Journal of Oilseed Brassica, 2012 3(2): 67-77

Presidential Address

Production barriers and technological options for sustainable production of rapeseed-mustard in India

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At the onset, I take this occasion to express my deep sense of appreciation to the fraternity of Society for Rapeseed-Mustard Research for electing me the President of this novel and important society of oilseed Brassica. It has been a sheer pleasure and a privilege to serve this great society. I wish and hope that the SRMR shall continue to flourish with greater momentum and vibrancy to take its prestige and image to new horizon in this era of technological revolution. I have choosen this topic to discuss today, since it has been very near and dear to my heart and soul the day opted for the crops of Oilseed Brassica in 1975. CCSHAU was selected the venue to hold this conference, because the University has made tremendous contribution in the field of rapeseed-mustard research and development. Several high yielding varieties have been developed by the University. I am happy at this occasion to several personalities known in the field of agriculture research and development, especially in rapeseed-mustard from across the country and also from Canada. The contribution of CCSHAU in oilseeds production in general and oilseeds Brassica in particular is remarkable. It is my concern that the overlook towards toria, which could be an important donor source for high temperature stress at seedling stage. The crop is gaining globally in importance due to its advantage over other oilseeds viz., higher yield potential, low moisture requirement, higher return at low cost of production, wider adaptability for various farming conditions, etc., which hold promise towards having the next yellow revolution. Despite these positives, the area, production and yield of the crop is fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programme.

Rapeseed-mustard group of crops is the major oilseed crop of India. Among the seven annual edible oilseeds, rapeseed-mustard contributes about 23% acreage and over 25 % production for the last five years. India holds a leading position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production respectively during 2010-11. 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 *rabi* 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 of oil and meal quality and 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 to bring about the Yellow Revolution. This calls for an all out effort of all the stakeholders for application of appropriate technology in the production process.

Annual scenario of edible oilseeds in India

Among the seven annual edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6 percent of the total oilseeds production based on the average of five years during 2005-06 to 2010-11 Among the edible *rabi* oilseeds of India, rapeseed-mustard is a major crop, being cultivated along with safflower, *rabi*- groundnut and *rabi*- sunflower. The share of rapeseed-mustard to the total edible *rabi*

oilseeds production was 78.9 %, during 2005-06 to 2010-11.

Scenario of Rapeseed-mustard production

India holds a premier position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production, respectively. During the four years period between 2005-06 and 2010-11, India's average share to world's production and area for rapeseed-mustard was 13.37 % and 21.67%, respectively. The yield of rapeseed-mustard in India (1089 kg/ha) was about two-third of the world's average yield of 1695 kg/ha. As maturity duration of Indian cultivars is only 4-5 months compared to almost 10 months in other rapeseed-mustard growing countries like Canada and European countries, the per day productivity of Indian cultivars is quite at par with the world average.

Rapeseed-mustard production trends in world and India during 2005-06 to 2010-11

Year	World			India		
	Area (mha)	Production (mt)	Yield (Kg / ha)	Area (mha)	Production (mt)	Yield (Kg/ha)
2005-06	26.79	46.27	1730	7.28	8.13	1117
2006-07	28.08	48.29	1720	6.79	7.44	1095
2007-08	30.51	57.55	1890	5.82	5.83	1001
2008-09	31.14	60.58	1950	6.30	7.30	1143
2009-10	32.63	58.73	1800	5.53	6.41	1159
2010-11	26.79	46.27	1730	6.49	7.41	1197
Average	**29.39**	**53.01**	**1700**	**6.37**	**7.09**	**1119**

In India, rapeseed-mustard is predominantly cultivated in Rajasthan, UP, MP, Haryana, Gujarat, West Bengal, Assam and Bihar states. Together these states accounted for 95% acreage and 96.7% production of rapeseed-mustard in the country.

Edible oil import in India

India has been importing on an average 46.8 lakh tonnes of edible to meet its requirement during the last six oil years at a cost of around 10,000 crores annually. Population pressure coupled with better standard of living, low oilseeds production due to aberrant weather for several years and liberalization of import-export policy are the causes behind such an import scenario.

There is a need to balance the government policies between availability of edible oils to the consumers in reasonable quantities at affordable prices on one hand and, promoting domestic production, without resorting to uncontrolled imports to safeguard the interests of the grower, employment, industry and human health on the other.

Demand projections for India's edible oil

The demand projections for edible oils made by the National Council of Applied Economic Research (NCAER, New Delhi) taking into account the expected per capita income growth (annual estimate of 4, 5 and 6%) and income elasticity of demand at the projected per capita consumption of about 15 kg (medium estimate), the total requirement of vegetable

oils is expected to be around 190 lakh tonnes, which is roughly equivalent to 570 lakh tonnes of edible oilseeds.

Quality of rapeseed-mustard oil & seed meal : best for nutritional security

Rapeseed-mustard oil contains lowest level of saturated fatty acids among all vegetable oil, which is quite desirable for good health. Both the essential fatty acids (EFA) such as linoleic acid (C18:2) and linolenic acid (C 18:3) are present in rapeseed-mustard oil. Rapeseed-mustard oil has high level of antioxidant (¡-tocopherol), which retards growth of free radicals mainly responsible for disease like cancer and ageing. Glucosinolates present in seed meal (e.g., Indolyl glucosinolate) has shown anti cancer properties. Brassica species are very rich in phenolic compounds and glucosinolates. About 100 glucosinolates are known in the Cruciferous crops. Glucosinolates concentrations in plant vary across its different parts and depend on factors such as cultivars, package of practices adopted and agro climatic conditions. Hydrolytic products of glucosinolates may be harnessed as eco-friendly bioagent for pest management.

Increasing acceptability for rapeseed-Mustard crops in India

The Indian productivity of rapeseed-mustard is comparatively lower as compared to the world average. Hence, there is greater scope for enhancing the productivity by adoption of improved production and protection technology. Rapeseed-Mustard crops are gaining wide acceptance among the farmers because of :

* Adaptability for both irrigated as well as rainfed areas and suitability for sole vis-a-vis mixed cropping
* Being relatively salt tolerant, it can be grown under a reasonable salinity and add to the income of farmers
* Higher return with low cost of production and low water requirement
* High net return on investment
* About 35-46 percent oil in the seed. Oil is rich source of energy with the saturated fatty acid as the lowest amongst the vegetable oils. Two essential fatty acids viz. linoleic and linolenic are present in desired ratio.
* The relatively high content (36-38%) and quality of protein make the rapeseed- mustard seed meal valuable raw material for food as well as feed industry The good amino acid composition often compared to milk protein, contributes to high nutritive value.

Reasons behind unsustainable production of rapeseed-mustard

The following are the major constraints limiting the productivity of rapeseed-mustard :

* Uncertainty of acreage of the crops due to several factors: Climatic, biological, natural resources, policy decisions (MSP), etc
* Low and erratic rainfall leading to continuous moisture stress/ drought over the years. Seedling stage is most sensitive to moisture stress followed by flowering. Initial moisture stress has resulted in re-sowing and poor plant stand. Farmers are also not well versed with the moisture conservation techniques
* Irrigation with saline and alkaline-blended water in most of the areas of Rajasthan and parts of Uttar Pradesh, Haryana, Punjab resulting in salinity build up**.**
* Mono cropping in most of the major areas has led to soil deficiency for nutrients and built-up of soil borne pathogens. Imbalance fertilizer use prevails invariably in all parts. Stress caused by insect, nematodes, fungal, bacterial and viral pathogens, *Orobanche* and weeds collectively result in approximately 45 per cent yield loss annually.
* The high temperature during crop establishment (mid September to early November), cold spell, fog and intermittent rains during crop growth also affect the crop adversely and cause considerable yield losses by physiological

disorder and appearance and proliferation of white rust, downy mildew and *Sclerotinia* stem rot diseases and aphid pest.

* Unawareness among the farmers about available improved varieties suitable for their farming condition, their reluctance regarding use of balanced dose of fertilizers, adoption of plant protection measures to control pest, diseases and weeds and harvesting at proper time adversely affected rapeseed-mustard production.

* Unavailability of seeds of improved varieties suitable for various micro-farming situations prevailing at the farmers' level.

Strategies for increasing sustainable production of rapeseed-mustard

Replacement of old/obsolete varieties with improved varieties suitable for specific envi onmental conditions

Replacement of old varieties by suitable recommended varieties can increase the rapeseed-mustard yield by average 15-20 per cent. Till 2011, 141 improved varieties of rapeseed-mustard have been notified by the Govt. They could play a critical role in enhancing the productivity if they are chosen as per their suitability to various micro-farming and environmental situations. Several varieties of Indian mustard have been recommended for specific conditions during 2005-08.

Improved varieties of Indian mustard for specific environmental conditions

Stress/situation/condition	Varieties Recommended
Salinity	CS-52, CS-54, Narendra Rai -1
High temperature tolerant	Kanti , Pusa Agrani,RGN-13, Urvashi
High Oil Content	Narendra Swarna Rai 8
Earliness	Kanti, Narendra Ageti Rai 4, Pusa Agrani, Pusa Mahak.
Intercropping	RH-30, RH781, Vardan.
Non Traditional Areas	Pusa Agrani, Pusa Jaikisan, Gujarat Mustard 2.
Late Sown	Ashirwad, RLM 619, Swaran Jyoti, Vardan, YRN-6 (Navgold)
Frost Tolerant	RGN13, RH-781, Swaran Jyoti
Drought (Rainfed)	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	Pusa Karishma, Pusa Mustard 21, LET-17 Gobhi Sarson: Hyola 401, GSC 5, GSC 6, NUDB 26-11.
White rust resistance	Basanti, JM 1, JM 2, Maya

Improved varieties with oil and seed meal quality needed promotion. The efforts to develop rapeseed-mustard varieties with improved oil and seed meal quality have led to the recommendation of three Canola quality (GSC-5, GSC-6 and TERI Uttam Jawahar) varieties of Gobhi sarson and two low erucic acid varieties (Pusa Karishma and Pusa mustard-21) of Indian mustard.

Breeder seed indent for newly notified varieties essential

In order to popularise and maintain the quality of seeds of improved varieties, 2251.16 quintals of

breeder seed was produced against the indent of 795.8 quintals during 1984-85 to 2006-07. Presently, 65 varieties (Indian mustard: 41; toria: 13; yellow sarson: 4; Karan Rai: 2; Gobhi sarson: 3; Brown sarson: 1; Taramira: 1) are in seed production chain out of total 116 varieties notified by the government of India. Breeder seed indent for all the newly notified varieties should be given by the DAC.

Proper cropping system essential

Cropping sequence with kharif legumes like moong, black gram, cowpea, green gram, guar, dhaincha, etc are beneficial for their N-fixing nature. Rapeseed-mustard crops fit well in various cropping systems, because of low water requirement (80-240 mm). Intercropping of rape-seed-mustard along with other crops enhances the cropping intensity and also minimizes risk against biotic and abiotic stress environment. The mustard based remunerative/prevalent intercrops and crop sequences are as follows :

State	Crop sequence	
	Irrigated	Rainfed
Bihar	Maize-Mustard / Yellow Sarson Maize-Toria-Wheat-Moong	Maize/Early rice-Toria/Mustard/Yellow Sarson.
Gujarat	Bajra/Groundnut/Sesame-mustard Moong /Urd-mustard	------
Haryana	Early fodder-Mustard Groundnut / Bajra-Mustard	Maize/Bajra-Mustard
Madhya Pradesh	Soybean Early duration/ Fallow / Moong-Mustard	Soybean-Mustard
Punjab	Rice-mustard/gobhi sarson	Bajra-Mustard
Rajasthan	Maize/Bajra/Moong/Cluster bean/Cowpea-Mustard / Taramira	Sorghum (Fodder) – Mustard Bajra-Mustard
	Bajra + Urd bean – mustard	Urd /Moong / Cowpea-Mustard
Uttar Pradesh	Maize-Autumn Sugarcane + Mustard Maize-Toria-Wheat Rice-Mustard/ Yellow sarson Sesame-Mustard Urd/Moong / Cowpea-Mustard	Miaze-Mustard Maize / Bajra-Toria / Mustard / Yellow sarson Rice-Mustard / Yellow sarson

Important mustard based viable cropping systems

Some of the important cropping systems suitable for different states in the country are :

Proper crop management practices are essential for sustainable production

The desired productivity can only be realized through adoption of systematic cultural management practices involving soil and moisture conservation, fertilizer management along with appropriate crop management practices. Improved agro- production technologies have been developed both for irrigated and rainfed areas, which emphasized timely sowing, line sowing with recommended spacing and

optimum seed rate, fertilizer application , thinning at appropriate time, etc varieties, fertilizer, plant protection, irrigation, weed control, etc.; have been identified as critical inputs for different regions. The key factors have been described below :

Crop sowing at optimum time : Timely sowing is an important aspect to obtain good seed and oil yield and the crop often escapes diseases and insect pests attack. Delay in sowing drastically reduces crop productivity. Since rapeseed-mustard crops are grown in diverse agro-climatic conditions, the optimum sowing time varies widely. The optimum sowing time in the major sarson growing areas (Rajasthan, UP, Uttaranchal, Madhya Pradesh, Haryana, Gujarat) spreads from mid-September to October end, however, in Assam, Chhattisgarh, Himachal Pradesh, Orissa, Punjab and West Bengal, the sowing time stretches up to mid November. Varieties suitable for late sown condition should be sown in November. It should also be ensured that crop is sown when the maximum daytime temperature is not more then 33^0C, which is essential for proper germination.

Adopt improved plating technique : For optimum spacing in the irrigated areas, rows should be 30 cm apart and plants 10 cm apart, however, for rainfed areas; the spacing should be enhanced to 45 and 15 cm, respectively. This spacing can be ensured when line sowing is done rather than the broadcasting. Use of Tractor drawn seed-cum-fertilizer drill suitable for sowing and basal fertilization is desirable. It will ensure desired seed rate at the recommended row spacing.To control white rust and downy mildew prophylactic seed treatment with Metalaxyl (Apron 35 SD) @ 6 grams/ kg seed should be done before sowing.

Perform timely thinning to keep optimum plant population : To keep an optimum plant population per unit area and uniform plant growth, thinning operation by removing the extra plants should be done at 15 - 25 days after sowing. For providing good aeration to the roots, conservation of moisture and removal of weeds, one intercultural operation should be done with double wheel hand hoe before first irrigation, preferably along with thinning to save labour cost. To control common weeds in the line sown mustard crop, double wheel hand hoe (dryland weeder) has been found as the low cost, time saving and simple to handle tool that reduces drudgery involved in the operation. Two drops of soybean oil on young shoot of orobanche was the best management of orobanche and gave higher seed yield over weedy check.

Integrated nutrient management : Fertilizer has been identified as the most critical inputs for rape-seed-mustard after variety in most of the areas. It has brought about 18 to 73% of yield increase over traditional practices of management. Optimum doses of nutrients have been worked out especially for N, P, K and S. Effect of different levels of nutrient on seed yield and oil yield has also been studied Micronutrients (Zn and B), having considerable effect on yield and have been recommended for deficient soils.

* Regular soil testing is necessary to determine the exact fertilizer dose. The requirement of fertilizer varies with the soil type, status of irrigation and species being grown. Fertilizer recommendations must be modified based on soil test value for better use efficiency and economy.

* For irrigated crop, 50 to 125 kg nitrogen (N) is recommended /ha across different regions, however, at most of the places 75-80 kg nitrogen /ha is recommended. Since the N is highly soluble hence, half of the recommended dose should be applied as basal at the time of sowing preferably through drilling at least 5.0 cm below the seeds for proper absorption. Remaining half should be applied by top dressing soon after the first irrigation and necessarily before flowering.

* Full dose of phosphorous (P_2O_5) @ 30-50 kg / ha is recommended as basal application at the time of sowing of irrigated crop. As the level of potash (K) in the soil is high, the impact of its application is not in every soil seen. However, if the soil test indicates deficiency, apply full dose of potash @ 20-40 kg / ha at the time of sowing under irrigated condition.

* Sulphur is critical in increasing the oil yield and is recommended @ 20-40 kg/ ha for deficient soils under irrigated condition. Sulphur requirement can be met by applying single super phosphate or gypsum.

* However, boron and zinc should also be applied in the deficient soils @ 1 kg boron/ha and 25 kg zinc sulphate/ha at the time of sowing. The basal applications of zinc is best, however, if it is missed, deficiency can be prevented by 2 foliar sprays of 0.5% sulphate salt up to 45 days after sowing.

* For rainfed crop apply/drill full-recommended dosages (about half the quantity recommended for irrigated crop) of nutrients at the time of sowing.

* In general, rapeseed-mustard is grown on coarse textured soils with very low organic matter. Use of organic manures can be exploited to boost the production and to improve the fertilizer use efficiency. Application of FYM up to10 t / ha has been found economical for seed yield. The mustard straw should not be removed from the field and mixed properly.

* Important bio-fertilizers, which play an important role in improving the nutrient supplies for the rapeseed-mustard crop, are Nitrogen fixer Azotobacter, Phosphate solubilizing bacteria (PSB) and Mycorrhizae. Use of Azotobacter can reduce the nitrogen requirement up to 25-30 kg/ha provided bacterial strain is efficient and soil is rich in organic matter. The PSB and Mycorrhizae are important to increase P uptake and dry matter yield at lower level of applied P.

Irrigation management : Timely irrigation can increase yield by 25-32 % through effective utilization of applied nutrients. First irrigation should be given between 25 and 40 days of sowing depending upon the species, location and soil moisture availability. Second irrigation should be given at the time of active pod formation stage that is 50 to 55 days in toria and 60 to 65 days in mustard. In the areas of limited irrigation or brackish water, only first irrigation is advisable.

With the monsoon failing year after year and recharge of ground water becoming impossible, promoting the use of sprinklers in the moisture deficient areas of mustard cultivation needs need to be promoted. Applying two-irrigations by sprinkler system for seven hours each time, keeping the nozzle at 12 m distance saves 38% water without any reduction in yield.

Strategies for technology dissemination

Exploitable yield reservoir for rapeseed-mustard in India

The results obtained from FLDs during the last five years (2001-02 to 2005-06) have conclusively proved the beneficial impact of the production technology over the farmers' practices. 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.

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 in frontline demonstration is as follows.

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

Increasing the use of Information Technology

The time has come for the use of information technology for the education of stakeholders with less dependence on the human resources for the extension work. The NRCRM, Bharatpur has developed two PC-based expert tools (software) named "Fertilizer Application Recommendation Manager" and "Disease Management System" to help and guide the farmers, extension personnel, researchers, etc in the cultivation of rapeseed-mustard in any part of the country. The former covers economic application of fertilizers based on scientific recommendations having the details like source, type, quantity and time of fertilizer applications. The latter will help in identification and management of diseases and provides options to select the infected part (s) of the plant, disease symptoms, causal organism, survival of the pathogen, favourable weather conditions, loss causing potential of the disease and its management.

Increasing the use of mass media than individual contacts

Broadcast of the sponsored radio and TV programmes during the crop season with proper follow up programmes like competition, evaluation and felicitation of the stakeholder farmers may prove to be a better extension strategy than to simply rely on the individual contacts where an extension personnel with little technical knowledge has to cater to the needs of over 10000 farmers spread over a group of 10 or more villages. Likewise increased use of cyber extension, helpline facility of 1551, preparation and distribution of video films of production technology among the extension personnel and farmers, training programmes for extension personnel are the need of the day.

Future prospects for increasing rapeseed-mustard production

Hybrids of Indian mustard in pipeline

The scientists have made the concerted efforts for the development of hybrids in rapeseed-mustard. Moricandia cytoplasmic male sterility-fertility restorer system has been perfectized and three experimental hybrids of Indian mustard (*B. juncea*) namely NRCHB-603, PAC-437 and DMH-1 are in the advanced stage of testing under AICRP-R&M. In Gobhi sarson two hybrids PGSH-51 and Hyola-401 ('00' hybrid) have been released for cultivation.

Policy, trade and market perspective

* Industrial development should be focused for *inter alia* better utilization of protein rich cakes. Value addition before exporting the oilseeds may increase the profitability and also help in industrialization.

* Policy support and measures should be taken to utilize the by-products in an efficient and economic way. Reforms should be visualized in marketing and trade to aid in developing and supporting domestic markets.

* Price environment should commensurate with the quality of produce to promote oil and seed meal of rapeseed-mustard with low level of erucic acid and glucosinolate, respectively.

* Maximum efforts should be made in production and supply of quality seed.

* The industry- research partnership, joint efforts of public and private sector, and timely action in various policy areas should be given high priority. The industries/private houses should support goal-oriented basic and strategic research and institutional transfer of technology programmes of the area.

* The institutional capacity building and human resource development have to be accorded prime importance.

* Enhancing capacity utilization of processing industry by ensuring higher supply of input-seed and reasonable profit margin with reduced cost of processing

* An incentive price for farmers and a competitive price for consumers in the global market of WTO era.

Rapeseed - Mustard varieties notified during 2005-08

Crop: Indian mustard (*Brassica juncea*)

Variety	Year of Notification	Maturity (Days)	Oil content (%)	Average Yield (kg/ha)	Recommended for the states	Special characteristics
CS 614-4-1-1 (CS54)	2005	109-147	39-41	1932	Indo Gangetic plain and water-logged saline soils of semi-arid regions (Haryana, MP, Rajasthan, UP and Gujarat)	For salt affected soils
RL 99-27	2005	114-153	39.41	1130-2690	Haryana, Punjab, Rajasthan	Suitable for rainfed conditions
JM 2 (JM WR 941-1-2)	2005	135-138	39-42	1717-2150	Madhya Pradesh	White rust resistant variety
JM-3 (JMM-915)	2005	130-132	40.0	1500-2500	Madhya Pradesh	Tolerant to Alternaria blight
Ashirwad (RK-01-03)	2005	125-135	31-41	1450-2358	Madhya Pradesh, Rajasthan, Uttar Pradesh, and Uttaranchal	Moderately resistant at leaf and pod stage for Alternaria blight and resistant for White rust. Suitable for irrigated late sown conditions
Narendra Swarna Rai 8	2005	130-135	36-16	1234-2357	Uttar Pradesh	Yellow seeded and high oil content
Pusa Karishna (LES 39)	2005	137-161	37-38	1731-2506	Delhi	Low erucic acid (< 2%)
JD-6	2005	81-114	39-44	597-1019	Orissa, WB, Bihar, Jharkhand, Chhattisgarh and Assam	An early maturing, for rainfed areas
Shivani (BAUR 9502)	2005	93	41	600-750 (Rainfed) 1200-1500 (Irrigated)	Jharkhand	Suitable for rainfed, low fertility conditions.
Navgold (YRN-6)	2006	122-134	39-40	1253-1303	Punjab, Haryana	Yellow seeded and suitable for late sown condition
RGN 48	2006	138-157	39-41	1692-2924	Haryana, Punjab, Rajasthan	Suitable for rainfed conditions
RRN-505 (RN 505)	2007	121-127	40.0	1200-1400	Rajasthan	Suitable for irrigated late sown conditions.
Shatabdi (AGN-9)	2007	99-105	36-40	800-1000	Maharashtra	Suitable for timely sown and late sown condition
LET 17*	2007	142	35.5	2070	Delhi, Haryana, Punjab, Jammu and parts of Rajasthan	Suitable for irrigated conditions, low erucic acid.

NRCDR-2	2007	143	39.4	2213	Haryana, Punjab, Jammu, parts of Rajasthan and Delhi	Suitable for irrigated conditions
PBR-210	2007	148	38	1800-2000	Punjab	Suitable for irrigated areas tolerant to white rust, Black seeds.
RGN-73	2007	132	40.0	2006	Uttar Pradesh, Uttaranchal, Madhya Pradesh and parts of Rajasthan	Suitable for irrigated conditions
Pusa Mustard-21 (LES 1-27)	2007	137-152	34.0 - 40.0	2111	Delhi, Haryana, Jammu & Kashmir (Plains) Punjab, Rajasthan, Western Uttar Pradesh	Low erucic acid (<2%)
TPM-1	2007	89-98	34-39	1127-1682	Western Maharashtra	Yellow seeds. High oil yield. Tolerant to powdery mildew
BLM-079	2008	152	38	1600-2000	Punjab	Suitable for irrigated areas, prone to lodging and shattering, tolerant to Alternaria blight, resistant to white rust, low erucic acid <2%.
LET 18*	-	140	36.6	2025	Delhi, Punjab and Haryana	For timely sown irrigated conditions, low in erucic acid.
CS 234-4*	-	131	36.5	1283	Punjab, Haryana and parts of Rajasthan	For late sown irrigated conditions, salinity tolerant.

Crop : Gobhi Sarson(*Brassica napus*)

Variety	Year of Notification	Maturity (Days)	Oil content (%)	Average Yield (kg/ha)	Recommended for the states	Special characteristics
GSC-5	2005	141-168	37-43	1719-2390	Punjab	Low erucic (< 2%) and low glucosinolate (26-41 micromoles/g defatted seed meal)
TERI Uttam-Jawahar [TERI (00) R 9903]	2007	130-135	43-45	1619-2685	Madhya Pradesh	Low erucic acid (< 2%) and low glucosinolate (12.2 micromoles/g defarred seed meal)
GSC-6 (OCN-3)	2008	151	39.2	1795	Punjab, Haryana, J&K	Short duration Low erucic acid and low glucosinolate.
NUDB 26-11*	2008	156	38.7	984-1339	J&K, H.P. and parts of Uttaranchal	Low in erucic acid and glucosinolate content (canola type) suited for normal sown irrigated conditions

Crop :Taramira (*Eruca sativa*)

Variety	Year of Notification	Maturity (Days)	Oil content (%)	Average Yield (kg/ha)	Recommended for the states	Special characteristics
Narendra Tara (RTM-2002)	2007	125-135	36-38	1200-1400	Rajasthan	Suitable for rainfed condition. Suitable for early and late sowing.

Crop :Torla (*Brassica rapa var. torla*)

Variety	Year of Notification	Maturity (Days)	Oil content (%)	Average Yield (kg/ha)	Recommended for the states	Special characteristics
VL Toria-3	2007	145	36-38	939	Uttaralchand	Tolerant to cold spell of mid Altitudes of Uttarakhand

Crop : Karan rai (*Brassica carinata*)

Variety	Year of Notification	Maturity (Days)	Oil content (%)	Average Yield (kg/ha)	Recommended for the states	Special characteristics
Pusa Aditya (NPC-9)	2006	160-173	38.2-41.2	1400	Delhi	Suitable for rainfed conditions.