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Canola Breeding in India

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Abstract

Several *Brassicaceae* (Crucifer) species are planted as oilseeds over the world, generating culinary, biofuel, and industrial oil as well as high-protein meal. *Brassica napus* is the most widely grown species, but *B. juncea*, *B. rapa*, *B. carinata* and *B. nigra* are all grown extensively in some parts of the world. *Brassica* seed quality and agronomic performance have both improved significantly. Canola provides a nutritious oil that is low in saturated fat and high in linolenic acid. *Brassica* oilseeds are very susceptible to modern biotechnologies, which have aided in the achievement of present breeding objectives as well as the development of new breeding objectives.

Introduction

Canola is a Canadian crop with a trademarked name derived from the contraction of the words "Canada" and "ola" which means "oil". A modified variant of rapeseed developed in Canada has been named "canola" or "double low" variety, for its low content in erucic acid (less than 2%) and glucosinolates (less than 30 µmol g^{-1} in meal fraction). *Brassica rapa* (syn. *B. campestris* subsp. *oleifera* (turnip rape), *B. napus* (rutabagas), *B. oleracea* (cabbage and cauliflower) and *B. juncea* (mustard) are among the 350 genera and 3,000 species in the *Brassicaceae* (Cruciferae) family. *B. campestris* is thought to have originated in the Himalayan foothills, whereas *B. napus* is thought to have originated in the Mediterranean region as a result of natural crossbreeding between *B. campestris* and *B. oleracea* plants.

Efforts to improve the canola quality in Brassica juncea cultivars have shown to be quite successful. The use of rapeseed oil has expanded dramatically as a result of the development of canola cultivars in major producing countries such as Canada (Canola Council of Canada, 2022). Canola has the following characteristics:

- Higher yield with < 2% erucic acid.
- Relatively shorter duration of the crop.
- Perceived as a healthy cooking medium having less than 2 percent erucic acid.
- Demand as livestock feed as oil meal contains less than 30 micromoles glucosinolates per gram of defatted meal.
- Used as salad oil for its light colour and texture.
- Used in baking industry (reduces the saturated fatty acid intake, modifies the texture of baked product by making it more moist and softer).

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Crop Improvement Programmes for Developing Canola Varieties in India

In India, crop improvement projects are being implemented to develop new canola types. As a result, the Indian rapeseed-mustard breeding programme was refocused to include quality characteristics and place a focus on developing "Canola" types. Initially, efforts were focused on developing genetic stocks for local cultivars with low erucic acid and glucosinolate levels utilising exotic donor sources (Agnihotri *et al*, 2004). Under the aegis of the All India Coordinated Research Project on Rapeseed Mustard, crop enhancement programmes have been implemented in a networked fashion (AICRP-RM). AICRP-RM selected Hyola 401 (2000) and TERI-Unnat (2001) as candidates for release. Another feature is the announcement of a double low *B. napus* var. TERI-UttamJawahar with > 43% oil content, early maturity, and shattering tolerance. The meal from this variety has showed greater digestibility as animal feed in trials conducted at IVRI, and is being investigated as a new protein source for food and feed, a better quality meal for cattle and poultry on par with soybean meal (Ravichandran *et al*., 2008). Strategic selection of plants with required quality parameters as well as good yielding properties is an important aspect of crop improvement for the creation of rapeseed-mustard of canola-grade varieties. The introduction of exotic canola quality cultivars was the first step in developing such types in India. Due to the incapacity of introductions to grow in Indian agro-climatic conditions, these efforts were only partially successful. It is commonly accepted that the fact that erucic acid and glucosinolate concentration of the oilseed are determined by many recessive genes makes crop development for canola attributes more difficult. To produce novel strains in such situations, a combination of traditional plant breeding procedures and biotechnology technologies must be used. Introgressing agronomic and quality features into *B. napus* through integeneric/ interspecific hybridization have been used to improve its genetics. Under the AICRP-RM programme, several canola quality rapeseed strains with additional desirable characteristics such as early maturity and shattering resistance have been created and registered. The National Bureau for Plant Genetic Resources has so far registered three Brassica juncea and six *Brassica napus* lines with double low features (NBPGR).

Sources for Canola Quality Characteristics

Indian scientists have used the zero erucic mustard developed by Kirk and Oram (1981) to transfer zero erucic genes to Indian mustard cultivars. Research efforts under the AICRP Program are focused on identifying potential donors for desirable traits to be used in the breeding programme. Many such donors have previously been found for canola-like properties, and efforts are still being made in this direction. In the breeding programme, Australian and Chinese double low lines have been employed extensively, and they may prove to be very valuable in the future. JR-042, JN-010, JN-033, JN031, JN-049, JN-009, JN-004, JN-028, JM-16, and JM-006 are Australian lines, whereas CBJ-001, CBJ-002, CBJ-003, CBJ-004, and XINYOU-5 are Chinese lines. Some of the recognised sources of such desirable traits in Rapeseed Mustard are listed in table 1. It is envisaged that these prospective donors shall further fast pace the development of canola variants both in *Brassica napus* and *Brassica juncea*.

Table 1: Sources for canola quality characteristics

Characteristics	Promising donors
Low erucic acid and high oleic acid (single low)	*B.juncea*: LES 39
High oleic and linoleic acid (double low)	*B. juncea*: TERI Uphaar (TERI GZ-05)
Glucosinolate content less than 30 µmole g^{-1} defatted meal	*B. juncea*: NUDH-YJ-1, NUDH-YJ-2 *B. napus*: HNS 99(0E)3, NUDB-09, NUDB-26-11
Low erucic acid (up to 2%)	*B. juncea*: LES 17-1, LES 21, LES 38, LET-14, LET-17, YSRL 9- 18 -23, TERI-Swarna [TERI (OE) M 21] *B. napus*: NUDB-26-11, Phaguni [TERI (0E) R 03], Shyamali [TERI (0E) R 09]
Low erucic acid (< 2%) and low glucosinolate (< 30 µmoles g^{-1} fat free meal)	*B. juncea*: Heera, NUDHYJ- 5 *B. napus*: OCN-3 (GSC -6), NUDB-26-11, NUDH-07, BCN 14, CAN 138, GSC 5 (GSC 3A), TERI-Garima [TERI(00) R985], TERI-Gaurav [TERI(00) R 986], TERIUttam [TERI(00) R 9903]

Strategies to Promote Canola Cultivation in India

Canola farming currently accounts for less than 1% of the entire area under rapeseed-mustard agriculture in India. It is critical to increase the share of canola crops in overall rapeseed mustard cultivation in order to improve the quality of edible oil accessible to the country's customers. Despite the traditional desire for traits such as pungency, there is a niche market for canola oil among a segment of the Indian population. Production strategies, which deal with the technical and agro-ecological aspects of canola cultivation, marketing strategies aimed at increasing market share for canola oil, and policy support strategies for creating a conducive environment for proper implementation of production and marketing strategies are among the strategies to be adopted to benefit canola cultivation in India.

Production Strategies

• Develop *Brassica juncea* genotype canola varieties for extensive adaptation in rapeseed mustard growing regions around the country.

• Through collaborative research and stronger connectivity, enhanced exotic donors will be used for canola variety creation.

• Using enhanced varieties and using conventional and innovative crop breeding approaches to improve the agronomic potential of current *Brassica napus* varieties.

• Timely sowing and balanced use of fertilizers especially sulphur.

• Timely management of serious menace like aphid, Alternaria blight and Sclerotinia rot.

Marketing Strategies

• Creation and stabilization of demand for the canola oil through awareness.

• Price rationalization of Canola oil with respect to that of other premium edible oils.

• Introduction of canola oil in non-traditional.

• Development of value added products from by products to enhance the profitability.

• Exploring the possibilities for export oriented production and processing.

Only through boosting the production of oilseed crops can the goal of increasing domestic supply of high-quality edible oil be achieved. Rapeseed-Mustard is a crucial component in the edible oil sector, accounting for roughly 80% of total *rabi* oilseed production. Improving the crop's production and productivity is important not just for farmers, but also for the edible oil sector and other vertically and horizontally linked businesses.

Constraints and Future Strategies

Canola-type rapeseed mustard cultivars face a wide range of production challenges. The absence of better seed material available to farmers at the right time, a lack of price support policies, the predominance of rain-fed cultivation in oilseed crops (72% under rain-fed circumstances), and insufficient research and extension links are all examples of common environmental difficulties. Apart from these, canola crops suffer a number of unique challenges, which are outlined below.

• *Brassica napus*, the most common canola genotype in India, is mostly grown in the states of Punjab, Himachal Pradesh, and Haryana. Due to climatic constraints, there is limited room for expansion outside these states.

• In the key producing areas of the crop, biotic stress (mustard aphid, white rust, Alternaria blight and Sclerotinia rot) and abiotic stress (freezing and high temperature) produce considerable yield loss.

• Crop seeding after Kharif crops such as cotton and rice is delayed, resulting in low yield realisation.

Conclusion

It is a need of the hour that conventional rapeseed cultivation should be shifted to Canola cultivation in the country. It can be achieved by increasing the area under canola cultivation. This will help to increase the farmer income, country self-sufficiency to edible oil, industrial growth in edible oil and consumer health.

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