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# GM Mustard: Will It Survive the Challenges

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## Introduction

India is an agrarian country with over 60% of the population engaged in agriculture. Oilseed crops are the second most significant factor affecting the agricultural economy next to cereals. The country imports around 13.3 million tonnes of edible oil which constitutes 55-60% of the domestic requirement worth of ₹1,17,000 crore. As per Statistica (2023), rapeseed-mustard ranks second after soybean contributing 30.84% (114.59 m Mt) of total edible oilseed production. A total of 248 varieties and 6 hybrids of rapeseed-mustard have been released till 2018 under the umbrella of AICRP-RM as reported by ICAR-Directorate of Rapeseed-Mustard Research, Rajasthan. Traditional rapeseed-mustard varieties' productivity (1–1.3 t/ha) has been constant for more than 20 years; in order to fulfill the population's growing demands, either existing varieties must be improved or new hybrid varieties need to be developed. Hybrid mustard leads to higher profitability for farmers because of increased yield, improved disease resistance, tolerance to abiotic stresses, consistent quality and improved adaptability. However, the hybrid development program is a challenging task in self-pollinated crops such as mustard where heterosis breakdown further complicates the process in the subsequent generations. Low genetic diversity, lack of male sterile lines and inadequate seed set are additional gaps. Nonetheless, the advances in plant breeding and modern biotechnological techniques are helping to overcome these challenges and improve the development of new mustard hybrid varieties such as Dhara Mustard Hybrid-11 (DMH-11).

**Keywords:** Indian agriculture, GM Mustard, DMH-11, Challenges

## What is GM Mustard?

Genetically Modified mustard is a genetically engineered plant having genes from gram-negative soil bacterium *Bacillus amyloliquefaciens* through the Barnase-Barstar system designed specifically for mustard and tobacco crops. It was developed to improve agronomic

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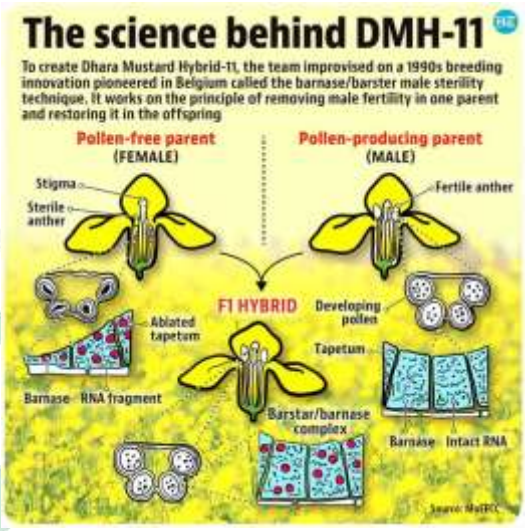
traits, such as yield, disease resistance and stress tolerance in mustard. DMH-11 was developed by Dr. Deepak Pental (former Vice-Chancellor of Delhi University) and his colleagues from Centre for Genetic Manipulation of Crop Plants at the University of Delhi, South Campus. DMH-11 has been Reported to have 28% higher yield than its parent Varuna and 37% better than zonal checks.

**Genetics behind Barnase-Barstar system**




DMH-11 is a cross between Varuna and Early Heera varieties however, such a cross would not have happened naturally. Therefore, two foreign dominant genes namely, barnase and barstar were introduced from the gram-negative soil bacterium *Bacillus amyloliquefaciens.* Barnase gene encoding RNase is driven by tapetum specific promotor (TA 29) responsible for the expression of this gene specifically in anther cells leading to selective disruption of tapetal cells which are involved in providing nutrition to pollens and cause sterility in plants. Another foreign gene called barstar, which is obtained from the same bacteria and encodes a barnase-specific RNase inhibitor, restores the fertility in these male sterile plants. The development of the barnase-barstar protein complex inactivates the barnase enzyme completely and fertility is restored. Barnase can cause tapetum cells to become cytotoxic, hence, there needs to be an equivalent or greater level of barstar presence.

**Opportunities and obstacles**

The use of GM mustard is a complex and controversial issue in India with opinions and perspectives varying widely. The centre had given green light for release of DMH-11 following the approval by Genetic Engineering Appraisal Committee for trials and demonstrations. However, people from various groups are opposing because of the potential environmental and health impacts of the technology. Mustard is the only natural crop that bee farmers depend on

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for honey production due to which beekeepers are protesting against it. Possible impacts of GM mustard on honeybees could include changes in plant chemistry that affect the availability of nectar and pollen, as well as potential toxic effects from the expression of the introduced genes.


***A protest against genetically modified crops outside the Ministry of Environment in New Delhi in 2016; (Photo: M Zhazo)***


**A farmer in front of ICAR-Directorate of Rapeseed-mustard Research, Bharatpur, Rajasthan. Photo: Vikas Choudhary/ CSE 4/11/2022**

Numerous evaluation tests pertaining to agriculture, environment, and health have not been evaluated. Scientists have criticised DMH-11 for expanding pesticide use, which has been linked to major health issues, particularly in foetal stage indicating the requirement of extensive trials.

**Conclusion**

It is important to ensure the food security of such a huge population of India and indeed DMH-11 could act as a potential alternative for reducing the investment on edible oil imports. However, a full evaluation experiment must be conducted to ascertain the long-term impact on health issues such allergenicity and the development of 'super-weeds' before its release for cultivation.