

Speed Breeding and Its Role in Plant Breeding

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SUMMARY

The world population keeps on increasing but the cultivable area remains same, so in order to meet the demand for the increasing population, the production efficiency and production amount needs to be increased. Also the crops are being threatened by several insects and disease, so it again gave a negative impact on the production capacity of the plant. So, one way to meet the increase in the production with the same available area can be obtained through speed breeding programme. Speed breeding works on the principle to use optimum temperature, light intensity and daytime length control which will stimulate early flowering thus helps in shortening the generation time, thus can get a number of generations in one year Speed breeding thus provides a boon and helps in maintaining national food security by producing more number of yield per year with good quality production. So, it helps in producing more production which will meet the future demand.

INTRODUCTION

The population of the world keeps on increasing but the cultivable area remains same, so in order to meet the demand for the increasing population, the production efficiency and production amount needs to be increased. Also the crops are being threatened by several insects and disease, so it again gave a negative impact on the production capacity of the plant. Hickey *et al.*, 2019 also studied and found that the crop yield need so be increased by 25% over the next 30 years to meet the increasing demand of food with increasing population. Besides this, with the unpredictable and changing environmental condition, the production and cultivation of the crop and its productivity keeps on affecting and leads to decrease in its production potential. So, one way to meet with increased production with the same available land can be possible with through speed breeding programme.

Speed Breeding and Its Methods

So, speed breeding was first time used in the breeding of cereals, like wheat. The work of growing of plant in speed breeding was inspired by the concept of growing plants in the space under controlled environment condition in NASA, USA. Through this concept, started the cultivation of crops under controlled environment condition on spring bread wheat (*Triticum aestivum*), barley (*Hordeum vulgare*) durum wheat (*Triticum durum*), and the model grass *Brachypodium distachyon*. So in 2003, the term speed breeding came into existence to accelerate speed of wheat breeding as a combination of methods. Speed breeding protocol for crops differ from crop to crop. Speed breeding works on the principle to use optimum temperature, light intensity and daytime length control (22 h light, 22 °C day/17 °C night, and high light intensity) which will stimulate early flowering thus helps in shortening the generation time, thus can get a number of generations in one year [Watson *et al.*, 2018, Chiurugwi *et al.*, 2018].

Flowering is affected and largely dependent on the amount of wavelength and light intensity, so by manipulating the amount of light intensity and wavelength, the flowering in a plant can be triggered. Example, a number of varieties of early and late flowering genotypes are developed for chickpea, pea, lupins and faba beans by Croser *et al.*, 2016 by using far-red and blue improved LED lights and metal halide. The production of crops through speed breeding can be done through three methods. 1. Speed breeding-1: Speed breeding I uses controlled chamber environment for speed breeding. 2. Speed breeding-2: Speed breeding using glasshouse for speed breeding purpose. 3. Speed breeding-3: homemade low cost room design for low cost speed breeding (Watson *et al.* 2018). It was also found that the low concentration of red: far red light (e.g., from incandescent lamps) helps in increasing stem elongation but reduce lateral branching and flowering. Speed breeding in the early days were generally used to reduce the generation time by extending photoperiods, but in certain crops like radish (*Raphanus sativus*), pepper (*Capsicum annum*) and leafy vegetables like sunflower (*Helianthus annuus*) and Amaranth (*Amaranthus spp.*) respond in favour of increased day length (Sysoeva *et al.*, 2010).

Increasing the daylength in the vegetable crop, Amaranthus result in obtaining more number of generations annually. But in case of rice and maize which require a short day condition with shorter photoperiod, speed breeding helps in improving the vegetative growth. Speed breeding can also be used in those breeding

programme which require a successive generations of improved crops for examination in the field through SSD in the form of rapid generation advance (RGA) method which is again a cheaper method as compare to the double haploid production. Nowadays speed breeding is also used in the gene insertion method for the production of elite hybrid line of distinct phenotypes followed by MAS (Hickey *et al.*, 2017, Wolter *et al.*, 2019). Rapid generation advance (RGA) technology was used by Collard *et al.*, 2017 to shorten the generation cycle in rice from F2 to F6 generation to a short period of time as compare to the field condition. The RGA methodology just like the SSD methodology use the single plant selection is carried out and move to the forwarding generation by self-pollination to produce homozygous or fixed lines. But the only difference between RGA and SSD is that RGA use controlled condition to trigger early flowering and seed set as compare to the field condition (Ahmar *et al.*, 2020)

CONCLUSION

Speed breeding thus provides a boon and helps in maintaining national food security by producing more number of yield per year with good quality production. So, it helps in producing more production which will meet the future demand.

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