESS in another name MODERNIZATION. Thus, breeder tries to apply the same for plants, through speeding up their breeding cycle. Here comes the idea of speed breeding or accelerated breeding.

A technique which involves extending photoperiod and controlled growing conditions such as temperature, soil media, spacing *etc.* In glasshouses, enabling rapid generation advancement by shortening the breeding cycles. This technique was originally inspired by the US National Aeronautics and Space Administration (NASA) that promises to develop new crop varieties. Research scientists of NASA observed accelerated growth in short time period during working on wheat crop by providing artificial environmental condition (Watson *et al.*, 2018).

Procedure of Speed Breeding



First - Initially, the seeds are prepared for sowing by providing the proper treatment and environmental conditions.

Second - The significant growing stages are taken into consideration and specific emphasis is given to phenotyping of only those stages. Like the time of anthesis or flowering is observed and their associated parameters are taken into consideration.

Third - Mostly seed is harvested at an immature stage and then given specific cold treatment for maturation. Although the seed produces in this process are somewhat shrivelled on hydration but they regain their original shape and vigour in later stage and germinate properly. But this process reduces the time from 15 to 3 days.

Fourth - The energy monitoring helps us to be specific while providing light, temperature and other biological setups.



Figure 1: Representative flowchart showing procedure of speed breeding

Speed Breeding Set Up

Light: PAR region (400-700 nm), ambient lighting with LED

Photoperiod: 22 hours with 2 hours of darkness

Temperature: 22 °C / 17 °C for 22 hours light and 2 hours dark.

Humidity: Ideally 60-70% (Wanga et al., 2021)

Why Speed Breeding is Better One?

- Rapid generation advancement - shortens the development of variety by two year through the manipulation of growing conditions like good seed set in less time.

- In shuttle breeding - two generations per year can be taken which reduces the time of the cycle to just half.

- The double haploid production through bulbosum technique, anther or ovary culture or chromosome elimination techniques.

- MAS - gave authentication of the selected variety through phenotyping along with genotyping which increases accuracy of selection and minimize cost and time by few years (Fang et al., 2021).

Conclusion

Speed breeding or accelerated breeding can contribute to hasten the plant growth to accelerate, research and development by reducing breeding cycle. Speed breeding can merge with several other technologies to get the end results faster. With the success in speed breeding particularly in wheat crop, India can also initiate such facilities for quick development of new varieties.

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