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Mustard and Rapeseed: Agronomy and Economic Significance

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INTRODUCTION

The two main oilseed crops grown in India for rabi are mustard (*Brassica juncea*) and rapeseed (*Brassica campestris*). India ranks among the world's top producers of these crops. In India, mustard and rapeseed account for around 18% of the nation's total oilseed production. While rai, raya, or laha are known as mustard, sarson, and toria (lahi) are commonly used to refer to rapeseed. The oil and seed are used as a condiment to flavor curries and vegetables, as well as to prepare pickles. The oil is used in northern India for frying and heating food intended for human consumption. objectives. Goitrogens (Thio glucosides or glucosinolates), tannic acid, erucic acid, and sinapine are examples of anti-nutritional factors that may be present in rapeseed-mustard oil and oil meal, as well as oligosaccharides, pectin's, and cholesterol. Mustard increases salivary secretion and digestion. Relatively high protein content (28–36%) and oil content (28–32%) characterize mustard seeds and indicate a high energy content. Mustard protein is high in essential amino acids and has a well-balanced amino acid composition. (20–28% oleic acid) in mustard oil; erucic acid (30–40%); linoleic acid (10–20%). Erucic acid levels above 2% in mustard seed oil are considered unhealthy for human consumption and antinutritional.

Area and distribution

India is a global leader in the production of mustard and rapeseed. India is the nation that contributes the most to the global output of mustard and rapeseed. In India, 9.12 million tonnes of mustard and rapeseed are produced, making up around 27% of the nation's total oilseed production. The diversity of agro-ecological conditions in India supports the successful cultivation of nine major annual oilseed

crops: groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, Niger seed, castor, and linseed (Patel et al., 2024)

During **2024–2025**, mustard cultivation in India covered **8.63 million hectares**, underscoring its continued importance among oilseed crops. The total production reached **12.61 million tonnes**, indicating a substantial contribution to the country's edible oil supply. The average productivity stood at **1461 kg per hectare**, reflecting improvements driven by better varieties and agronomic practices. Overall, mustard remains a key crop supporting both farmer income and national oilseed security.

Soil Requirments

Although mustard and rapeseed can grow in a variety of soil types, including sandy loam and clay loam, light loam soils are ideal for their growth. They don't thrive in thick soils or in environments where there is a lot of waterlogging. While plants may withstand a certain amount of moderate salinity, optimal growth and development occur in soil with a neutral pH.

Climate Requirments

Necessitate cold, dry weather, a good supply of soil moisture for growth, and clear, dry weather when they reach maturity. Rabi season (September-October to February-March) is when they are grown in India. They need an annual precipitation of 35-45 cm, and the crop also does not tolerate waterlogging. Average optimum temperature $<25^0$C best for plant growth and development. Mustard and rapeseed are grown through India an elevation of about 3000 metres above mean sea level. Mustard and rapeseed require minimum, optimum, and maximum temperatures of 0.6-3.2, 16-25, and 34-40°C, respectively, for better growth and development.

Field Preparation

Better germination requires a seedbed that is well-tilled, clean, and well-pulverized. First, the land needs to be thoroughly prepared by deep plowing, followed by two cross-harrowing. Take care to ensure that the field is free of weeds and stubble and that there is enough moisture in the soil.

Variety

The important varieties and their key characteristics are listed in **Table 1.1**

Varieties	Year of release	Releasing Centre	Yield (kg/ha)	Oil Content (%)	Recommended States	Special traits/ Remark
GSC-101	2013	Himachal Pradesh Krishi Vishvavidyalaya ,Palampur.	1990	40.0	Delhi, Haryana, Punjab, J&K, Rajasthan	Double low (low erucic acid and low glucosinolate content)

PGSH-1707	2020	P.A.U., Ludhiana	2200	41.2	Himachal Pradesh, J&k	It is tolerant of white rust.
Pusa Double Zero Mustard 33(PDZ-11)	2021	IARI	2640	38.0	Punjab, Haryana, Delhi, Rajasthan	Low erucic acid, low-glucosinolate
Pusa Mustard-32 (PM 32)	2020	IARI	2800	38.0	Rajasthan, Punjab, Haryana, Delhi, Western UP, Himachal Pradesh	Low erucic acid and glucosinolates environmental tolerance (Low water stress and good adaptability under timely-shown.
BPM-11 (Bharatpur Mustard-11)	2024	DRMR-Bharatpur	1860	37.9	Rajasthan, Western-UP, Madhya Pradesh	Preferably for cultivation in specific agro-climatic conditions. Disease resistance to white rust.
Govardhan (KMR L 17-5)	2024	C.S.A.U.A&T, Kanpur	1800	39.6	Uttar Pradesh, Bihar	Late sown conditions in Uttar Pradesh and other regions

Table 1.1

Time of Sowing

The best time to sow toria is in the middle to the end of September. It is necessary to finish sowing sarson and rai within the first two weeks of October. On the basis of the period at early sowing in the last week of September to the first week of October, mid sowing in 15-30 October, and late sowing in the first fortnight of November are most suitable for germination and highest yield with good quality of oil content.

Seed Rate and Spacing

The general planting method for toria is rows spaced 30 cm apart, whereas rows spaced 45 cm apart are used for sarson and rai. In order to keep a plant-to-plant spacing of 10 to 15 cm, thinning is

done in three weeks after seeding, maintaining the expected plant-to-plant distance. Mustard seed rate lines sowing in 4-5 kg/ha and 6-7 kg/ha in broadcasting are most preferable, and in rapeseed line sowing 6-8 kg/ha and 8-10 kg/ha in broadcasting.

Manures and Fertilizers

Use 15 to 20 tons of FYM or compost when preparing the field. and 40 kg K2O, 60 kg P2O5, and 60–90 kg nitrogen per hectare. For mustard and rape crops, split nitrogen application has been distributed to be beneficial. Approximately 30-40 kg/ha of Sulphur should be given to increase the oil content and better yield quality.

Water Management

Mustard and rapeseed nowadays, throughout 75% of the area is irrigated, and this crop requires 300-400 mm of water, and the consumptive use range is 200-300 mm. Mainly two irrigations are needed, first at the branching stage (25-31 DAS) and second at the pod formation stage (60-65 DAS), which are enough for cultivation.

Weed Management

Argemone maxicana are noxious/objectionable type and it is serious type weed, when eating of mustard oil with >0.1% argemone oil causes dropsy in human beings because this is due to the alkaloids dihydro-sanguinarine and sanguinarine are present in this weed. Preventive measures involve clean cultivation practices, use of certified weed-free seed, weed-free seedbeds, well-decomposed organic manures, weed-free bunds and irrigation channels, and clean farm tools and machinery and preventing weed seed production by controlling weeds prior to the reproductive stage (Bahadur *et al.,* 2015). The most critical period of crop-weed competition is 45-60 DAS, so if weed control is achieved through hand weeding, then in rainfed conditions, only one hand weeding should be applied at 25 DAS, and in irrigated conditions, two hand weeding should be applied at 25 and 40 DAS. The recommended herbicides and their application details for the mustard crop are given in

Table 1.2.

Herbicide	Applied as with time	Dose (kg/ha)
Fluchloralin	PPI (0-2 DBS)	1.00
Isoproturon	Post-emergence (30 DAS)	0.75
Pendimethalin	Pre-emergence (0-3 DAS)	1.00

Table 1.2.

Plant protection

In mustard crops, integrated plant protection is essential to manage major pests, such as aphids, and diseases, such as Alternaria blight and white rust. Regular field monitoring and the use of resistant varieties help reduce early infestation. Seed treatment and timely sowing minimize disease incidence. Need-based spraying of recommended insecticides and fungicides should be carried out after crossing the economic threshold levels. Cultural practices like crop rotation, proper spacing, and field sanitation also play an essential role in effective control. The major pests and diseases of mustard and their recommended control measures are summarized in **Tables -1.3 & 1.4**

Diseases Control

Disease	Causal organism	Disease symptom	Chemical control	Natural control
Alternaria blight	*Alternaria bressica*	very serious disease, small, circular, light brown spot on cotyledonary leaves, which later becomes large and black with concentric rings.	Spray iprodione or mancozeb 75 WP at 2kg/ha at 10-day intervals as soon as symptoms appear on the plants. Seed treatment with Vitavax + Thiram @3 g/kg of seed before sowing.	Collect and burn the affected plants. Grow tolerant varieties.Seed treatment/ foliar spray with Trichoderma viride. Neem oil kernel extract (NSKE 5%) or neem oil (2-3%).
White rust	*Albugo candida*	Small, white raised pustules on leaves, stem and floral parts which later merge and form large patches.	Spray 625 g of Ridonil Gold (metalaxyl 4% + mancozeb 64%) by dilution with 300 lit. of water per hectare.	Similar to it, it is controlled by the Alternaria blight.
Powdery mildew	*Erysiphe cruciferarum*	Dirty white patches with spherical spots on the stem, leaves, and pods. Patches increase with temperature increment.	Spray Dinocap @0.1% at disease appearance and can be repeated after 15 days.	When using the liquid soap, 1-2 drops, then change the pH of the leaf so that the fungus can't survive.
Downy mildew	*Perenospora brassicae*	Affected plants have yellow irregular spots on the upper surface of the leaves, and white growth is visible on the under surface opposite the spots.	Seed treatment with Apron 35 SD @6 g/kg of seeds	This is also controlled in the same way of Powdery mildew and Alternaria blight.

Table -1.3

Insects Control

Insects	Injured symptoms	Chemical control	Natural control
Aphid (*Lipaphis erysimi*)	Attack during the end of Dec to mid-March, that time had a highly multiplied rate. Moist and cloudy weather and 10-18^{0}C is favorable. When highest infestation rate results	Spray Oxidematon methyl 25 EC or Dimethoate 30 EC 850 ml/850 liters water.	Use of some beneficial insects to prevent the insect. Ladybird beetle (*Coccinella Sepempunctata*) Green larvae (*Chrysoperla carnae*) Parasitic wasps (*Diaeretiella rapae*) Neem-based products (very effective) like- NSKE, Neem oil etc.
Saw fly (*Athalia proxima*)	Attack in early crop stage (Oct to Nov).Larvae holes in leaves.	Foliar spray with 500 ml Mailathion 50 EC in 500 lit water.	Timely irrigation to kill larvae. Parasitoids: Bracon spp. Perilissus cingulator, Predators: ants, Birds, spiders.
Painted bug (*Bagrada crusiferarum*)	During Oct-Nov and then again during mid-march. Adults and nymphs suck the plant sap. Bushy appearance of plant with white blotchy spot on leaves.	Dusting with Quinalphos 1.5% @ 20-25 kg/ha	Ash or soil dusting on moist plants Neem leafs extract / cow urine spray Soap solution (1.2%) as repellent. Predators: birds, spiders, ants Use of Neem based products

Table -1.4

Harvesting and Threshing

When the pods become yellow-brown in color, harvest the crop. Harvesting the crop immediately before the pods open will help prevent losses because it is prone to shattering. Compared to mustard and toria, sarson is less likely to break and is less prone to the Shattering of pods as compared to mustard and toria. After harvesting, let the crop rest for five days before threshing on the threshing floor. A slow-moving natural air circulation will helps to separate the threshed grain from the husk. It is necessary to dry-clean the seed in the sun for four to five days, or until the moisture content drops to 8%.

Yield

Farmers can expect yields of 14 to 20 quintals of rapeseed and 20 to 25 quintals of mustard seed per hectare by using improved varieties, agronomic practices, and plant protection strategies. According to the ICAR–DRMR, the global rapeseed market is projected to grow by 5.00% from 2021 to 2028, driven by increased production and sales of farm equipment, which will enhance cultivation efficiency. In the 2023-24 season, rapeseed and mustard were cultivated on 42.58 million hectares globally, yielding 88.34 million tons, with an average yield of 2.07 metric tons per hectare (Mit S and Bhaduria *et al.,* 2025).

CONCLUSION

Rapeseed and mustard are vital components of India's rabi oilseed economy, contributing significantly to edible oil availability, farmer livelihoods, and national nutritional security. Their adaptability to diverse agro-ecological conditions, short growth duration, and high oil and protein content make them essential for the sustainable intensification of cropping systems. Productivity gains during 2024–2025 highlight the positive impact of improved varieties, balanced fertilization, Sulphur application, efficient irrigation, and integrated management of weeds, pests, and diseases.

However, productivity still remains below potential due to yield instability, biotic and abiotic stresses, market price fluctuations, and limited adoption of advanced technologies. Continued research on high-yielding, low-erucic, and stress-tolerant varieties, supported by strong extension services, is crucial to bridge these gaps. An integrated approach combining technological innovation, supportive policies, and market reforms is essential to strengthen the sustainability, profitability, and resilience of the rapeseed–mustard sector.

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