Genetic Engineering in Male Sterility for Hybrid Variety Development

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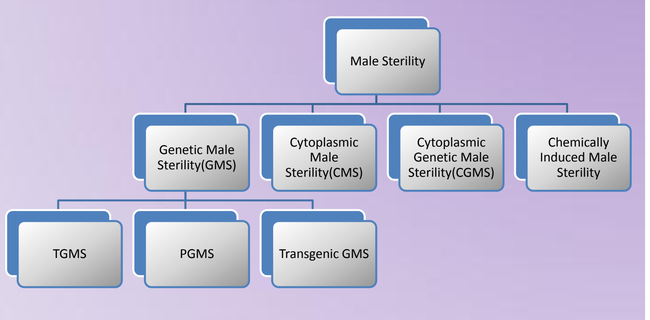
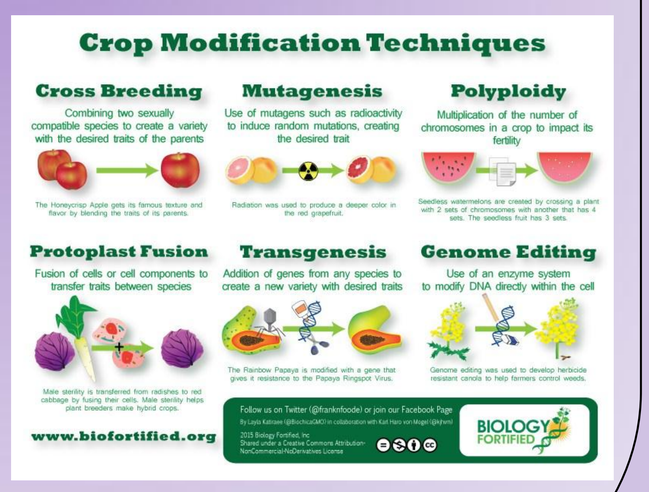
ABSTRACT

The development of strategies to improve crop plants by the production of hybrid varieties is a major goal in plant breeding. Hybrid progeny often have a higher yield, increased resistance to disease, and an enhanced performance in different environment compared with the parental lines. Availability of cost effective mechanism/ method to produce large scale hybrid seed utilizing selected parental line is one of the important factors which ultimately determine the commercial viability of hybrid varieties. Manual emasculation increased cost of production, so use of various genetic mechanism via; male sterility, self incompatible, gynoecious lines, use of sex regulators and chemical hybridizing agents based on relative importance in hybrid development. Among these, genetic emasculation tools male sterility is commonly used for hybrid production. Male-sterile transgenic plants can be obtained through genetic transformation with related genes destroying or interfering with pollen or anther development. Male sterile cauliflower, tomato, cabbage, etc. have been developed in this way, and some begin to be used to produce hybrid seed. Appling some techniques can also maintain and restore the male sterility. These related researches will effectively promote the heterosis utilization and the development of crop breeding.

INTRODUCTION

Male sterility is the failure of plant to produce functional anthers, pollen, or male gametes. The agricultural exploitation of hybrid crop varieties has enabled enormous increases in food productivity through increased uniformity and hybrid vigor. In 1763, the first documentation of male sterility came in Joseph Gottlieb Kolreuter observed anther abortion within species and specific hybrids. Male sterility is easy to detect because a large number of pollen grains are produced and are easily studied. Genetically engineered male sterility provides tremendous opportunities to the breeders for enforcing pollination control in hybrid seed production systems.





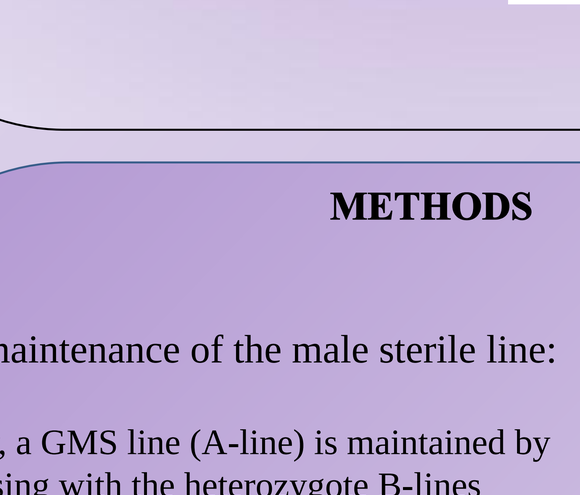
METHODS

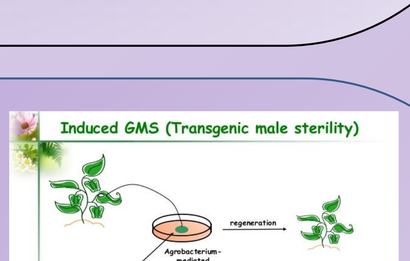
❖ The maintenance of the male sterile line:

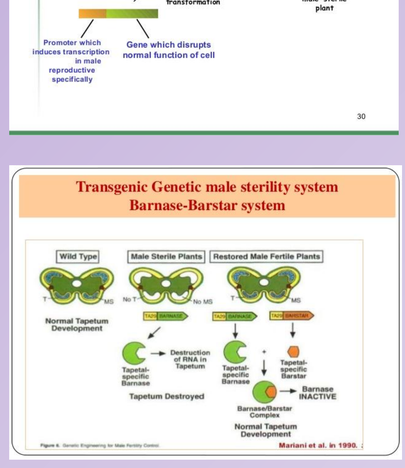
Normally, a GMS line (A-line) is maintained by backcrossing with the heterozygote B-lines (Maintainer lines), but the progeny produced are 50% fertile and 50% male sterile

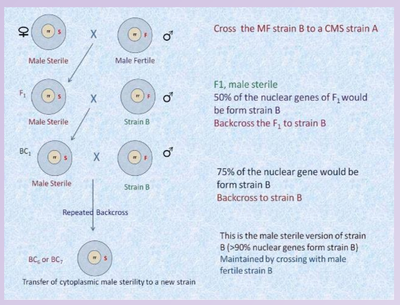
❖ Solution:

1. Identify marker genes that are closely linked to ms genes and affect some vegetative characters
2. Use of environmental and chemical methods that can lead to production of 100% male-sterile seed









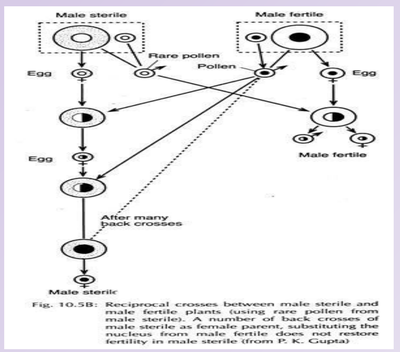


Fig. 10.5B: Reciprocal crosses between male sterile and male fertile plants (using rare pollen from male sterile). A number of back crosses of male sterile as female parent, substituting the nucleus from male fertile does not restore fertility in male sterile (from P. K. Gupta)

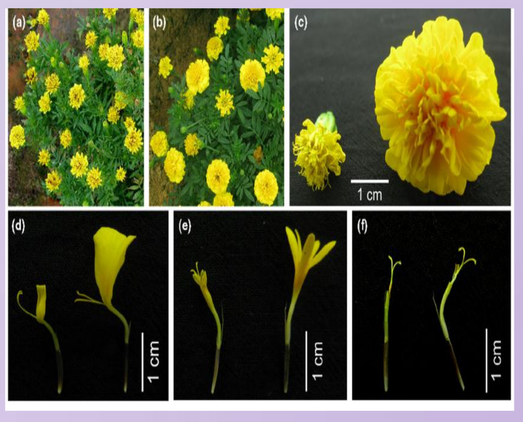
RESULTS

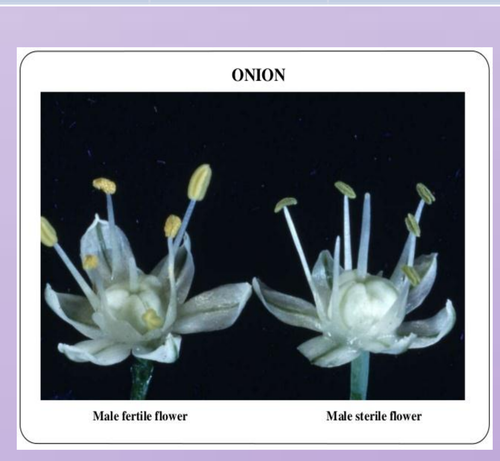
❖ Contribution of Male Sterility for Hybrid Variety Development:

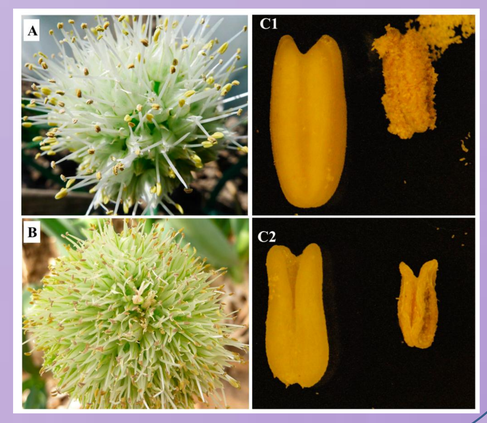
Genetic Male Sterility					
Pigeon pea	Castor	Tomato	Lima bean	Barley	Cotton

Cytoplasmic Male Sterility		
Sugarcane	Potato	Forage crops

Cytoplasmic Genetic Male Sterility					
Maize	Bajara	Cotton	Rice	Sunflower	Jowar

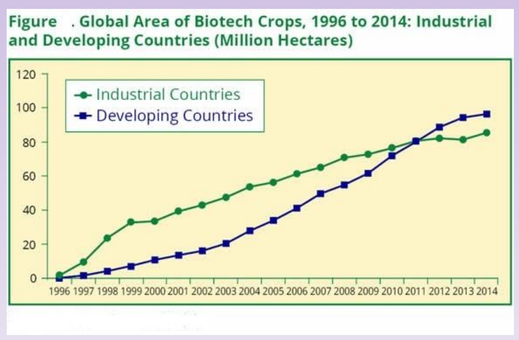






CONCLUSION

- ❖ Increase flower longevity and number.
- ❖ Eliminate nuisance fruit.
- ❖ Increase vegetative growth.
- ❖ Reduce allergic reactions.
- ❖ Prevent sexual propagation and crossing.
- ❖ Eliminate invasiveness.
- ❖ It's a new tool to eliminate plant invasiveness.



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