No-till Rapeseed-Mustard

Production Technology in Rice Fallow

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Rapeseed-mustard belonging to the family of cruciferae under genus *Brassica* is the second most important edible oilseed crop after groundnut in India. The rapeseed-mustard group broadly includes Indian mustard (*Brassica juncea*), yellow sarson (*Brassica rapa* L. var. yellow sarson), brown sarson (*Brassica rapa* L. var. brown sarson), and toria (*Brassica rapa* L. var. toria) crops. The oil content of rapeseed-mustard varies from 37-49%. Rapeseed-mustard is the most favourite oilseed for consumption point of view amongst the people of North Eastern Region (NER) of India but presently it is not grown at a larger scale. Presently, the NER is deficient in approximately 80% of its oilseed requirement. Hence, there is need to increase its area and

productivity with improved technological interventions to meet the oilseed requirement of the region. Out of the 3.5 million hectare area under rice, about, 66% area after kharif rice harvest remains fallow in the region. Thus, in rice fallow areas rapeseed-mustard has a very good potential for increasing farm income as well as cropping intensity and meet oilseed requirement. Rapeseed-mustard being winter/rabi season and low water requiring crop, fit well in the rainfed cropping system of NER. Excessive moisture content in valley land and low moisture in uplands after kharif rice are the main constraints to its cultivation.Besides this, fast decline in water table with the advancement of winter season in uplands results in mid-season and terminal drought and adversely affects the productivity of these crops. Due to excess moisture in lowland and fast decline in soil moisture content in upland, growing of these crops under conventional tillage is not a feasible option.In case of water logged lowland, one of the best options is adoption of no-till along with the provision of field drainage. Similarly, in uplands, adoption of no-till and residue retention can conserve moisture for cultivation of these crops. Retention of crop residues on soil surface in combination with suitable planting techniques can conserve soil moisture and alleviate drought stress. There is also need of suitable short duration varieties to fit in the cropping system. Early maturing varieties may escape the terminal moisture stress and suitable for late planting in rice fallow areas. Toria is more suitable for rice fallow areas due to its shorter duration, tolerant to moisture stress and gives reasonable yield even under late planting conditions.

The seeds are used as condiment in the preparation of pickles and for flavouring curries and vegetables. The oil is utilised for human consumption throughout Northern and North eastern part of India for cooking and frying purposes. It is also used in the preparation of hair oils, medicines, greases, etc. The oil cake derived after extracting the oil is used as a

Mustard seed and oil

livestock feed and manure. Green stems and leaves are good source of green fodder for livestock. The leaves of young plants are used as green vegetables in NER and they are rich source of sulphur and minerals.

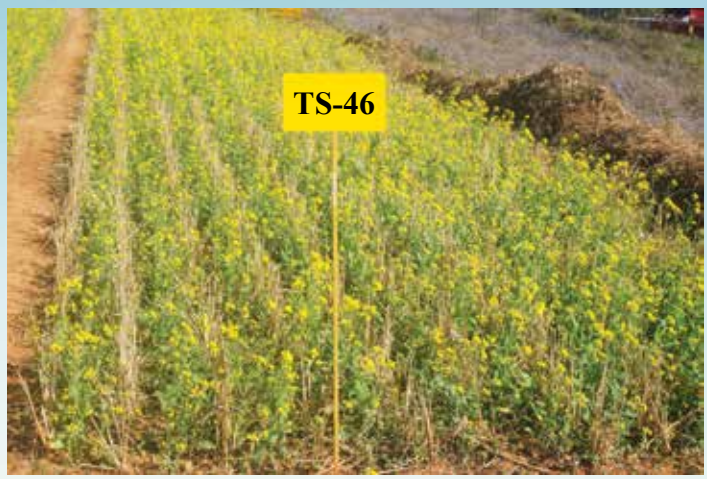
Climate and soil requirements

Rapeseed-mustards are crops of tropical as well as temperate zones and require cool and dry weather for satisfactory growth. Cool temperature, clear dry weather with plentiful of bright sunshine accompanied with adequate soil moisture increases the oil yield. They require an annual precipitation of 350-450 mm. These crops are capable of growing under a wide range of soil conditions varying from sandy loam to clay loam soils but they perform best on light

loam soils. Good drainage is required, because even short periods of exposure to waterlogged or flooded field conditions drastically reduce the yield. Plants can tolerate moderate acidity but a soil having neutral pH is ideal for their proper growth and development.

Selection of varieties

Early maturing high yielding rapeseed-mustard varieties may escape the terminal moisture stress in rice fallow and could convert these mono-cropped areas into double cropped areas. Long duration varieties may coincide with pre monsoon rain at the time of maturity and subsequently decline the productivity and quality of seed. Different varieties/ lines of rapeseed-mustard were evaluated in ICAR Research Complex for North Eastern Hill (NEH) Region, Umiam and most promising lines suitable for mid-hill ecosystem of NER are given below:



Rapeseed variety TS-46

Varieties	Duration (days)	Lowland rice fallow (q/ha)	Upland rice fallow (q/ha)
Toria (Rapeseed)			
M-27	90-100	7.0-8.5	5.50-6.0
TS-36	95-105	7.5-8.5	5.50-6.0
TS-38	95-105	7.5-9.0	5.50-6.50
TS-46	95-110	7.5-9.0	6.0-6.50
TS-67	95-105	9.0-10.0	6.0-6.50
Mustard			
Pusa Agrahani	110-120	10.0-11.0	-
Pusa 26	110-120	10.0-12.5	-
Pusa 27	110-120	10.0-13.0	-
Pusa 28	110-120	11.0-13.0	-

Seed rate and Seed treatment

Optimum plant population is a pre-requisite to exploit full potential of rapeseed-mustard. It has been observed that 5-6 kg seed is sufficient for one hectare area to sow in lines of 25 cm apart and 3-5 cm plant to plant spacings (in between 25 cm standing rice stubbles in upland and 20 cm rice stubble in lowland). Before sowing, seeds can be treated with *Trichoderma harzianum* (5 g/kg seed) or *Pseudomenas fluorescence* (10 g/kg seed) to control leaf blight and white blister disease in rapeseed-mustard.

Sowing

The optimum sowing time for rapeseed-mustard is in between 2nd fortnight of October to last week of November. The sowing should not be done after 30th November because of dropped down in temperature below 10^0C during December which reduces the seed germination, growth and development

Opening furrow using manual furrow opener and fertilizer application

of plants. Under mid-hill altitude conditions, sowing of rapeseed-mustard during last week of September to middle of October helps in utilizing the residual moisture effectively. Delay in sowing results in exposure of crop to moisture stress at reproductive stage.

In case of valley land/lowland rice fields, the fields need to be drained at physiological maturity (one week before harvesting) to get a suitable soil condition for sowing of the crop. Rice crop should be harvested by leaving about 20cm standing stubbles in lowland, whereas 30 cm standing rice stubbles should be retained in upland condition for better conservation of soil moisture. Transplanting of preceding rice in lines is recommended for no-till cultivation of rapeseed-mustard. Line transplanting of rice facilitates easy operation of no-till furrow opener and reduces the labour requirement for sowing of the crop. After harvesting of the rice, rapeseed-mustard is sown under no-till system using manual furrow opener (or mechanical no-till seed drill) with recommended dose of fertilizers, manures and plant protection measures.

No-till Rapeseed understanding stubbles in lowland rice fallow

No-till Rapeseed understanding stubbles in upland rice fallow

Nutrient Management

Organic nutrient management

For cultivation of rapeseed-mustard under organic production system, application of 5-10 t/ha of well decomposed farmyard manure (FYM) in opened furrows between rice lines is recommended. In case of availability of vermicompost, application of 3-5 t/ha is sufficient. The seeds should be covered with soil and FYM mixture (2:1 ratio) so that, proper seed-soil contact is made for good germination. As most of the soils of Meghalaya are acidic in nature, there is deficiency of available phosphorus (P), zinc (Zn) and boron (B). Liming @ 400-500 kg/ha in open furrows at the time of sowing is required for ameliorating soil acidity and to increase nutrient availability especially P, Zn and B for good crop growth. Retention of rice residue as mulch or standing stubbles also contributes to adequate nutrient recycling. Rock phosphate is an excellent natural source of P and calcium (Ca). Application of rock phosphate @ 150 kg/ha to supply phosphorus and calcium requirement of rapeseed-mustard crop is recommended. Application of sulphur (S) enhances oil content. Application of well decomposed poultry manure @ 2- 3 t/ha in furrows is helpful in supplying S along with N,P,K and calcium (Ca).

Integrated nutrient management

During sowing, well decomposed FYM 5 t/ha along with 30 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha (65 kg urea, 375 kg single super phosphate and 66.6 kg muriate of potash, for supply of N, P_2O_5 and K_2O, respectively) are applied in furrows before sowing of the seeds. Another 30 kg N (65 kg urea/ha) is top dressed at vegetative stage (30 DAS). In case of moisture stress conditions, N dose for top dressing may be reduced by 25-30%. Rapeseed-mustard have higher requirement for sulphur, therefore, N should preferably be applied through ammonium sulphate and P from single superphosphate. As 'sulphur (S)' fertilization enhanced both yield and oil content of oilseed crops, application of S @ 15-20 kg/ha is viable option to fulfill requirement of the crops.

Water management

Flower bud initiation and siliqua/pod development stages are the critical growth stages in rapeseed-mustard. Hence, in case of moisture stress, two life-saving irrigations may be provided at these stages to harness its high yield potential. Mulching or retaining standing stubbles

Rapeseed crop under residue retention

Rapeseed without rice residues

helps in conserving soil moisture and reduce irrigation requirement. Timely sowing following no-till practice, immediately after harvest of rice also reduces moisture stress by giving initial vigour to plants. Proper drainage facility should be provided along the border of the rice fields at the time of physiological maturity for draining of excess moisture in case of lowland rice fields. Mulching with rice straw (5 t/ha) is very useful in upland for moisture conservation. Whereas, in case of lowland mulching may be done if terminal drought is a problem.

Weed management and thinning

The field should be kept free of weeds in the initial stage of crop growth i.e. up to 30-45 days after sowing (DAS) to avoid competition on the reserve of moisture and nutrients. Weed infestation in rapeseed-mustard crop may result in 20-30% reduction in seed yield. Spraying of Glyphosate 41WSC (Glycel) @ 1.5 kg a.i./ha (5 ml/l of water) after rice harvesting and about a week before sowing of rapeseed-mustard helps in controlling initial flush of weed. One hand hoeing or weeding at 30 DAS followed by one hand weeding at 45 DAS is found to check the crop-weed competition. However, incase of organic production, one additional hand weeding is recommended. Besides controlling weeds, hoeing creates soil mulch and thus, reduces moisture losses through evaporation. Thinning of excess plant population should be done at the time of first weeding (30 DAS) to maintain plant to plant distance of 8-10 cm to provide the plants proper space within the row. This operation helps in better growth and development of crop plants.

Diseases

Common fungal diseases of rapeseed-mustard are leaf blight/spot (*Alternaria brassicae, A. brassicicola*) and white blister/rust/stag head (*Albugo candida*).

Leaf blight/spot of mustard

Organic disease management

White rust of mustard Rapeseed at flowering stage

Crop rotation is the most effective method of preventing disease problems. Use of resistant/tolerant varieties for sowing is the best management practice. Initially when the disease pressure is low, neem based formulations (neem oil, nimbicidine, etc.) can be sprayed @ 3-4 ml/l as foliar application. Soil application of neem cake (150 kg/ha) before planting/sowing is recommended for managing soil borne pathogens. Treat the seed with bioagents like *Trichoderma harzianum* (5 g/kg seed) or *Pseudomenas fluorescence* (10 g/kg seed) to control leaf blight and white blister disease in rapeseed-mustard. Timely weeding should be done for avoiding the favourable microclimate for disease development. Diseased plant materials should be collected and burnt properly.

Integrated disease management

Timely sowing, use of resistant varieties, optimum fertilizer dose etc. minimizes disease problem in rapeseed and mustard crop. If the disease incidence is severe and the area is not under organic production system, seed treatment with Apron 35 SD (metalaxyl 35%) @ 6 g/kg seed followed by foliar spray of Ridomil MZ 72 WP @ 2 g/l water at 50-60 DAS should be done. Seed treatment with *Trichoderma harzianum* @ 10 g/kg seed followed by foliar spray of Ridomil MZ 72 WP (metalaxyl 8% + mancozeb 64%) @ 2 g/l water at 50-60 DAS is also effective in controlling various fungal diseases.

Insect pests

Aphids (*Lipaphis erysimi*), leaf minor (*Chromatomyian horticola*) and diamond back moth (*Plutellaxyl ostella*)are important insect pests of rapeseed and mustard.

Diamond back moth on mustard siliqua

Organic pest management

Avoid excessive applications of N fertilizer, as it makes the crop vulnerable to pestinfestation. Some biological control of aphids occurs by predators such as lady bird beetles (*Coccinella septempunctata*), larvae of syrphidflies, etc. Initially when the insect pressure is low, neem based formulations (neem oil, pestoneem, etc.) can be sprayed @ 3-4 ml/l as foliar application.

Integrated pest management

Avoid late sowing to minimize aphid problems. Manual collection and destruction of the insect pests and dipping in kerosene solution can be done if there is less infestation. If the pest population is severe and the area is not under organic production system, spraying of dimethoate 30 EC @ 1 ml/l or Thiaclopid @ 0.3 ml/l or Dinetefuran @ 3 ml/l is recommended. The seedling and bolting stages are the two pivotal periods for managing aphid populations. The insecticides Dinetefuran and thiacloprid markedly reduce aphid damage. Crop rotation, use of bio-pesticides, indigenous technical knowledge, etc. is recommended to reduce use of agrochemicals for management of insect-pests in rapeseed-mustard.

Harvesting

Harvest the crop at proper maturity i.e. when the pods/silique turn yellowish-brown in colour. Otherwise yield losses are likely to occur due to shattering of siliqua. Harvesting should preferably be done in morning hours when the dews are still in the field in order to prevent shattering of the siliqua. Crop is harvested with the help of sickles. The harvested crop should be stacked and stored in threshing floor for five to six days for sun drying before threshing.

Threshing and cleaning of seeds

Threshing may be done by beating the plants with sticks or using a mechanical thresher. While beating with stick, the pods easily shatter giving out the seeds. The threshed seeds are separated from the husk with the help of slow moving natural air current or by winnowing. Cleaned seed must be dried in the sun for three to four days or till the moisture content comes down to 8%. Seeds should be stored in cool and well ventilated conditions.

Cleaning of threshed seed by winnowing

Economics

Rapeseed-mustard is high value oilseed crop. The cost of cultivation as well as net returns from rice-rapeseed/mustard system were estimated to be about ₹ 55,000 and ₹ 51,970 /ha in comparison to ₹ 38,000 and ₹ 36,250/ha for *rice-fallow*, respectively (ie cultivation cost of no-till rapeseed-mustard is about ₹ 17,000/ha). Thus, due to cultivation of rapeseed/mustard after lowland rice, the net income enhanced by ₹ 15,720/ha. Thus, rapeseed-mustard should be cultivated after rice harvest in NER for enhancing oil production, cropping intensity and income.

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