

Package of practices

for organic mustard in Bundelkhand

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India is the largest rapeseed-mustard growing country in the world, occupying second position in area and fourth position in production. Rapeseed-Mustard is a rabi annual, drought hardy crop, capable to grow under diverse agro-climatic conditions and different types of soils. Oil content in rapeseed-mustard varies from 33–46% amongst different species and varieties. Mustard oil is a great affordable alternative of palm oil. Organic farming of mustard 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 crops under organic management using recommended production technology provides a very good yield of 25–30 q/ha obtained in Bundelkhand region.

Keywords: Bundelkhand region, Organic mustard, Production technology

India is one of the largest rapeseed-mustard growing country in the world, occupying second position in area (19.8% of world acreage) and fourth position in production (9.8% of world production). Mustard crop is capable to grow under diverse agro-climatic conditions and in different types of soils. Indian-Mustard is cultivated under both irrigated (79.2%) and rainfed (20.8%) across nation. Oil content in rapeseed-mustard varies from 33–46% amongst different species and varieties. Mustard oil is a great affordable alternative of palm oil (popular to cause severe heart problems) as it contains linoleic acid (5–13%) and oleic acid (27%).

Organic farming is gaining importance in the country as chemical fertilizers, pesticides, etc. are causing drastic problems like soil degradation, environmental hazards and affecting human health. Crops grown under organic management are proved to be beneficial to the human health as well as to the environment and soil. Organic system involves incorporation of organic manures, crop residues,

bio-fertilisers, crop rotations and no use of chemical fertilisers and additives for crop cultivation. Organic manures like farm yield manure (FYM), vermi-compost and poultry manure, etc. not only contain primary nutrients like NPK but also contain micro-nutrients like copper, zinc, boron, iron, etc. and beneficial micro-organisms. As such, organic manures improve soil physical properties, reduce soil loss and ensure better crop growth.

Bundelkhand, a region lying in the Central and North India split between the states of Uttar Pradesh (U.P.) and Madhya Pradesh cultivates mustard. The soil in this region is categorised as red soil and black soil with poor organic content except black cotton soil. The use of chemical fertilizers and pesticides is very low which can be substituted through organic sources. Therefore, growing of crops under organic management



Bumper crop of mustard under organic management

is most appropriate to improve soil health and crop production in Bundelkhand. Mustard being hardy crop is the most suitable oilseed crop for this region. But, the package of practices for growing organic mustard in Bundelkhand are not available. Therefore, based on the studies conducted at Organic Research Farm, Karguaji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh during 2017–2021, the production technologies as developed and refined are presented here for ready reference of producers of organic mustard to ensure higher production with better quality.

Refined production technologies

Selection of suitable soil and land preparation: Mustard crop is capable to grow in a wide range of soil ranging from sandy loam to clay loam, but medium loamy soil with a neutral pH is most suitable for mustard. As it cannot tolerate water logging and excess soil moisture and heavy soils affects its growth. The initial success in any crop cultivation is considered if 90–100% germination is observed. This can be achieved by preparing the land well. Therefore, one ploughing by disc plough for dicing and slicing of soil should be done followed by two ploughings by cultivator and planking after each ploughing to get fine seedbed for sowing.

Nutrient management through organic sources: Recommended dose of fertiliser for mustard crop in U.P. is 60:40:40 NPK kg/ha and 12–15 t/ha of FYM, which can be applied through the use of FYM and vermi-compost in the ratio of 1:1 at the rate of 6 t/ha of FYM and 3 t/ha of vermi-compost. FYM and vermi-compost are the most commonly and easily available sources of organic manures. FYM is incorporated in the soil at the time of land preparation and vermi-compost is applied 2–3 cm below seed during sowing in the moist soil. Biofertilizers like PSB and *Azotobacter* can be used to increase economical yield. Studies conducted at organic farms reveal that the phosphorus and sulphur needs (Table 1) 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.

Table 1. Effect of sulphur and biofertilizers (PSB and *Azotobacter*) on grain and stover yield of mustard

Treatment	Grain yield (q/ha)	Stover yield (q/ha)
T ₀ RDF	10.23	32.37
(Sulphur 20 kg/ha through rock phosphate + PSB)	15.49	42.83
(Sulphur 20 kg/ha through rock phosphate + <i>Azotobacter</i>)	14.25	41.63
(Sulphur 20 kg/ha through rock phosphate + PSB + <i>Azotobacter</i>)	20.09	48.89

Choice of suitable varieties: While selecting seeds (variety) of mustard, this should be always kept in mind that seeds are certified, free from foreign material to get good germination. Varieties like Varuna, Pusa Bold, Giriraj, Super Gold and JM-3 were found most suitable in a research work done on organic farm of Bundelkhand University, Jhansi (Table 2). Other varieties that are suitable for this region are Kranti, Krishna, Narendra Rai- 8501, etc.

Table 2. Promising mustard varieties for organic farming in Bundelkhand

Name of promising variety	Yield (q/ha)	
	Grain	Stover
Varuna	27.5	40.3
Pusa Bold	25.7	39.1
Giriraj	24.6	38.6
Super Gold	23.1	38.0

Ensure early sowing: The most optimum time for sowing is mid-October to first week of November. Timely sowing of crop seed is important to reduce the incidence of diseases. Studies conducted at organic farm of Bundelkhand University revealed that sowing of mustard in first week of November

(4th November) was significantly better than sowing in 3rd week of November (18th November). Short duration varieties like Varuna and KMH-721 are better suited for sowing under delayed conditions (Table 3).

Seed treatment and sowing methods

Seed treatment with *Tricoderma viridae* should be done to avoid incidence of seed borne diseases. Generally, seed rate differs from variety to variety, sowing method, sowing time, germination per cent, etc., common seed rate being 4–5 kg seeds per hectare. Seeds should be sown 3–4 cm deep in a moist soil to ensure good germination. In Bundelkhand, broadcasting is the most common method practised for sowing but scientifically, seeds should be sown in lines at 45 cm apart at a distance of 15 cm. This technique ensures good germination, optimum plant population and ease in intercultural operations which ultimately improves growth and yield. The studies conducted at organic farm, Institute of Agricultural Sciences, Bundelkhand University, Jhansi involving three sowing methods revealed that line sowing was improves than cross sowing and broadcast sowing under organic management using variety Giriraj (Table 4).

Table 4. Effect of different varieties and sowing methods on yield of mustard.

Particular	Grain yield (q/ha)	Stover yield (q/ha)
<i>Varieties</i>		
Giriraj	26.70	56.25
RH – 749	21.78	48.44
RH – 406	18.67	44.35
<i>Sowing method</i>		
Line sowing	23.60	52.39
Cross sowing	21.12	47.50
Broadcast sowing	22.43	49.16

Table 3. Effect of dates of sowing on yield of mustard varieties under organic management

Date of sowing	Grain yield of selected varieties (q/ha)							
	Pusa Bold	RH-0749	RVM-2	Bayer-5222	Varuna	Super Gold	JM-3	KMH-721
4 th Nov 2017	34.58	29.99	30.56	34.95	32.64	33.13	33.89	28.93
18 th Nov 2017	31.99	30.41	30.51	31.43	32.64	31.02	31.34	33.20

Timely intercultural operations

Gap filling and thinning: The gap filling and thinning are not highlighted as important practices and are very commonly avoided which result in low yield. But, these are most important, as these practices ensure optimum plant population. After germination, re-sowing should be done at places where germination fails to occur to fill the gap and when plant attains a height of 15 cm removing extra plants to maintain crop geometry needs to be ensured.

Timely weeding: Mustard fields in Bundelkhand are most commonly infested with annual weeds like *Chenopodium album* (bathua), *Chenopodium murale* (khartua), *Phlaris minor* (Gehun ka mama), and perennials like *Cyperus rotundus* (purple nutsedge), *Cyanodon dactylon* (Bermuda) etc. Mustard plant once attain a certain height can suppress the growth of weed. Timely weeding reduces yield loss as weeds compete with crops for water, space and sunlight, thus weeding should be done at the right time to conserve moisture. One hand weeding at 40–45 DAS is necessary to avoid initial completion between weeds and crops, followed by manual weeding when field gets infested during crop period. Field should be deep ploughed to uproot weed debris at the time of land preparation. Stale seedbed techniques are considered better wherein, field is irrigated prior to sowing and weed seeds are allowed to germinate. The weed seedlings are turned into soil by ploughing before sowing.

Irrigation at optimum time: In Bundelkhand most commonly, crops are cultivated under rainfed conditions on the conserved soil moisture from monsoon rains. In absence of rains, one pre-sowing irrigation (to ensure good germination) and two irrigations first at rosette stage (30 DAS) and second at siliqua formation (55–60 DAS) respectively, should be provided to get higher yield. If only, one irrigation is available, it should be scheduled at 0.6 IW/CPE ratio at 50% flowering or early pod formation stage to get maximum



Promising varieties of mustard for Bundelkhand under organic management

yield. On the other hand, as mustard is highly sensitive to water logging, hence, adequate drainage facility of water should be maintained to avoid ill effects of heavy winter rains.

Use water saving techniques

Mulching: Organic mulches like rice straw, stubble, etc. at the rate of 10 t/ha 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.

Broad bed furrow (BBF): The most advanced and beneficial technique in current times which not only conserves moisture but also increase yield effectively is BBF. It is designed especially for *vertisols* (deep black soil) where flat beds of

90–120 cm wide with a V shaped shallow furrow of 30 cm width are laid out with a slope of 0.3–0.5%. BBF is highly effective as it provides drainage during heavy rains and conserves moisture during dry spells (Table 5)

Integrated approach for pest management

Major pests of mustard in Bundelkhand are mustard aphid, mustard saw fly, painted bug, diamond backmoth, leaf miner, etc., while major diseases are *Alternaria blight*, white rust, downey mildew, etc. The common control measures that should be adopted to reduce the infestation of pests and incidence of diseases are as follows:

- Deep ploughing to expose the soil borne pathogens and hibernating stage of defoliators.

Table 5. Mustard equivalent yield (MEY), Crop equivalent yield (CEY) and Land equivalent ratio (LER) as influenced by sowing methods using land configurations for inter-cropping of Mustard (M) with Kabuli Chickpea (KC) under organic management

Treatment	MEY (q/ha)	CEY (q/ha)	LER	Aggressivity		Competition ratio	
				Mustard	Kabuli Chickpea	Mustard	Kabuli Chickpea
M (F) + KC (BB) (1:3) (BBF)	45.49	39.24	1.32	0.58	-0.58	2.53	0.42
M (F) + KC (NB) (1:2) NBF	44.88	28.85	1.31	0.34	-0.34	2.19	0.46
M (F) + KC (R) (1:1) FIRB	39.90	25.65	1.18	0.36	-0.36	1.56	0.63

- Timely sowing of crop to reduce the chances of pest attack and disease incidence.
- Adoption of proper drainage to avoid water stagnation in the field.
- Destruction of plant debris.
- Crop rotation to disturb the cycle of obligate pathogens.

Control measures for important insects and diseases

Aphids: Aphids are most important insects and generally attack from January to March. Therefore, early sowing of crop is desirable. If the infestation reaches at economic threshold level, i.e. 20% plant infestation and 13–14 aphids/plant, spray 2% neem oil (20 ml oil + 1 ml liquid soap) at flower stage or 5% neem seed kernel extract (NSKE). Spray bio-agent *Verticillium lecanii* 1 kg/ha in 5000 l/ha water or use bio-predators like ladybird beetles as they can feed up to 10–15

adult aphids/day.

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

Mustard painted bug: Irrigate the crop at 30 DAS to reduce pest attack. Burn the remains of mustard crop so that the stage of insect do not reach the next year crop. Kill the bugs by removing from leaves and stems and sinking them in kerosene water.

Mustard sawfly: Collect and destroy larvae of sawfly in morning and evening. Use bitter gourd seed oil emulsion as an anti-feedant.

Alternaria blight: Spray of cow urine on affected plants. Proper sanitation of field is desirable. Adopt crop rotation to break the cycle of pathogen.

White rust/Downy mildew: Treat seeds with 4 g/kg seed with *Tricoderma viridae* before sowing.

Treatment of the seeds with freshly prepared garlic bulb extract @2% (w/v) is also recommended. Ensure timely sowing of crop to reduce disease load. Avoid over irrigation and water stagnation.

Ensure timely harvesting and threshing: Crop becomes ready to harvest when 75% silique turns brown. There should be no delay in harvesting as the seeds can shred of. After harvesting plants should be dried on threshing floor and once threshing is done seeds should be stored properly.

SUMMARY

Bundelkhand region comprising 14 district of Uttar Pradesh and Madhya Pradesh is considered to be potential area for promoting organic farming. Pulses (greengram, black gram and chickpea) and oil seeds (groundnut, sesame and mustard) are the major crops of the region. The production technologies related to organic farming are not available. Therefore, series of experiments were conducted at Organic Research Farm, Karguaji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi since 2017 to generate perfect technologies for improving production of selected crops under organic management. As a result, the production technologies developed for raising organic mustard are described here for ready reference of planners, extension workers and farmers of Bundelkhand region and other areas representing similar rainfed conditions. With the adoption of the recommended technologies, a potential grain yield up to 30 q/ha of mustard with better quality of oil are achievable in Bundelkhand region under organic management.

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Evaluation of mustard varieties for organic conditions

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