

Package of practices for organic production of rapeseed-mustard

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In the last several years, agricultural research has primarily focused on immediate productivity gain and profit increase, relying mainly on external inputs, either neglecting or improper use of local resources. The long-term consequences of these faulty practices have emerged as deterioration in soil health and environmental quality, and ultimately the human health. Additionally, productivity and profitability from conventional agriculture production systems are either declining or remain stable. Therefore, alteration in crop production practices is need of the hour. Adoption of organic farming practices in rapeseed-mustard group of crops appears to be a good alternative option in the present context. In addition to protecting the soil and the environment, the organic farming may help to improve and sustain the productivity and quality of the produce. Thus, adoption of recommended production technologies of the organic management in rapeseed-mustard group of crops could be more remunerative for farmers and environment friendly as well.

Keywords: Package of practices, Organic farming, Rapeseed-mustard, Sustainability

India is the fourth largest vegetable oil economy in the world next to the USA, China and Brazil. Oilseeds are the second largest contributor in Indian agricultural economy after the cereals. Being second largest grower (21.1%) after Canada, and third largest producer (12.6%) after Canada and China, India plays a key role in global rapeseed-mustard industry. Rapeseed-mustard is an important group of oilseed crops in India. Rapeseed-mustard comprises eight different species. Of these, toria (*Brassica rapa* L. var. toria), brown sarson (*B. rapa* L. brown sarson), yellow sarson (*B. rapa* L. var. yellow sarson), gobhi sarson (*B. napus* L. ssp. *oleifera* DC var. *annua* L.) and taramira (*Eruca sativa/vesicaria* Mill.) are together termed as rapeseed; and Indian mustard (*B. juncea* (L.) Czern. & Coss.); black mustard (*B. nigra* (L.) Koch) and Ethiopian mustard or karan rai (*B. carinata* A. Braun) are collectively called mustard. Morphological differences between different species of rapeseed-mustard are

depicted digrammatically. During 2023-24, rapeseed-mustard group of crops occupied around 30.2% area (9.1 mha) and 33.3% (13.2 mt) production of total oilseeds in the country (Economic Survey, 2023-24), besides contributing around 23-25% of total vegetable oil production through nine oilseed crops, thus it is playing a pivotal role in meeting the edible oil requirements of the country. Rapeseed-mustard is a *rabi* annual, adapted to grow under diverse agro-ecologies and different types of soils. Oil content in rapeseed-mustard varies from 33-46% amongst different species and varieties.

Organic farming of rapeseed-mustard group of crops is gaining importance in the country in recent years due to increasing soil, human and environmental concerns. The use of chemical fertilizers and pesticides is very low which can be substituted through organic sources. Therefore, growing of rapeseed-mustard under organic management using recommended

production technology could be more remunerative for farmers of states like Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, Gujarat, West Bengal, Assam, Punjab etc.

Package of practices for organic cultivation of rapeseed-mustard

In organic farming, all recommended package of practices of crop production are followed as such, except the use of artificial external inputs such as chemical fertilizers and pesticides. It is actually based on the minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. The International Federation of Organic Agriculture Movements (IFOAM) has defined it as a production system that sustains the health of soils, ecosystems and people. Therefore, except the use of chemical fertilizers and pesticides, all other package of practices which have been recommended for conventional rapeseed-mustard



Indian mustard (*B. juncea*)



Gobhi sarson (*B. napus*)



Toria (*B. rapa* var. toria)



Yellow sarson (*B. rapa* var. yellow sarson)

Morphological differences among different species of rapeseed-mustard crops

production can be followed for organic rapeseed-mustard cultivation. Therefore, in this article, the available information on organic management of nutrient and pest in rapeseed-mustard is discussed. The agronomic management practices to be followed for the cultivation of rapeseed-mustard under the organic farming system are summarized below.

Land preparation

Deep ploughing during summer should be done, which helps to destroy pests. One deep ploughing with MB plough/ disc plough should be done followed by 3-4 ploughing with harrow or cultivator

or *desi* plough and planking after each ploughing to get fine seedbed for sowing.

Nutrient management

Organic manures, green manures, crop residues, bio-fertilizers, natural sources of nutrients, crop rotations etc. are used for meeting the nutrient requirement of the crop and improving the soil health in organic production systems. Application of farm yard manure (FYM) and vermicompost in the ratio of 1:1 has been advocated for meeting the nutrient requirement of the rapeseed-mustard under the organic farming system. FYM should be incorporated in the soil at the time of land preparation and

vermi-compost should be applied 2–3 cm below seed during sowing in the moist soil. The phosphorus and sulphur requirements of the crop under organic farming system can be met out through the use of 20 kg/ha P_2O_5 through rock phosphate at the rate of 110–160 kg/ha with bio-fertilizers (PSB + *Azotobacter*). Incorporation of 2.5 t/ha mustard residue followed by *Sesbania* green manuring during *kharif* recorded the highest mustard seed yield (Table 1).

The organic farming packages recommended for rapeseed-mustard cultivation in different states are summarized in Table 2.

Selection of varieties

Promising varieties released for location specific conditions may be used under organic cultivation. The varieties of the rapeseed-mustard that are recommended for different growing conditions are listed in Table 3.

Sowing time

Sowing time of rapeseed-mustard varies from mid-September to late-November at different places in India. Sowing of crop between 10 to 25th October is the most optimal window for the mustard. The middle of October, when the mean temperature in the north Indian plains is 24–26°C, is considered optimum for sowing of rapeseed/ mustard. Sowing of the crop should not be done if the day temperature exceeds 32°C. Timely sowing of crop is important to reduce the incidence of diseases.

Table 1. Effect of organic sources of nutrients on Indian mustard productivity (kg/ha) under organic and conventional cultivation practices

Fertilizer management strategy (FMS)	Organic sources (OS)						Mean
	<i>Sesbania</i> green manuring (SGM)	Mustard straw incorporation (MSI, 2.5 t/ha)	SGM + MSI (2.5 t/ha)	Mustard straw mulch (2.5 t/ha)	Farm yard manure (2.5 t/ha)	Vermi-compost (2.5 t/ha)	
Conventional fertilizer management (100% RDF)	2841	2567	3033	2664	2602	2540	2708
Moderate fertilizer management (50% RDF)	2373	1794	3032	1877	2141	2319	2256
No fertilizer	2046	1941	2251	1709	1900	2002	1975
Mean	2420	2101	2772	2083	2214	2287	-
Absolute control: 410; Conventional control (100% RDF): 1798							
CD ($p \leq 0.05$): FMS: 290; OS: 231							

Source: DRMR Annual Report (2018-19)

Table 2. Organic farming packages developed for rapeseed-mustard cultivation in India

State	Crop(s)	Nutrient supply	Pest management
Madhya Pradesh	Mustard (Variety: Pusa bold)	Cow dung manure (0.95% N) @ 1.5 t/ha + Vermicompost (1.41% N) @ 1.7 t/ha + Poultry manure (2.36% N) @ 1/ha	Neem oil (10000 ppm) @1 litre/ha along with soap solution
Uttarakhand	Gobhi Sarson (Variety: GLS-1)	Pre-sowing treatment by Pant Bioagent-3 (mixture of <i>Pseudomonas</i> + <i>Trichoderma</i>) @ 10 g/kg seed + FYM 10 t/ha + Vermicompost 5 t/ha as basal application + 3-4 sprays of cow urine fortified with neem leaves (one kg green leaves/10 L of urine) @ 50 L/ha at 15 days interval from 20-25 DAS	Spray of <i>Pseudomonas fluorescens</i> and <i>Trichoderma</i> spp. @ 5 g/litres at the time of soil preparation, before and after flowering for managing root rot, white rust, downy mildew and cow urine fortified with neem leaves (one kg green leaves/10 litres of urine) or cow urine + neem oil @ 50 L/ha or 50 litre cow urine + 5 litre neem oil/ha for management of aphid and sawfly
Uttar Pradesh	Barley + Mustard (Variety: Barley-Azad, DWRB-91; Mustard-Pusa Bold, Pusa Vishal)	FYM @ 8.0 t/ha + Vermicompost @ 4.8 t/ha + <i>Azotobacter</i> @ 10.0 kg/ha + PSB @ 5.0 kg/ha + <i>Trichoderma</i> @ 5.0 kg/ha + Neem cake @ 2.0 q/ha + <i>Panchagavya</i> @ 15.0 L/ha at 45 and 60 DAS	Soil application of <i>Beauveria bassiana</i> @ 5.0 kg/ha to control termite. Neem leaf manure @ 5.0 q/ha or neem seed manure 1.0 q/ha or foliar spray of neem leaf extract @ 3.0% with water
Uttar Pradesh	Mustard Variety (Pusa Bold, Pusa Vishal)	FYM @ 5.0 t/ha + Vermicompost @ 5.0 t/ha + Seed treatment with Bioagent-3 (mixture of <i>Pseudomonas</i> + <i>Trichoderma</i>) @ 10.0 g/kg seed + Cow urine (10.0 L) fortified with neem green leaves (1.0 kg) @ 3-4 sprays at 15 days interval after 20-25 DAS @ 50.0 litres/ha	Spray of <i>P. fluorescens</i> and <i>Trichoderma</i> at the time of field preparation, before and after flowering @ 5.0 g/litre water to manage root rot, white rust, downy mildew. Cow urine (10.0 L) fortified with neem green leaves (1 kg) or cow urine (10.0 L) fortified with neem oil (1.0 L) @ 50.0 litre/ha
West Bengal	Mustard (Variety: B9)	Vermicompost @ 6.0 t/ha + Foliar application of <i>Panchagavya</i> (3.0%) @ 166.6 litre/ha in each spray	Neem oil (10,000 ppm) @ 300 L/ha in 15 days interval to manage Jassids

Source: Panwar et al. (2022)

Seed treatment and sowing methods

Seed treatment with *Trichoderma viridae* @ 6 g/kg seed should be done to avoid incidence of seed borne diseases. Seed treatment should also be done with biofertilizers

like *Azotobacter*, *Azospirillum*, Phosphobacteria @ 200 g each per 10-15 kg seed. Soil application of these biofertilizers can also be done @ 5 kg each/ha. Liquid formulations of these biofertilizers should be used @

500 mL/ha. In general, the optimum seed rate is 3.0-4.0 kg/ha. Sowing the seeds with seed-drill machine or *pora* method and maintaining the planting geometry at 45 cm × 15 cm (Indian mustard, Gobhi sarson and

Table 3. Recommended varieties of the rapeseed-mustard for cultivation in India

Ecology/ specific quality	Recommended varieties
Indian mustard (<i>B. juncea</i>)	
Early sown irrigated condition	PM-28, PM-27, PM-25, Pant Rai-19, Pusa Tarak
Timely sown irrigated condition	PM-32, DRMR IJ-31, RH-749, NRCDR-601, Pusa Vijay, NRCDR-2, NRCHB 506, GRN-73, Urvashi, Maya, RVM-2, PM-29, PM-30, GDM-4
Late sown irrigated condition	Brijraj, Radhika, RGN-145, NRCHB-101, CS-56, PM-26, Ashirwad, RGN-236
Rainfed condition	RH-1424, DRMR-150-35, DRMR-1165-40, RH-406, RB-50, RH-725, RGN-229, RGN-298, RGN-48, PM-1, RVM-2, Pant Rai-20, PBR- 378
Drought tolerant	RH-781, RH-819
High temperature tolerant	PM-28, PM-27, PM-25, Azad Mahak, Pant Rai-18, Pant Rai-19, Pusa Vijay, RH-0119, RH-406, GRN-229, RGN-236, RGN-298
Salinity tolerant	CS-64, CS-60, CS-58
Double zero (quality type)	PM-33, RCH-1, PM-31, Pusa Double Zero Mustard-1 (PDZ-1)
Low erucic acid (quality type)	RH-1706, PM-34, PM-30, PM-29, PM-24, RLC-2
Non-traditional areas	DRMR-150-35, PM-25, NRCHB-101, Pusa Agrani, GM-2, TPM-1, Shatabdi
Black mustard (<i>B. nigra</i>)	Surya (LBM 428)
Ethiopian mustard or Karan Rai (<i>B. carinata</i>)	Pusa Aditya, Pusa Swarnim, PC 5-17, JTC-1
Toria (<i>B. rapa</i> var. toria)	TS-38, Sushree, Tapeshwari, Azad Chetana, RSPT-2, Uttara, Tripura Toria-1
Brown sarson (<i>B. rapa</i> var. brown sarson)	Shalimar Sarson-1, Shalimar Sarson-2, Shalimar Sarson-3
Yellow sarson (<i>B. rapa</i> var. yellow sarson)	Pitambari, YSH-0401, NRCYS 05-02, Pant Pili Sarson-1, Pant Sweta, Pant Girija
Gobhi sarson (<i>B. napus</i>)	GSH-1699, Him Palam Gobhi Sarson 1 (AKMS-8141), RSPN-25, GSC-7, ONK-1
Taramira (<i>E. sativa/vesicaria</i>)	Krishna Tara, Jobner Tara, Jwala Tara, Vallabh Taramira-2, Vallabh Taramira-2, Narendra Tara

Karan rai) or 30 cm × 10 cm (Toria, Brown sarson, Yellow sarson and Taramira) distance gives optimum plant population and better yields than broadcast and cross sowing methods. Seeds should be sown 3–4 cm deep in a moist soil to ensure good germination.

Gap filing and thinning

After germination, re-sowing should be done at places where germination fails to occur to fill the gap. Thinning operation i.e., removing the plants from dense areas keeping 15 cm plant-to-plant distance should be done at 15 to 25 days after sowing.

Weed management

Weeds may reduce 20-70% seed yield of the rapeseed-mustard. Initial 45-60 DAS is critical period for crop weed competition. Deep ploughing should be done to uproot weed debris at the time of land preparation. Two mechanical weeding using hand hoe is recommended at 15-20 and 35-40 DAS. Stale seedbed and soil solarization techniques can be followed for controlling weeds in organic management. For reducing infestation of *Orobanche*, avoid continuous cropping of mustard on the same field and follow crop rotation with cereals and legumes. Cowpea/ black gram/ moth bean/ sunhemp/ clusterbean/ sesame-mustard sequence significantly reduce *Orobanche* infestation.

Irrigation management

Though, water requirement of the rapeseed-mustard is low (190-400 mm), but it is sensitive to moisture stress at critical stages of crop growth and development. In general, rapeseed-mustard requires two irrigations, first at pre-flowering stage (35-40 days after sowing) and second at silique formation stage (65-70 days after sowing) for optimum crop performances. However, irrigation requirement of the crop in different growing areas ranges between 1 to 6 irrigations due to variation in soil and climatic conditions of the region. The rapeseed-mustard crop

seed yield increases by 24% using micro-sprinkler (irrigation efficiency 60-70%) and by 18% using drip irrigation (irrigation efficiency 80-90%).

Mulching: Organic materials like crop residues/ straw/ stubble, etc. can be used as mulch and it should be spread evenly to cover the inter row spaces. This checks the water losses through evaporation and at the same time suppress weeds that are also responsible for water loss. It also adds the organic matter and increase the microbial activity and strengthen the nutrient cycling mechanisms.

Insect-pest and disease management

The important insects of the rapeseed-mustard are mustard aphid (*Lipaphis erysimi*), saw fly (*Athalia proxima*), painted bug (*Bagrada cruciferarum*), pea leaf miner (*Chromatomyia horticola*), bihar hairy caterpillar (*Spilosoma obliqua*) etc. The important diseases of the rapeseed-mustard are *Alternaria* blight (*Alternaria brassicae*), white rust (*Albugo candida*), downy mildew (*Peronospora parasitica*), powdery mildew (*Erysiphe cruciferarum*) and stem rot or blight (*Sclerotinia sclerotiorum*). In addition to pest management options given in Table 1, following management strategies should be adopted to reduce the infestation of insect-pests and incidence of diseases in rapeseed-mustard.

Control measures for important insects

Aphids: To protect the crop from aphid infestation, it should be sown early at optimum time recommended for particular area. The mustard sown before 15 October in north India often escapes aphid damage. Plucking and destruction of infested twigs is very useful. It should be done 2-3 times at 10 days interval early in the crop season. Release of *Coccinella septempunctata* @ 5,000 beetles/ha or spray of bio-agent *Verticillium lecanii* @ 1 kg/ha in 5,000 L/ha water helps in reducing the aphid population. Use of 2% neem oil (20 mL oil + 1 mL liquid soap) and 5% neem seed kernel extract (NSKE) reduces the

aphid infestation. Whenever, aphid population crosses the economic threshold level (20% plant infestation and 13-14 aphids/plant), two foliar sprays of Azadirachtin 3000 ppm @ 5 mL/litre of water at 10 days interval provides the effective control of aphids in rapeseed-mustard.

Sawfly: Timely irrigation helps in killing larvae of mustard sawfly through drowning. Collect and destroy larvae of sawfly in morning and evening. Use bitter gourd seed oil emulsion as an anti-feedant.

Painted bug: Apply the first irrigation 3-4 weeks after sowing wherever possible to reduce the painted bug infestation. Kill the bugs by removing from leaves and stems, and sinking them in kerosene water. Thresh the crop as early as possible to avoid further losses and dispose off plant material immediately.

Pea leaf miner: If infestation of pea leaf miner is observed, then pluck all the infested leaves and burn them to kill the larvae and pupae resting inside.

Bihar hairy caterpillar: If infestation of bihar hairy caterpillar is observed, then pluck all the infested leaves containing first/second instar gregarious phase larvae and dip them in kerosene-water.

Diamond back moth: Picking and destroying the larvae of pests. If the infestation is severe, install pheromone traps @ 4/acre to monitor the adult activity. Application of 4% NSKE (Neem Seed Kernel Extract) is very effective.

Control measures for important diseases

- Early sowing in first fortnight of October enables the crop to escape severe development of white rust, downy mildew and *Alternaria* blight.
- Seed treatment with biocontrol agents like *Trichoderma viridae* @ 6 g/kg seed or *Trichoderma harzianum* @ 10 g/kg seed, soil application of *Trichoderma* (1 kg/50 kg FYM), recommended spacing and proper drainage to avoid water stagnation helps in reducing disease infestation.
- Spray of cow urine on affected plants. Proper sanitation of field

is desirable. Adopt crop rotation to break the cycle of *Alternaria* blight.

- Seed treatment with botanicals like garlic (*Allium sativum* L.), bulb extract (2%) followed by garlic bulb extract foliar spray (2%) at 45 and 75 DAS reduce the infestation of *Alternaria* blight and stem rot.
- No irrigation between 25 December and 15 January is helpful to manage *Sclerotinia* rot disease.
- Use the seed from stag head free plants to avoid carry-over of oospores of *Albugo candida* and *Peronospora parasitica* through seeds.

Harvesting and threshing

The physiological maturity of the crop comes when 75% of siliquae turn to brown/ golden yellow. Crop should be harvested at this stage as delay in harvesting could lead to shattering losses. Threshing

should be done preferably by using threshers. Seeds should be sun-dried for a week to reduce the moisture content less than 8% at the storage time.

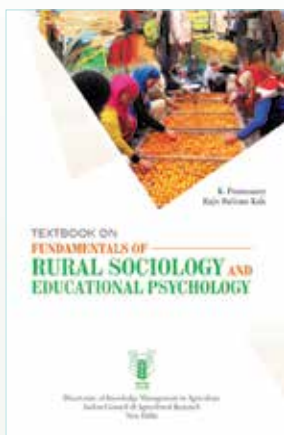
SUMMARY

Rapeseed-mustard ranks third among the world's key edible oilseed crops, and play a pivotal role in meeting the growing demand for edible oils across the world. Indian mustard (*Brassica juncea*) and rapeseed (*B. rapa*) are major *rabi* oilseed crops in India, extensively grown in states like Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, West Bengal, Assam, and Punjab under conventional chemical-based farming practices. However, the use of chemical fertilizers and pesticides is very low which can be substituted through organic sources. Therefore, growing of rapeseed-mustard crops under organic management using recommended production

technology as summarized here in this article, could be more remunerative for the growers. Research findings that support organic farming not only align with consumer health concerns but also open up potential revenue streams for farmers. Organic food is getting increasingly popular due to its perceived health benefits and environmental sustainability. Farmers who adopt organic practices could potentially access premium markets where consumers are willing to pay more for organic products. Moreover, these practices often contribute to soil health and biodiversity conservation, which can have long-term benefits for agricultural productivity. It is definitely a promising direction for farmers looking to diversify and to cater conscientious consumers.

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TECHNICAL SPECIFICATIONS

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