OILSEED BRASSICA RESEARCH IN INDIA

P.R. Kumar
Director
National Research Centre on Rapeseed-Mustard
(Indian Council of Agricultural Research)
Sewar, Bharatpur -321 303 (Raj.) INDIA

Oilseed Brassica species are cultivated most widely throughout the globe and as vegetable crops for human consumption, condiments and spices for improved flavour of human diets and as fodder crops for livestock. But the major cultivation of these crops is for vegetable oil production. Globally, oilseed Brassica occupies about 25 million hectares with an oilseed production of 34 million tonnes. In India, oilseed Brassica is the second most important oilseed crop after groundnut. These occupy an area of approximately 6 million hectares with an annual production of about 6 million tonnes of seeds (Table 1). In the last two decades, the oilseed Brassica crop growth in production held the first position in the country as compared to other oilseed crops. This is attributed to greater adaptability to diverse environments and relatively less input requirements of the crop. The available diverse agroclimatic conditions favour the growth of different oilseed Brassica species. These crops are mainly grown in winter season except for early forms of *Brassica rapa* ssp. toria. The sowing in potential areas is done in the first fortnight of October and usually harvested in the second week of March. As a catch crop in northern India, toria is sown in last week of August, early September and harvested in December. The cultivation of rapeseed-mustard which used to be confined to the northern belt has now spread to non-traditional areas in western and southern region of the country. Rajasthan followed by Uttar Pradesh, Madhya Pradesh and Haryana contribute about 81 per cent in acreage and 83 per cent in total rapeseed-mustard production (Table 2). Rajasthan alone contributes 39.3 and 38.2 per cent to acreage and production in the country, respectively. Considering the importance of rapeseed-mustard group of crops in the Indian oil economy and the urgent need for undertaking basic and strategic research for stabilizing and increasing the production and productivity in the country, the National Research Centre on Rapeseed-Mustard (NRCRM),as nodal research centre in the country, came into operation in October 1993, at Bharatpur (Raj.). It brought under its umbrella, the All India Coordinated Research Project on Rapeseed-Mustard with 21 research centers and 11 verification centers across the country to cater to location specific problems of different states.

Brassica oilseed species in India

The genus *Brassica*, belonging to the family Cruciferae (Brassicaceae), tribe Brassiceae and sub-tribe Brassicinae, includes the largest number of economic plants. They are cultivated in a wide range of environments and has the ability to survive and grow at relatively low temperatures. The botanical and common names of rapeseed-mustard species cultivated in India are classified in table 3. *Brassica juncea* is the most predominant accounting for more than 80 per cent followed by *Brassica rapa* L. ssp *toria* covering nearly 14 per cent. *Eruca sativa, B. rapa* L. ssp. *brown sarson* and others occupy nearly 6 per cent of the total area. While most of these species are grown both in sandy and heavy soils and under both irrigated and rainfed conditions, *Eruca sativa* and *Brassica carinata* are grown in very poor sandy soils in low rainfall areas. The crop commodity is grown in marginal and sub-marginal land, either as a pure crop or as mixed/ inter-cropped with wheat, sugarcane, lentil, gram, pea, etc.

Nomenclature

There is much confusion about the proper nomenclature of the *Brassica* group of crop in general and Sarson and Toria, in particular. The confusions in Sarson and Toria have aggravated by the fact that plants are predominantly cross pollinated and uniform population of any variety is difficult to come across.

The Indian Brassica, as already mentioned belongs to two genera *Brassica* and *Eruca*. While the genus *Brassica* includes the three distinct species, viz., *B. campestris* (syn. *B. rapa)* (brown sarson, yellow sarson and toria), *B. juncea* and *B. nigra,* the genus *Eruca* is represented by *Eruca sativa* (taramira or Duan). From the long list of names used for yellow sarson, brown sarson and toria, it is evident that there is still lack of unanimity among the workers regarding the Latin names to be used for the different forms. The classification of the different forms into species will, however, depend upon the way in which the species concept is defined. Stebbins (1950) said, "all agree that species must consist of system of populations that are separated from each other by complete or atleast sharp discontinuities in the variation patterns and these discontinuities must have genetic basis, i.e., they must reflect the existence of isolating mechanisms which greatly hinder or completely prevent the transfer of genes from one system of population to another."

The difference observed among yellow sarson, brown sarson, yellow toria and brown toria are not enough to warrant separate species designation (Alam, 1945). Therefore, they were placed together into one species. A critical examination of the morphological traits of yellow sarson, brown sarson and toria would reveal that these three are morphologically different and have distinct mating systems. While toria is self-incompatible and highly cross pollinated, yellow sarson is highly self pollinated. On the other hand, brown sarson, *tora* types are self compatible while brown sarson *lotni* types are self-incompatible and highly cross-pollinated. They are also cultivated under distinct eco-geographical areas. In view of such dissimilarity within the species, Kumar (2001) considered these three ecotypes as distinct sub-species of the species *B. rapa* L. (syn. *B. campestris* L.).

Based upon the aforesaid facts, it would be appropriate to designate the botanical names of yellow sarson, brown sarson and toria ecotypes as :
Brassica rapa L. (syn. *B.campestris* L.) ssp. *yellow sarson*
Brassica rapa L. (syn. *B.campestris* L.) ssp. *brown sarson*
Brassica rapa L. (syn. *B.campestris* L.) ssp. *Toria*

CROP IMPROVEMENT

Genetic resources

Systematic, planned and coordinated efforts have resulted in collection/assembly of 17439 accessions of cultivated, wild and allied species. Nearly 9500 working collections are being maintained in the country. In recent years, 4000 accessions have been evaluated and characterized at the National Research Centre on Rapeseed-Mustard for various agro-morphological traits and biotic stresses. Data collected demonstrates the availability of valuable genetic reservoir which could be exploited for improving the existing cultivars. The sources for resistance to pests, diseases, salinity, frost and drought were identified and utilized in resistance breeding programmes. Improved or local varieties which were otherwise very promising were further improved. Interspecific hybridization was also used for the transfer of economic characters. The systematic evaluation for various morpho-agronomic, quality traits, biotic and abiotic stresses, resulted in the identification of donors for use in the varietal improvement programme. Amongst the exotic collections, Midas and Tower of *B. napus;* Candle, Span, Torch and Tobin varieties of *B.rapa* have been found to be promising. The Span variety, possessing low erucic acid has also been found to be tolerant to frost injury. The sources for frost resistance, namely, RH 781 and RW 175 in *B. juncea* and DBS 1 and FR-80 of *B. rapa*, identified, are being used in hybridization programme. Likewise, the sources for resistance/ tolerance to Alternaria blight (PAB 9511, PAB 9534) and white rust diseases (Jawahar Mustard, JMMWR 93-37, WR 9541) and aphid resistance (T 6342 and Cream white flower and glossy stem identified from the genetic stock of *B. juncea)* are being extensively used in hybridization programme and several varieties/ strains were developed. *B. carinata,* by and large, has been found to be free from white rust and downy mildew infection.

B. oxyrrhina, B. tournefortii, D. siifolia, moricandia, trachystoma and *enarthrocarpus* into *B. juncea*. However, the success in developing the hybrid could not be achieved due to non-availability of fertility restorer genes and developmental constraints such as chlorosis. Two recently developed CMS-fertility res*tora*tion systems, viz., *mori* and *trachy* appear to be very promising for hybrid development. Chlorosis associated with *mori* CMS system, has now been rectified and diversified into improved backgound of identified heterotic combination for developing commercial hybrids. Prospects of hybrids, based upon barnase/barstar system of pollination control also appear to be promising. Molecular constructs containing barnase/ barstar genes are being deployed in *B. juncea* to develop male sterile and fertility restorer lines. In *B. rapa* ssp *brown sarson* and *toria,* self incompatibility which is an effective mechanism for out crossing, may be used for hybrid development. However, its use has proved impracticable since the inbreds obtained through continuous selfing exhibit high level of inbreeding depression and are very difficult to maintain by continuous selfing. Thus the difficulties and costs associated with production of parental seed stock, would severely limit the potential of this through crosses with *B. rapa* carrying S alleles. To avoid the potential problem of poor seed set in commercial hybrid fields, due to poor pollen dispersal among the self-incompatible plants, use of a three-way hybrid using a dominant self-compatible line as the third parent was proposed by Thompson in 1983. Self-incompatibility is dominant over self-compatibility.

The production of hybrid cultivar using genetic male sterility system is also possible. Genic male sterility in *B. rapa, B. napus* and *B. juncea* has been reported in sixties. However, its large scale exploitation has not been possible because of problems associated with identification of markers. Nevertheless, in regions where adequate and inexpensive labours is available, this system is likely to work efficiently by removing male fertile segregants from female lines before flowering. In yellow sarson, using genic male sterility, an experimental hybrid, BCH 16 giving 19 per cent yield advantage has been developed at NDUA&T, Faizabad in 2000.

Improvement of quality traits

Research work on improvement of quality traits for the development of zero and double zero cultivars were initially concentrated on introduction of exotic double low varieties and screening of wild and cultivated species for their nutritionally superior oil and meal quality. These efforts did not yield encouraging result due to the poor adaptability of exotic strains under Indian conditions. They were late in maturity, poor growth, with poor seed set. Realizing the need for transfer of genes for quality traits in the background of well adapted Indian cultivars, systematic quality breeding programme was initiated under the All India Coordinated Research Project on Rapeseed-Mustard in eighties. Later, to give greater thrust to the quality research, a national network on improvement quality traits of rapeseed-mustard was initiated with five research centres in the country, viz., National Research Centre on Rapeseed-Mustard, Bharatpur; Punjab Agricultural University, Ludhiana; Indian Agricultural Research Institute, New Delhi; Tata Energy Research Institute, New Delhi and GB Pant University of Agriculture and Technology, Pantnagar. Concerted efforts have resulted in development of a large number of '0' erucic acid strains of *B. juncea.* Most of these were evaluated (1998-2000) under All India Coordinated Research Project on Rapeseed-Mustard. Notable among them are LES 39 and YSRL-9-18-2 which are at advance stage of testing in Advanced Varietal Trial 1 (Zone II). In the rapeseed group, spectacular progress has been made by developing early maturing, dwarf, low erucic acid and / or low glucosinolate strains. The promising strains are at advanced stage of testing (AVT 1) under All India Coordinated Research Project on Rapeseed Mustard. In the hybrid breeding programme, efforts are being made to develop double low CMS and restorer lines of *mori*, *lyr* and *trachy* sources to develop commercially viable canola quality hybrid in *B. juncea*. Low glucosinolate traits from poorly adapted BJ 1058 has been transferred to the background of high yielding Indian cultivars, viz., Varuna, Pusa Bold and Rajat. Success has been achieved in developing valuable '00' genetic stocks in *B. juncea* cultivar Varuna. Advanced progenies with '0' erucic and high oleic, low linolenic acid with yellow seed coat has been developed in *B. juncea* cv. Varuna, Pusa Bold, Kranti and Rajat. In *B. napus,* low erucic and high oleic acid;

double low, dwarf and early maturing strains have been developed and are being tested under the All India Coordinated Research Project on Rapeseed – Mustard. To expand the market and enhance the value of oil researches are in progress to develop high yielding cultivars with high erucic acid (> 60 %) are being developed. The future efforts are proposed towards the development of canola type oilseed Brassicas with low saturated fatty acid, high oleic and low linolenic acid and seed meal with reduced levels of glucosinolates, nitriles and phytic acid.

Disease resistance

Alternaria blight : In most genotypes, resistance to Alternaria blight is of non-specific type characterized by restricting the colonization, growth and dispersal of the pathogen and reduced infection rate. Such a kind of resistance is usually under multigenic control and is much more difficult to evaluate and manipulate. Transferring such quantitative traits such as this into plants of improved type is a formidable task. However, such form of resistance can be further improved by intercrossing various [partially resistant genotypes selectively to combine F_1's with each other and with other short-statured plants of *B.juncea* genotypes leading to genetically enhanced acceptable cultivars. Developmental traits of plants such as less foliage, and uniform and early maturity also lead to improved disease management by exploiting such traits in a plant characteristics which ultimately help either in reduced infection rate (tolerance) and / or early maturity (escape). Strains PAB-9511, PAB-9534 lines developed at Pantnagar have been found resistant over years and locations in multilocation testing under AICRP on Rapeseed-Mustard and National Screening Nurseries during last three year, i.e., 1996-97 to 1998-99.

White rust: Usually the white rust caused by *Albugo candida* and downy mildew caused by *Peronospora parasitica* appear simultaneously as mixed infection on rapeseed-mustard crop. Resistance to white rust in *Brassica* species is governed by single dominant major gene in *B.juncea* against race 2, three dominant genes in *B. napus* against race 2 pathotype infecting *B. juncea*. White rust resistance due to a few major genes is likely to be overcome by appearance of a new race within a period of 10 years time or so (Personal communication, S. J. Kolte). Some of the recently identified white rust resistant genotypes are : Jawahar Mustard, JMMWR 93-37, PWR 9541 and RGN 7. Attempt are, however, required to be made to combine resistance to white rust and downy mildew diseases in one genotype as downy mildew is associated with the white rust.

Aphid resistance

To develop aphid resistant mustard cultivars, a line T 6342 has been commonly used as donor parent. Using the back cross method, strains RH 7846, RH 7847, RH 7848 and CSR 1017 developed by hybridization, have been found to be high yielding and aphid tolerant. Two mutant lines, one having cream-white flower color and the other having glossy stem character have been identified. When evaluated, it was observed that the glossy stem population was less prone to the attack of aphid compared to the cream white flowered population. BARC, Mumbai has developed a new detached leaf method for screening against aphid tolerance.

Using *in vitro* seedling screening coupled with mass selection for tolerant types, promising lines of mustard from a cross between RLM 514 x T 6342 have been developed. Among the species evaluated for aphid resistance, *Brassica alba* was having the lowest aphid population. Genetical studies revealed the presence of both additive as well as non-additive genes in the inheritance of aphid resistance.

Salt tolerance

Soil salinity as well as irrigation with brackish water affect large area under rapeseed-mustard especially in the states of Rajasthan, Haryana, Punjab and Uttar Pradesh. The yield reduction due to salinity/sodicity has been reported to be 33 per cent. At high ESP (42), the reduction in seed yield could be 50 per cent. The salt stress also reduced oil content and altered the fatty acid composition of oil. A large number of improved germplasm lines are available (CS 416, RH 8814, RH 8816, RH 8701, RK 9807 and RK 9703) which can be used as donors for resistant cultivar development. Breeding efforts have resulted in release of resistant varieties CS 52 and NDR 8501 which give 10-20 per cent higher yield than the checks like Varuna under saline soil conditions (ECe 8-10 dS/m). CS 52 also tolerates irrigation water upto ECe 12 dS/m. It has tolerance to alkalinity also.

Frost tolerance

Rapeseed-mustard is a frost susceptible crops. In northern states of the country, frosts are common in the second half of January and this concides with flowering and pod formation. Yield losses upto 70 per cent have been reported due to a single expoure to frost. Promising donors being used in bredding programme of *B.juncea are* RH 8814, RH 8602, RH 8824 and RH 781. The variety RH 781 is a frost tolerant variety. In brown sarson *(B. campestris)*, crosses were made between Pusa Kalyani and Yukina in Japan by the author with a view to transferring frost tolerance to brown sarson. Subsequently, the promising progenies were grown in India during 1977-81. One of the selected lines, FR 80, was found to be very promising in frost prone areas of Himachal Pradesh and released for general cultivation as KBS 3. This variety has also given, on an average, 10 q/ha seed yield even under Ist week of December planting conditions in Himchal Pradesh.

Drought tolerance

Rapeseed and mustard is grown as a rainfed crop on conserved moisture received from monsoon rains in 37 per cent of the total area under the crop. Substantial area in Bihar, West Bengal, Assam, Rajasthan, U.P., M.P. and Orissa is rainfed. Depending on planting time and winter rains, the crop is exposed to water stress at one or more phenological stages. Genetic variation in osmo-regulation exists in Brassicas. Transpirational cooling and water loss from excised leaves were better correlated with yield than osmo relgulation. The genotypes which could extract moisture from deep soil profiles during the reproductive phase drought would yield higher. Osmotic adjustment and transpirational coolings have been reported to be controlled by single gene. It is suggested that recurrent selection should be practiced for incorporating drought tolerance. Several high yielding varieties like Vardan, RH 781, RH 819 and Pusa barani have been released for cultivation for drought prone areas.

Biotechnological approaches:

In India, biotechnological tools are used for the following objectives in rapeseed-mustard.

DNA fingerprinting: DNA fingerprints of important released varieties of rapeseed-mustard has been developed. DNA profiling using the Randomly amplified polymorphic DNA (RAPD) and Internal Simple Sequence Repeats (ISSR) and DAF resulted in the satisfactory profile over the species.

Diversity analysis: Molecular markers along with statistical tools are frequently being used in India to assess the diversity. One of the studies have revealed the close similarity between the released varieties of *B.juncea*. However between the species, there was significant variation and therefore, there is need to introgress the additional diversity from other species. The diversity analysis has been also used for the selection of the most heterotic parents for the production of hybrids.

Molecular genetic mapping and gene tagging: Genetic maps using the molecular maps are under progress for rapeseed-mustard in India. A genetic map using 94 recombinant inbred line (RIL) and RAPD was developed. The map consists of 21 linkage group and covers about 790.8 cM of mustard genome. Usinng Amplified Fragment length polymorhism (AFLF) profiling system and bulk segregants analysis , a white rust resistant gene designated as Ac2 was tagged. Six RAPD markers obtained with different primers were also found to be linked with yellow seed coat colour. Two loci were also mapped for erucic acid. Currently the work on tagging for quality traits like erucic acid, oleic acid and QTLs for agronomic traits like length of siliqua, number of seed and thousand seed weight etc are under progress.

Genetic engineering : First somaclone variety in rapeseed-mustard Bio 902 was developed and some others like Bio-YS-1 and Bio 772 are in advance stage of testing. The CMS(mori) *B.juncea* line was initially chlorotic and the chlorosis was removed through somatic hybridization.CMS lines using *Dipotaxis catholica* and *B juncea* was discovered using somatic hybridization. Fertility restorer genes was introgressed form *E. canariense* through chromosome manipulation. The work on cloning of the gene involved in the microspore development is under progress for engineering the male sterile plants. Similarly, engineering the male sterile plant using the mitochondrial gene is also going on. Some other aspects on which genetic engineering work is at present going on India include the isolation and characterization of phoelm specific promoters for expression of lectin genes and the development of male sterile and fertility restorer line by using the construct of barnase/ barstar gene.

Mustard hybrids have been developed at Proagro Seed Company using a genetically engineered hybridization system, comprising of a male sterility (Ms) gene and a restorer (Rf) gene. Transgenes have been transferred to *B. napus* lines in which these genes were introduced by genetic transformation. Results of field trisl and biosafety studies are encouraging. To ensure that the benefits of such a technology reach the farmers in the shortest possible time, there is need for streamlining the regulatory process for transgenics in India.

Production of double haploid: Production of double haploid not only speed up the breeding progress but also save the resources. Double haploid technology is now frequently used in some of leading institute working on rapeseed-mustard in India. Some of the lines Swarna -Teri in *B.juncea* and others in *B. napus* for zero erucic acid have been developed by TERI and other Govt. institute in India using double haploid production technologies. The work towards the production of double zero varieties is under progress.

AGRO-PRODUCTION TECHNOLOGY

Integrated nutrient management

In integrated nutrient management, inadequate and / or imbalanced use of fertilizers has been identified as one of the critical constraints holding oilseeds production., Yield increases ranging from 26 to 300 per cent with fertilizer application alone have been recorded in rainfed area under oilseeds. The main nutrients from fertilizer management point of view are nitrogen, phosphorus, sulphur and in many cases zinc, and to some extent boron play a key role of stepping up the yields. Sulphur nutrition is critical for increasing the yield and oil yields in different oilseeds. The response of S depends upon soil S status and irrigation water. Application of 43 kg S/ha increased mustard yield by 7.7 kg seed/kg S and oil content by 9.6 per cent. A response of 7.3 kg seed/kg N was obtained in mustard at 40 kg N/ha and 4.6 kg seed/ kg N at 80 kg N/ha in black soil under irrigated condition in Andhra Pradesh. An increase in yield of mustard ranging 12-124 per cent under irrigated and rainfed conditions at various locations in India with sulphur application ranging from 2 to 100 kg/ha has been observed.

Biofertilizers

Biofertilizers have been found to be effective in enhancing the productivity. Spraying of phyllospheric bacteria culture Klebsiella (having the ability to fix nitrogen from the atmosphere), thrice on mustard crop, after 30, 45 and 60 days fo sowing alongwith the application of 20 kg N/ha (as basal dose) gave the seed yield as high as 1900 kg/ha. The seed yield was statistically at par with the yielders recovered in plots receiving 80 kg/N ha. The three year results demonstrated an increase in mustard yield by 63 per cent due to the phyllospheric micro organism over the control treatment.

Organic farming

It is very conductive for maintaining the soil health and subsequently reducing the adverse effect fo inorganic fertilizers. Such approaches include green manuring, use of FYM and fertilizers, crop residue management, biogas technology, etc.

Continuous applications of chemical fertilizers create problems of acute soil acidity resulting in phytotoxicity to crop plants. It can be corrected with application of lime and / or FYM alongwith chemical fertilizers. Hence, utilization of organic wastes, bulky crop residues and wet dung from farm animals/cattle after and proper decompositions will play in importance role in sustainability of crop productions.

Water management

Availability, mobility and uptake of plant nutrient is primarily dependent upon soil and water. In the gangetic alluviums of UP, response of mustard N with adequate irrigation can go even beyond 120 kg N/kg. In loamy sand to sandy loam soils, it goes even up to 180 kg N/kg under irrigated conditions. The water use efficiency can be enhanced through genetic and / or environmental manipulations of the crops or by decreasing evapotranspiration and other water losses. Six important issues for better management of available water resources identified are: (i) optimum exploitation of water resources, (ii) crop planning in relation to water availability (iii) increasing water use efficiency, (iv) increasing irrigation efficiency and improving drainage, (v) safe use saline/solid ground water in agriculture and (vi) rain water management in dryland agriculture.

Allelopathic activities

Indiscriminate use of herbicides have resulted in several global problems. Allelopathic effect in cropping sequence, intercropping systems needs to the established. Preliminary studies have shown that the weed control potential exists in accessions of mustard. An indepth study in this direction is required so that the lines could be identified/developed for different oilseed crops and also for the control of orbanche and sclerotinia disease.

Low monetary inputs

A number of simple, location and situation specific practices which otherwise require little or no investment have significant bearing on returns as compared to costly inputs. They include quality seed of recommended crops varieties, optimum seeding rates, plant geometry, seed treatment, crop rotation, timely weed, nutrient and pest management as well as achieving optimum moisture use efficiency. Plucking of 4 lower leaves at pre-flowering stage and N-S sowing has increased the yield.

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Table 1. Area, production, productivity and area under irrigation of rapeseed-mustard

Year	Area (m ha)	Production (m t)	Productivity (kg/ha)	Area under irrigation (%)
1950-51	2.07	0.76	368	-
1960-61	2.88	1.35	467	12.1
1970-71	3.32	1.98	594	25.2
1980-81	4.11	2.30	560	43.7
1990-91	5.78	5.23	904	59.8
1999-2000	6.05	5.95	982	-

Source: Directorate of Economics and Statistics, Govt. of India.

Table 2: Area, production and productivity of rapeseed-mustard during 1999-2000

State	Area (000, ha.)	Production (000 tonnes)	Yield (kg/ha)
Andhra Pradesh	2.6	0.5	-
Arunachal Pradesh	21.3	21.1	991
Assam	266.2	129.4	457
Bihar	107.3	102.5	965
Gujarat	320.0	301.0	941
Haryana	445.0	593.0	1324
Himachal Pradesh	10.7	6.1	-
Jammu & Kashmir	63.6	48.0	756
Karnataka	6.2	1.5	-
Madhya Pradesh	707.0	656.1	949
Maharashtra	10.7	2.8	-
Manipur	1.4	0.6	-
Meghalaya	6.9	4.6	-
Nagaland	14.0	14.0	-
Orissa	17.7	2.3	-
Punjab	57.0	63.0	1126
Rajasthan	2568.5	2652.6	1033
Sikkim	5.8	4.5	-
Tamil Nadu	0.5	0.2	-
Tripura	3.6	2.9	-
Uttar Pradesh	1066.0	1087.4	1020
West Bengal	344.4	251.7	731
Delhi	4.6	0.7	-
All India	**6051.0**	**5946.9**	**982**

Table 3. Botanical name, genome, chromosome number and English name of cultivated rapeseed-mustard species

Botanical name	Genome	Chromosome number (2n)	Common English nar
Brassica juncea(L.) Czern. & Coss.	AABB	36	Indian mustard/ Brown mustard
Brassica rapa L. (syn. *B.campestris* L.) ssp. *toria*	AA	20	Indian rape/ Rapese Toria
Brassica rapa L. (syn.*B. campestris* L.) ssp. *brown sarson*	AA	20	Brown sarson / Rapeseed
Brassica rapa L. (syn. *B.* campestris L.) ssp. *yellow sarson*	AA	20	Colza/ Yellow sars Rapeseed
Brassica nigra (L.)Koch	BB	16	Black mustard
Sinapis alba / Brassica hirta Moenach (syn. *B. alba* L.)	SS	12	White mustard
Brassica tournefortii Govan	TT	10	Wild turnip
Eruca sativa Mill	EE	22	Rocket / Salad
Brassica napus L.	AACC	38	Rapeseed/ Rutabag
Brassica carinata A Br.	BBCC	34	Abyssinian must Ethiopian mustard