Analysis of present status, production constraints and future research strategies in Oilseed *Brassica* species

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**ABSTRACT**

Rapeseed-mustard crops in India comprise traditionally grown indigenous species, namely toria (*Brassica campestris* L. var. toria), brown sarson (*Brassica campestris* L. var. brown sarson), yellow sarson (*Brassica campestris* L. var. yellow sarson), Indian mustard (*Brassica juncea* L. Czern and Coss.), black mustard (*Brassica nigra*) and taramira (*Eruca sativa/vesicaria* Mill.), which have been grown since about 3,500 BC along with non-traditional species like gobhi sarson (*Brassica napus* L.) and Ethiopian mustard or karan rai (*Brassica carinata* A. Braun).

**KEYWORDS**

Oilseed, Analysis, *Brassica* species, Present Status, Production Constraints, Future Research

Rapeseed–mustard crops in India are grown in diverse agro-climatic conditions ranging from North-Eastern/ North-Western hills to down south under irrigated/ rainfed, timely/late sown, saline soils and mixed cropping. Indian mustard accounts for about 75-80% of the 5.8 million hectare (mha) under these crops in the country during 2009-10. The cultivation of brown sarson which once dominated the entire rapeseed-mustard growing region is now shadowed by Indian mustard. There are two different ecotypes of brown sarson: lotni (self-incompatible) and tora (self-compatible).

The ‘lotni’ is predominantly cultivated in colder regions of the country particularly in Kashmir and Himachal valley. The ‘tora’ on the other hand is cultivated in limited areas of Eastern Uttar Pradesh. Yellow sarson is now mainly grown in Assam, Bihar, North-Eastern states, Orissa, Eastern Uttar Pradesh and West Bengal. Toria is a short duration crop cultivated largely in Assam, Bihar, Orissa and West Bengal in the east mainly as winter crop. In Haryana, Himachal Pradesh, Madhya Pradesh, Punjab, Uttarakhand and western Uttar Pradesh, it is grown as a catch crop.
Taramira is grown in the drier parts of north-west India comprising the states of Rajasthan, Haryana and Uttar Pradesh. Gobhi sarson and karan rai are the new emerging oilseed crops having limited area of cultivation. Gobhi sarson is a long duration crop confined to Haryana, Himachal Pradesh and Punjab. Rapeseed-mustard crops because of their low water requirement fit well in the rainfed cropping system of resource poor farmers. Important oil seed crop grown in cool season sub tropics, higher elevations and winter crops. Rapeseed oil was produced in the 19th century as a source of a lubricant for steam engines. It was less useful as food for animals or humans because it has a bitter taste due to high levels of glucosinolates. Varieties have now been bred to reduce the content of glucosinolates, yielding more palatable oil. This has had the side effect that the oil contains much less erucic acid. The oil and protein content varies from 37 to 49% and 22-28%, respectively.

The seed and oil are used as condiment in the preparation of pickles and for flavouring curries and vegetables. The oil is utilized for human consumption throughout the northern India in cooking and frying purposes. It is also used in the preparation of hair oils and medicines. It is used in soap making, in mixtures with mineral oils for lubrication. Rapeseed oil is used in the manufacture of grease. The oil cake is used as feed and manure. Green stem and leaves are a good source of green fodder for cattle. The leaves of young plants are used as green vegetable as they supply enough sulphur and minerals in the diet.

In the tanning industry, mustard oil is used for softening leather. Rapeseed oil is one of the oldest vegetable oils, but historically was used in limited quantities due to high levels of erucic acid, which is damaging to cardiac muscle of animals, and glucosinolates, which made it less nutritious in animal feed (Sahasrabudhe, 1977). Rapeseed oil can contain up to 54% erucic acid (CFR, 2010). Food-grade canola oil derived from rapeseed cultivars, also known as rapeseed 00 oil, low erucic acid rapeseed oil, LEAR oil, and rapeseed canola-equivalent oil, has been generally recognized as safe by the United States Food and Drug Administration (The Commission of the European Communities, 1980).

Canola oil is limited by government regulation to a maximum of 2% erucic acid by weight in the USA and 5% in the EU (Humbert et al., 2001) with special regulations for infant food. These low levels of erucic acid are not believed to cause harm in human neonates. Rapeseed-mustard oil contains lowest level of saturated fatty acids among all vegetable oil, which is quite desirable for good health. Both the essential fatty acids (EFA) such as linoleic acid (C18: 2) and linolenic (C18: 3) are present in rapeseed-mustard oil. Rapeseed-mustard oil has high level of antioxidant, which retards growth of free radicals mainly responsible for disease like cancer and ageing. Glucosinolates present in seed meal has shown anticancer properties. Brassica species are very rich in phenolic compounds and glucosinolates. These results were also similar to (Singh, 1928, Malinowski, 1929, Mohammad et al., 1931, Mohammad, 1940, Mohammad, 1941, Mohammad and Sikka, 1941, Mohammad, 1944, Mohammad and Sikka, 1957, Labana and Gupta, 1987, Arvind Kumar, 1992, Banga, 1996).

Production Status

The estimated area, production and yield of rapeseed-mustard in the world was 36.68 million hectares (mha), 72.42 MT and 1974 kg/ha, respectively, during 2017-18 (fig 1). Globally, India account for 19.8% and 9.8% of the total acreage and production (USDA 2016-17). During the last seven years, there has been a considerable increase in productivity from 1840 kg/ha in 2010-11 to 1974 kg/ha in 2017-18 and production has also increased from 61.64 MT in 2010-11 to 72.42 MT in 2017-18. Rapeseed–mustard crops in India are grown in diverse agro climatic conditions ranging from North-Eastern/ North Western hills to down south under irrigated/ rainfed, timely/ late sown, saline soils and mixed cropping. Indian mustard accounts for about 75-80% of the 6.07 mha under these crops in the country during 2016-17 crops season.

Rapeseed-Mustard Production Trends in India

Soybean, groundnut and rapeseed-mustard are the major oilseed crops in India contributing nearly 84% and 88% to its total acreage and production respectively (average of 2012-13 to 2016-17).
Fig 1. Rapeseed-mustard production trends in World

Fig 2. Contribution of different countries in R & M acreage average (2013-14 to 2017-18)

Fig 3. Contribution of different countries in R & M production average (2013-14 to 2017-18)

Fig 4. Rapeseed-mustard production trends in India
Fig 5. Contribution of different oilseed crops acreage average (2013-14 to 2017-18)

Fig 6. Contribution of different crops production average (2013-14 to 2017-18)

Fig 7. Contribution of different oilseed producing states in total area and production of rapeseed-mustard (average of 2012-13 to 2016-17)

Constraints in Production

The rapeseed-mustard, which contributes nearly 80% of the total rabi oilseed production, is a vital component in the edible oil sector. The rapeseed-mustard crops are diverse in their agro-climatic requirements and crop management practices. The production constraints facing each of the crops are also diverse in nature. The objective of raising domestic availability of edible oil can be realized only by increasing the productivity of these oilseed crops. Enhancing the production and productivity of the crop assumes significance; not only from the farmers’ viewpoint but also for the edible oil industry and other vertically and horizontally linked enterprises. The major constraints faced by these crops are:

- Uncertainty of acreage of the crops due to several factors: climatic, biological, natural resources and policy decisions.
- Low and erratic rainfall leading to continuous moisture stress/drought over the years. Seedling stage is most sensitive to moisture stress followed by flowering.
• Farmers are also not well versed with the moisture conservation techniques.
• Irrigation with saline and alkali-blended water in most of the areas of Rajasthan and parts of UP, Haryana and Punjab resulting in salinity builds up.
• Mono cropping in most of the major areas has led to soil deficiency for nutrients and built-up of soil borne pathogens.
• Stress caused by insect, nematodes, fungal, bacterial and viral pathogens, Orobanche and weeds collectively result in approximately 45% yield loss annually.
• High temperature during crop establishment (mid-September to early-November), cold spell, fog and intermittent rains during crop growth cause considerable yield losses by physiological disorder and appearance and proliferation of white rust, downy mildew and Sclerotinia stem rot diseases and aphid pest.
• Farmer’s reluctance in using balanced dose of fertilizers, poor adoption of plant protection measures to control pest, diseases and weeds and harvesting at improper time.

**Future Research Plans**

It would concentrate on the following key researchable areas to achieve quantum jump in production and productivity of rapeseed-mustard:
• Efficient utilization of rapeseed-mustard genetic resources.
• Exploitation of available heterosis in mustard and toria for further enhancing the yield potential.
• Developing high yielding varieties/hybrids with improved oil and seed meal quality for food, feed and industrial uses using conventional as well as biotechnological approaches.
• Development of thermo and photo-insensitive genotypes for diverse cropping systems under varied agro-ecological situations.
• Development of cultivars with high water and nutrient use and photosynthetic efficiency for different situations.
• Development of designer Brassica for different fatty acids profile and value-added product.
• Development of rapeseed mustard genotypes tolerant to various biotic (Alternaria blight, Sclerotinia rot, white rust, Orobanche, mustard aphid, painted bug) and abiotic stresses (drought, temperature and salinity).
• Production technologies for mustard based cropping systems under climate change scenario.
• Bio-molecules, bio-remediation and bio-fertilization for environmental safety.
• Survey and surveillance of insect-pests, diseases and weeds under climate change.
• Remote sensing for energy-water balance, disease and pest surveillance, forewarning and crop modelling.
• Bio-intensive integrated pest management (IPM) module development for major insect pests and diseases.
• Host-pathogen interaction and induced resistance for management of diseases.
• Impact of pesticide residues on the dynamics of soil flora, fauna and environment.
• Socio-economic, operational and institutional constraints in the transfer of technology, yield gap analysis and farmer’s perceptions.
• Development of information technology (IT) based decision support systems, innovations in knowledge management and technology dissemination.
• Impact of policies (procurement, price, export-import, storage, incentives etc.) and development programmes on area and production of rapeseed- mustard.

**Conclusion**

The Vision 2030 on rapeseed-mustard aims not only at sustaining the present level of production but also to improve the productivity and quality in fragile environments across diverse agro-ecological regions. Enhancing the nutritional security of the increasing human population and providing quality feed market for livestock sector are also targeted.
It also aims at meeting the industrial requirements and brings about substantial savings of foreign exchange through import substitution and higher export earnings. Timely availability of seeds of improved varieties suitable for the mitigation of these constraints requires out of the box thinking and innovative research strategies. The research approach itself needs an urgent revamp to harness the full potential of rapeseed-mustard crop.

References


