Rapeseed-Mustard cultivation in India- An Overview

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India is the third largest rapeseed-mustard producer in the world after China and Canada with 12 per cent of world's total production (2006-07). This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Rapeseed-mustard is the major source of income especially even to the marginal and small farmers in rainfed areas Since these crops are cultivated mainly in the rain-fed and resource scarce regions of the country, their contribution to livelihood security of the small and marginal farmers in these regions is also very important. By increasing the domestic production substantial import substitution can be achieved. Due to its low water requirement (80-240 mm), rapeseed-mustard crops fit well in the rainfed cropping system. Cultivated in 26 states in the northern and eastern plains of the country, about 6.8 mha is occupied under these crops (2006-07). Nearly 30.7% area under rapeseed mustard is under rainfed farming.

Rapeseed Mustard Scenario in India

Indian mustard (*Brassica juncea*) is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat which contribute 81.5% area and 87.5% production (2001-02 to 2005-06). During 2006-07, more than 84 % of the total rapeseed-mustard acreage and production in the country is accounted for by these states, out of which more than 47.0% contributed by Rajasthan state alone. The crop takes 135-150 days to mature. Some early varieties maturing in 110 days are also available. Its cultivation is also being extended to non-traditional areas of Southern States like Karnataka, Tamil Nadu and Andhra Pradesh. 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 (*Brassica rapa var brown sarson*): *lotni* (self-incompatible) and *tora* (self-compatible). The *lotni* is predominantly cultivated in colder regions of the country particularly in Kashmirand Himachal valley. Yellow sarson (*Brassica rapa var yellow sarson)* is now mainly grown in Assam, Bihar, North-eastern States, Orissa, eastern Uttar Pradesh and West Bengal. The *toria* (*Brassica rapa var toria*) on the other hand is cultivated in limited areas of eastern Uttar Pradesh. It 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, Uttaranchal and western Uttar Pradesh, it is grown as a catch crop during September- December. Taramira (*Eruca sativa*) is grown in the drier parts of North

West India comprising the states of Rajasthan, Haryana and Uttar Pradesh. Gobhi sarson (*Brassica napus*) and karan rai (*Brassica carinata*) are the new emerging oilseed crops having limited area of cultivation. Gobhi sarson is a long duration crop (more than 155 days) confined to Punjab, Himachal Pradesh and Haryana.

Rapeseed-mustard group of crops is the major oilseed crop of India. Among the seven annual edible oilseeds cultivated in India, rapeseed-mustard contributed 28.6 percent in the total production of oilseeds as has been indicated below based on the average of five years during 2002-03 to 2006-07 (Table 1). India holds a premier position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production, respectively. This group of oilseed crops is gaining wide acceptance among the farmers because of adaptability for both irrigated as well as rainfed areas and suitability for sole as well as mixed cropping. Besides, it offers higher return with low cost of production and low water requirement. Being a major *rabi (winter season)* oilseed crop and having an advantage of soil moisture conserved during monsoon, it has greater potential to increase the availability of edible oil from the domestic production.

Despite the high quality of oil and meal and also its wide adaptability for varied agro-climatic conditions, the area, production and yield of rapeseed-mustard in India have been fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programme. Nevertheless, the crop has potential to ensure the nutritional security and contribute to livelihood security. The highest productivity is in Gujarat (1396 kg/ha), Haryana(1343 kg/ha) and Rajasthan (1185 kg/ha) with overall national yield of 1151 kg/ha.

Table 1: Production of annual edible oilseeds in India - 2002-03 to 2006-07 (Average)

Annual edible oilseeds	Production (m tonnes)	Contribution (%)
Soybean	7.3	31.1
Groundnut	6.4	27.4
Rapeseed-mustard	6.7	28.6
Sunflower	1.1	4.7
Sesame	0.6	2.6
Niger	0.1	0.4
Safflower	0.2	0.9
Other oilseeds	1.0	4.3
Total oilseeds	**23.4**	**100**

Source: Agricultural statistics at a glance, Ministry of Agriculture, Govt. of India, 2008

Crop Improvement

The major objectives of the Brassica research programme in the country are

- Improve oil and seed yield
- Hybrid development

- Stabilizing yield through insulation of cultivars against major biotic (white rust, *Alternaria* blight, *Sclerotinia* rot diseases and aphid insect) and abiotic stresses (drought and salinity)
- Improving oil (low erucic acid) and seed meal (low glucosinolate) quality
- Developing suitable varieties for non-traditional areas (southern states) and rice fallows in eastern and northeastern states.

Crop Improvement in Oilseed Brassica

Crop Improvement is one of the most potential production enhancing technology. Concerted efforts over the last 41 years led to the development and recommendation of 146 rapeseed-mustard varieties after the inception of the All India Coordinated Research Project on Oilseeds in 1967 for varied cropping systems and situations. Presently the varietal development programme is carried out under the umbrella of All India Coordinated Research Project on Rapeseed Mustard (AICRP-RM) spread over 23 main and 15 verification centres to augment the needs of various agro-climatic zones throughout the country .In all, 187 varieties have been recommended / released from 1936 to 2008 in India. Of these, Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agriculture Crops has notified 118 varieties for breeder seed production. Among the varieties recommended, highest number was for Indian mustard (96) followed by Toria (32), Yellow sarson (23), Gobhi Sarson (13), Brown sarson (9), Karan rai (7), Taramira (6) and Black mustard (1). The contribution of varietal technology to production and productivity enhancements is related to several factors which are interlinked. The recommended varieties recorded 9 to 53 per cent yield increase over national checks under varied situations. Short duration varieties of less than 100 days duration are available which can be used as a catch crop or give an additional crop and thereby augmenting gross income for the farmer. Some recently released varieties suitable for different environments are given in the table below.

Table 2: Improved varieties of Indian mustard for specific environmental conditions

Stress/situation/condition	Varieties Recommended
Salinity	*Indian mustard : CS-52, CS-54,CS 234-4, Narendra Rai -1*
High temperature tolerant	*Indian mustard: Kanti, Pusa Agrani, RGN-13, Urvashi*
High Oil Content	*Indian mustard: Narendra Swarna Rai 8*
Earliness	*Indian mustard: Kanti, Narendra Ageti Rai 4, Pusa Agrani, Pusa Mahak.*
Intercropping	*Indian mustard: RH-30, RH781, Vardan.*
Non Traditional Areas	*Indian mustard: Pusa Agrani, Pusa Jaikisan, Gujarat Mustard 2.*
Late Sown	*Indian mustard: Ashirwad, RLM 619, Swaran Jyoti, Vardan, Navgold*
Frost Tolerant	*RGN13, RH-781, Swaran Jyoti*

Drought (Rainfed)	*Indian mustard RH-819, RH-781, GM1, Pusa Bahar, Pusa Bold, Aravali Mustard, Sej-2, JD-6, Geeta, RGN-48, RL-99-27, Shivani, PBR-97*
Low erucic acid /glucosinolate	*Indian mustard: Pusa Karishma, Pusa Mustard 21, LET-17, LET-18* *Gobhi Sarson: Hyola 401, GSC 5, GSC 6, NUDB 26-11, Teri Uttam Jawahar.*
White rust resistance	*Indian mustard: Basanti, JM 1, JM 2, Maya*

Hybrid development in Indian Mustard

The development of hybrid in Indian mustard by National Research Centre on Rapeseed-Mustard, Bharatpur, namely NRCHB-506, through heterosis breeding using moricandia cytoplasmic genetic male sterility system is a major advancement in the field of varietal technology and allied research. This is the first mori candia CMS based hybrid of Indian mustard in India and an important milestone in Brassica research programme of the country. The hybrid was identified for release primarily for Rajasthan and U.P. states. This hybrid had shown superiority for oil yield over existing popular varieties of the region viz., Maya and Varuna, respectively in trials across the states of Punjab, Haryana, Rajasthan, Gujarat and Uttar Pradesh. It is of medium duration (133 days), medium tall (190 cm) and has high oil content (40.6 per cent) and has shown wide adaptability. Another hybrid, namely DMH-1 has also been developed by Dhara, a wholly owned subsidiary of NDDB, in collaboration with Delhi University. Further yield enhancements can be made by exploiting the hybridisation technology in the years to come.

Breeder seed production

Seed forms one of the major inputs for improving the productivity of the crops. Public sector has played a major role in developing and supplying improved seeds of rapeseed-mustard to the Indian farmers. During the period, 1986-87 to 2007-08, a total of 2290.9 quintals of breeder seed was produced for rapeseed-crops and supplied to various public and private organizations for multiplication and the supply of certified seed to the farmers. During 2007-08, 65 varieties (Mustard 41 ; Toria 13 ; Yellow Sarson 4 ; Gobhi Sarson 1 ; Karan Rai 1 ; Taramira 1) of rapeseed-mustard were in the seed production chain. The leading varieties of rapeseed-mustard during the last five year (2002-2007) were Pusa bold, Pusa Jai Kisan, Laxmi, RH-30 of mustard and M-27 of Toria, contributing 16, 9, 8, 6.7 and 6%, respectively to the total indent of breeder seed.

The varietal technology component is an important aspect in the strategy to increase the productivity of rapeseed mustard. In recognition of the important role of improved germplasm in crop breeding programmes , constant efforts are made in this direction at National Research Centre on Rapeseed Mustard. A total of 8521and 5909 accessions of rapeseed-mustard is available at NRCRM and otherAICRP-R&M Centers, respectively. Out of this, 196 accessions of rapeseed

mustard germplasm were obtained, 1482 germplasm were evaluated ,1600 lines maintained and 409 lines distributed during the year 2007-08, alone.

Sources of Resistance

Under the AICRP Programme, research efforts are directed towards identification of suitable donors for desirable characters to be used in the breeding programme. Many such donors have been identified in the past and efforts are continued in this direction. Some of the identified sources for biotic stresses are given in Table 3.

Table 3 . Sources of various biotic stresses

Characteristics	Promising donors
Tolerance to Alternaria blight	***B. juncea*:** EC-129126, EC 399301, PAB 9511, PAB 9534, RC 781 ***B. carinata*:** PBC-9921 (Kiran), PC 5, Pusa Swarnim (IGC 01) ***B. napus*:** GSL-1, HNS-3, PBN-9501, PBN-9502, PBN-2001, PBN-2002
Location/ race-specific (moderate) resistance to White rust	***B. juncea*:** EC 399300, EC 399301, JMMWR-941-1-2, PWR 2001, PWR 9541 ***B. carinata*:** JTC 1, Kiran (PBC-9921), PC 5, PC5-17, Pusa Gaurav (DLSC 1), Pusa Swarnim (IGC 01) ***B. napus*:** GSL-441, HNS-4, PBN-2001,PBN-2002
Location/ race-specific (moderate) resistance to downy mildew	***B. juncea*:** BIOYSR ***B. napus*:** PBN-2002

Crop Production

Cropping sequence

Cropping sequences differ according to climate and soil types. In rainfed areas it is desirable to select a crop and variety, which produce fairly a good yield under limited soil moisture conditions. The productivity of rapeseed – mustard can be increased substantially by incorporating crops in the existing cropping systems at the farmer's field. Bajra-mustard sequence was more remunerative under flood prone eastern plain zone of Rajasthan. Moreover mustard can be intercropped successfully with wheat, barley, gram and lentil under rain fed conditions and with potato as irrigated conditions. Intercropping systems as Potato + Mustard (3:1), Field pea + Mustard (3:1) and Gram + Mustard (3:1) are widely practiced in mustard growing areas.

Intercropping systems

The suitable mustard based intercropping systems for different states of India have been identified/ refined (Table 4). Except for wheat + mustard and potato combination, the remaining ones are recommended for rainfed.

Table 4 . Intercropping combinations with Indian mustard

State/region	Intercropping combination	Row ratio
Haryana	Gram + Mustard	5:1
Rajasthan	Gram + Mustard	3:1
	Potato + Mustard	3:1
	Lentil + Mustard	6:1
Uttaranchal	Lentil + Mustard	5:1
	Wheat + Mustard	9:1
	Gram + Mustard	4:1
Uttar Pradesh	Wheat + Mustard	9:1
	Potato + Mustard	3:1
	Barley + Mustard	6:1
	Linseed + Mustard	5:1

Nutrient management

On an average, 25% districts in the country as a whole are reported to be S deficient since cultivation of oilseeds that require high S is concentrated in rainfed regions. Maintenance of optimum organic matter level is imperative to avoid multiple nutrient deficiencies. Among micronutrient disorders, Zn deficiency in soils is the most common. The Zn deficiency ranges from 21% in the soils of Rajasthan to as high as 60% in the soils of Haryana.

The INM package specific to rapeseed and mustard which essentially integrates all sources of plant nutrients is highly responsive in increasing mustard productivity. In general, rapeseed-mustard is grown on coarse textured soils, very low in organic matter. Under such situations organic manures can be exploited to boost the production of rapeseed-mustard and to improve fertilizer use efficiency. Balanced fertilization is all the more essential even at low levels of fertilizer usage for maintaining long term fertility. The present emphasis on the production and promotion of fertilizers containing N, P and K has to be modified to include the fourth major plant nutrient S. The K recommendation in different states varies from 20 to 40 kg K_2O/ha. Generally S uptake is 9-15% of N uptake and similar to or more than P uptake. For efficient S management, rate, source and time of S application have to be optimized. Among several micronutrients zinc deficiency is

fairly wide spread. Mustard is reported to respond to zinc application @ 10-20 kg/ha as basal or 0.5% as foliar spray. Next to zinc, boron nutrition is important to mustard. Deficiency of boron could be corrected either through soil application (1 kg Boron/ha) or foliar application of borax. Azotobacter and Azospirillum are the two major micro organisms that are found to help rapeseed-mustard group of crops to fix atmospheric N. The associative and antagonistic action of soil micro flora and organic matter content of the soil greatly influence the growth of *Azotobacter* and it N fixing ability. Lack of organic matter in mustard growing areas is a limiting factor and the beneficial effects of small amounts of humus on the growth of *Azotobacter* and its N fixation is well documented. Some of the specific issues related to important crop nutrient are discussed below.

Nitrogen

Nitrogen is the most responsive nutrient for rapeseed-mustard. Two major factors that determine the quantum of yield response to fertilizer are genotype and environment. The nitrogen requirement of the crop also depends on the soil type and organic matter content. Improved varieties of mustard have been reported to respond nitrogen application up to 120 kg N/ha. Consequent upon the release of improved cultivars a significant change occurred in plant type and fertilizer use efficiency compared to traditional varieties. Significant response was obtained to nitrogen-applied up to 80 kg N/ha under rainfed conditions and up to 120 kg N/ha under irrigated conditions. The nitrogen accumulation curve during growth period follow sigmoidal pattern. The rate of nitrogen accumulation exceeds the rate of dry matter production in early stages of growth up to 70 days after sowing and decline there after, indicating shedding of leaves. The time of nitrogen application in rapeseed-mustard is also importance for getting better response to applied nitrogen. In multi location trials split application of nitrogen, 50% as basal and 50% as top dressing after first irrigation gave better utilization of nitrogen and higher seed yield under irrigated condition. Methods of application of nitrogen play an important role to increase the efficiency of applied fertilizer as well as the seed yield of mustard. The foliar nutrition is normally resorted to for correcting acute nutrient deficiency and for supplying nutrient, which have more leaching, and volatilization losses when applied to the soil. This form of nutrient application has scope in rainfed conditions where soil moisture is not adequate to support soil application, especially at later stages. Foliar spray could lead to a 25 per cent saving of nitrogen in mustard.

Phosphorus

This nutrient element is commonly lacking in many soils. Although abundant amount of phosphorus are absorbed and accumulated by rapeseed-mustard group of crops, the actual amount of phosphorus needed in metabolic reactions and structural components of cells are relatively small. The total P_2O_5 uptake/ tonne produce ranged between 12.4 to 42.7 kg in mustard. Adequate phosphorus helps the

mustard plant to partition greater proportion of the additional dry matter into the grain. Mustard genotypes exhibited differential response to phosphorus application. Apart from genotype, soil type and soil fertility status, level of applied nitrogen, potassium and environment for optimum crop growth are the factors that affect response to phosphorus. The best results are obtained only through balanced fertilizer use and in the absence of nitrogen; there is little response to phosphorus on account of nitrogen being the most limiting nutrient. In northern India, the rate of P_2O_5, application varied between 30-50 kg/ha depending upon availability of moisture. Use of SSP should be done as it contains 12 percent S, also, which is also an important requirement of mustard.

Potassium

Potassium deficiency may not be a serious problem for the rapeseed-mustard growing areas. The response to K application had generally been very small. The recommendation in different states varies from 20 to 40 kg K_2O/ha.

Sulphur

Sulphur is a vital component of essential amino acids. In general, the amount of S taken up to produce one ton of economic yield (main produce) is considered to be 12 kg for oilseeds. When averaged across a number of field studies, the response to applied S (in terms of yield increase over no-S) was 30% or above in mustard. S fertilization significantly improved various quality parameters within plant system. The N/S ratio and the content of nitrate and non-protein N were reduced, and protein content increased. Application of S in combination with balanced amounts of other nutrients significantly increased the oil content of *Brassica* spp. (5-6%) and also the protein content. To correct S deficiency in rapeseed- mustard in different soils, 40 kg S/ha was optimal under most field conditions. The yield increase with the application of S varied from 12 to 48 per cent under irrigated conditions depending upon crop species, S carrier and extent of S deficiency. Among the sources, application of gypsum increased the seed yield of mustard as compared with Single Super Phosphate.

Strategic Interventions in crop production technologies

Technologies like Resource Conservation Technology (RCT), Crop Contingency Planning (CCP), Precision farming, Crop Ecological Zoning (CEZ), Crop modelling and simulation etc. are some of the key areas of innovative agro techniques. Resource-conserving technologies improves the efficiency of use of natural resources, including water, air, fossil fuels, soils, inputs, and people. Resource-conserving technologies has been successfully developed, tested, and deployed for rice-wheat cropping system. Development of suitable machinery, studies on residue management in oilseed crops, development and agronomic testing of varieties suitable for zero tillage conditions , advantages and impact of

land leveling on rapeseed-mustard production , productivity and input use efficiency etc are some of the indicative areas of research gaps which needs to be addressed. Rapeseed-mustard are mostly grown in marginal and resource poor conditions. Weather aberrations are a potentially limiting factor in realizing optimum yield. In such a scenario, emerging fields of agronomic research like contingency crop planning techniques can be of help. Contingency Crop Planning refers to alternative crop plan to minimize adverse effect of weather aberrations. A case in point for the use of this technique is the severe drought conditions experienced during the 2002-03 crop season. The production of oilseeds which was 20.80mt during 2001-02 decreased to 14.84 during 2002-03. Such types of major fluctuations in production and productivity can be avoided by suitable crop contingency planning. Given the importance of resource conservation and emphasis on enhancing input use efficiency, the role of precision farming in oilseed crops cannot be undermined. It requires the use of new technologies, such as global positioning system (GPS), sensors and information management tools to assess and understand variations. Collected information may be used to more precisely evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to more accurately predict crop yields. Crop Ecological Zoning refers to the practice of delineating efficient zones for specific crops to help in realizing potential yields with high input use efficiency. Crop ecological zoning involves division of an area of land into smaller units within a geographical continuum, which have similar characteristics related to land suitability, potential production and environmental impact.

The research potential of emerging areas like nutrient and water use efficiency, nutrient interactions, role of micro-nutrients, source sink relationship and modification of assimilate partitioning mechanisms in rapeseed mustard research are being taken up in different research organizations in the country. Along with the improvements in conventional and advanced crop research areas, some non conventional approaches, which could be adopted in rapeseed mustard cultivation, are also taken up by the research system. They include the use of effective micro organisms, use of PGPRs, anti- transpirants, and plant growth hormones etc. While a reason for concern, the existing low level of productivity also offers immense potential for advancements in crop improvement through application of research findings. From a proper perspective, there exists lot of avenues for further yield enhancement in rapeseed mustard provided they are explored meticulously.

Crop Protection

Diseases

Expression of full inherent genetic potential of a genotype is governed by inputs that go in to the production system. Production has to be increased vertically

taking in to account the exploitable yield reservoir. The losses in oilseed crops due to biotic stresses is about 19.9%, out of which diseases cause severe yield reduction at different growth stages. Various plant pathogens are reported to affect the crop. Among them, 18 are considered to be economically important in different parts of the globe. In India, the following diseases cause considerable yield losses.

Disease	Yield losses
Alternaria blight	Up to 47%
White rust	Up to 47%
Sclerotinia rot	Up to 40%
Powdery mildew	Up to 18%

A systems approach needs to be considered for a better crop management. The following strategies are helpful for disease management.

- Choosing the sowing time is very important as it affects the disease incidence significantly
- Deep summer ploughing.
- Use of disease resistant or tolerant or early maturing disease escaping cultivars.
- Use of good quality seeds.
- Seed treatment with biocontrol agents viz., *T. viride*, G. *virens* or botanicals like *Allium sativum* bulb extract (1 % w/v) or carbendazim @ 0.1% a.i. or mixture of carbendazim with Apron 35 SD (6 g/ kg). There is a need for mixture of fungicides for avoiding resistance development in pathogens to fungicides. Use of biocontrol agents is advantageous as they are often effective against a wide range of soil-borne pathogens. Moreover, they are ecofriendly, cost effective and their use avoids the risk of development of resistance in the pathogen towards the control agent.
- Application of recommended doses of N, P and K fertilizers with split application of N
- Maintaining optimum plant population with recommended spacing.
- Proper drainage to avoid water stagnation

Insects

These crops are highly vulnerable to large number of insect pests. About 50 insects are known to damage *Brassica* crops. Among these insects, mustard aphid (*Lipaphis erysimi*) is the key pest of the*Brassica* crops while saw fly (*Athalia proxima*), painted bug (*Bagrada cruciferarum*) causing yield losses. Yield losses due to aphid may be up to 97 per cent and sawfly and painted up to 15 and 30 per cent, respectively. The period of peak activity for aphids is January – February in most part of the country. The economic thresh hold level (ETL) values for aphid in rapeseed-mustard for different states has also been worked out. The integrated insect management strategies are given below:

Integrated insect management

- Crops should be sown at optimum time recommended for particular area. The mustard sown before 15th October in north India often escapes aphid damage.

- Use balanced dose of fertilizers. Overuse of fertilizers particularly nitrogen attract more aphids.
- Plucking and destruction of infested twigs / plants at initial stage of attack is very useful.
- Plucking the infested leaves and burry them in soil helps in the reduction of the pest.
- Plant extracts of *Azadirachta indica, Lantana camer* and *Ipomoea carnea* proved toxic to mustard aphid
- Microbial pesticides have been widely used in the management of insect pest and avoiding the development of resistance. The use of *Verticillium lacani* against the mustard aphid and other aphids has been found encouraging.

Exploitable yield reservoir for rapeseed-mustard in India

The results obtained from crop demonstrations in the farmers field during the five years period from 2001-02 to 2005-06 have conclusively proved the beneficial impact of the production technology over the farmers' practices. The productivity improvement varied between 17-212% (rainfed) and 10-131% (irrigated) in frontline demonstrations involving whole package. The yield increase with Improved Technology over Farmers Practice ranges from 12 to 110%. The impact of improved technologies in yield increase was positive and the realizable yield gap was 40% between the mean yield with improved technology (IT) and the national average yield. Thus, an additional production of 2.48 mt can be expected by exploiting existing IT .

Possibilities of productivity enhancement from various technological components

The favourable yield increments are attributed to appropriate choice of varieties, timely planting in conjunction with application of recommended fertilizer dose, use of sulphur and need based plant protection measures. The impact of improved technological components on the productivity in irrigated conditions during 2002-03 to 06-07 is presented in Table 5.

Table 5: Impact of technological components on the productivity of rapeseed-mustard

Technological components	Increase in productivity (%)
Improved varieties	9-45
Plant protection measures	7-24
Recommended fertilizers	16-18
Sulphur nutrient	9-16
Thinning to remove excess plants/sqm	13-16
Thiourea spray at flowering	10-12
Timely weeding	11-27
Chemical weed control	14-35

Conclusion

Rapeseed-Mustard crop offers immense scope for further yield enhancement as far as India is concerned. This stems from the fact that the existing yield at the national level is much less than the demonstrated yield level possible with the

existing technologies and also due to the fact that further yield enhancement possibilities exist in the form of unexplored and scantily researched areas in crop production and crop improvement in oilseed *Brassicas* in the country. This acts as a potential yield reservoir which needs to be tapped with advancements in research and through the spread of the existing technologies. Development of new methodological approaches and crop production and protection techniques which are eco regional in scope and simultaneously incorporating the constraints imposed by the natural resource availability of the region is the need of the hour. The existing low level of productivity offers immense potential for advancements in crop improvement through application of research findings. For India, the attainment of self sufficiency in edible oils is possible if the production potential of our annual edible oilseed crops are harnessed through improved technologies and their timely transfer to the oilseed cultivators.