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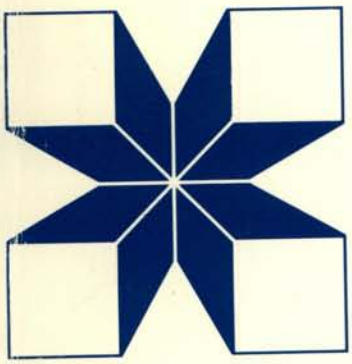

CANADA

OIL CROPS: PROCEEDINGS OF THE THREE MEETINGS HELD AT PANTNAGAR AND HYDERABAD, INDIA, 4 – 17 JANUARY 1989

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This series includes meeting documents, internal reports, and preliminary technical documents that may later form the basis of a formal publication. A Manuscript Report is given a small distribution to a highly specialized audience.

La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d'être publiés plus tard dans une série de publications plus soignées. D'un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.

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OIL CROPS:
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1. The Brassica Subnetwork-II
2. The Other Oil Crops Subnetwork-I
3. The Oil Crops Network Steering Committee-I

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OILSEED BRASSICA RESEARCH IN INDIA

P.R. Kumar

Among the oilseed crops grown in India, oilseed Brassica, collectively referred to as rapeseed-mustard, comes next to groundnut in importance. It is the most important winter oilseed crop of the country constituting the cultivation of the following eight species:

1. *Brassica juncea* ... Indian mustard
2. (i) *Brassica campestris* var. *Toria* ... Indian rape
   (ii) *Brassica campestris* var. *Dichotoma* ... Brown sarson
   (iii) *Brassica campestris* var. *Sarson*... Yellow sarson
3. *Eruca sativa*... Taramira
4. *Brassica napus*... Gobhi sarson
5. *Brassica nigra*... Black mustard
6. *Brassica tournefortii*... Wild mustard
7. *Brassica carinata*... Karan rai
8. *Brassica hirta/Sinapis alba*... White mustard

Production Trends

During the last three and a half decades there has been substantial increase in production and productivity of rapeseed-mustard in the country. The area which was 1.95 million hectares in 1949-50 has increased to 4.51 million hectares in 1987-88. Likewise, the production and productivity have increased from 0.81 million tones and 417 kg/ha in 1949-50 to 3.37 million tones and 747 kg/ha in 1987-88, respectively.

During 1988-89, the production is estimated to attain a new peak of more than 4.0 million tons.

Major Constraints

The cultivated species of the genus *Brassica* are highly prone to the attack by insect-pests and diseases. Aphid is the most serious insect-pest which causes heavy damage (35 - 73%) to the crop. This is followed by diseases like Alternaria blight, white rust and downy mildew which collectively cause yield losses ranging from 10 to 70%. Frost is another menace which takes a heavy toll of the crop. Although it is not a regular phenomenon, in a frosty year which occurs unpredictably, the extent of damage is more than 90%. In certain situations a parasitic weed, Orobanche, causes considerable damage to the crop. Nearly 53% of the area under rapeseed-mustard is grown under rainfed conditions. It is largely in the domain of small and marginal farmers. More than 60% of the area of the crop is grown as a mixed crop, mostly with wheat. Mustard receives little attention in terms of maintenance of plant population per unit area, crop management and crop protection because of the major emphasis of farmers on wheat. Cumulative effect of all these factors results in lower average yield of rapeseed-mustard.

Crop Improvement

Rapeseed-mustard group of crops has a wide spectrum of mating systems ranging from total cross pollination to total self pollination. The breeding methodology employed for the improvement, therefore, is different in different species/ types.

Introduction, mass selection, pure line selection, mass pedigree selection, back-cross method, recurrent selection, disruptive selection, diallel selective mating system, polycross method of

developing synthetics, breeding composites, mutation and polyploidy method of breeding are the methods usually employed for improving the productivity of rapeseed-mustard group of crops.

Besides the development of high yielding varieties, efforts are being made to develop varieties possessing resistance/tolerance to biotic stresses like aphid and diseases and abiotic stresses like froal, drought, salinity/alkalinity and shattering.

(i) High yielding varieties

The development of varieties possessing high seed yield and high oil content have been the major objectives of breeding rapeseed/ mustard using the above breeding methodologies. A good number of varieties of mustard, toria, brown sarson, yellow sarson and taramira have been developed which are released/recommended either by the State or by the Central Variety Release Sub-Committee. Prior to 1980, more than 10 varieties of toria, 6 varieties of yellow sarson, 11 varieties of mustard and 2 varieties of taramira were recommended for general cultivation. During 1981-88 period, as many as 18, 6 and 2 varieties of mustard, toria and yellow sarson, respectively, for irrigated areas and 8, 1 and 2 respectively for rainfed areas; have been recommended for different zones in the country, Table 1. The increased yields of recommended varieties under the multilocation testings ranged from 9 to 53% over standard checks under irrigated conditions. Under rainfed conditions, yield increases ranged between 9.92 to 31.26%.

Table 1. High yielding varieties of oilseed Brassica recommended during 1981-88.

Crop	Irrigated/ rainfed	No. of varieties	Average yield kg/ha (range)	increase over standard check (%)
Mustard	Irrigated	18	1950 - 1285	9.40 - 32.04
	Rainfed	8	1615 - 824	8.92 - 45.80
Toria	Irrigated	5	1125 - 573	9.32 - 31.80
	Rainfed	1	607	17.00
Yellow-sarson	Irrigated	2	1836 - 1236	23.33 - 53.00
	Rainfed	2	928 - 845	21.00 - 31.26
Toria* (TL-15)	Irrigated	1	1258	20.30

*Recommended for high altitude of Himachal Pradesh as a summer crop

(ii) Aphid resistance

Using T-6348 strain as a source for aphid resistance, extensive hybridization programs were taken up resulting in development of promising strains like TK-8501, RH-7846, RH-7847, CSR-1017 and Glossy B-85 identified as possessing high yielding ability as well as moderate resistance to mustard aphid. These strains are under the advance stage of testing.

(iii) Disease resistance

The resource genes in RC-781, YRT-3 and EC-126743 identified as resistant to Alternaria blight and white rust diseases were

extensively utilized in hybridization program. A high yielding variety, RH-8113 of mustard possessing moderate resistance to Alternaria blight disease was recommended in 1985 for pre-release multiplication in

North-Western Zone which constitutes Punjab, Haryana, Rajasthan and Gujarat. In 1988, this particular variety was recommended by the Haryana State for general cultivation. Besides, a number of strains like PR-8701, PR-8705, KRV Tall and RH-8114 have been identified showing tolerant reaction against Alternaria blight disease.

(iv) Frost tolerance

Using the movable frost chamber, a good number of varieties of rapeseed-mustard have been identified as tolerant to frost injury. The most promising amongst them are the varieties RH-781 and RH-7361 of mustard. These varieties, besides showing frost tolerance, have been found to be high yielding. The variety RH-781 has already been recommended for Eastern Zone constituting Bihar, Orissa, West Bengal and Assam on account of its high yielding ability. In *B. campestris*, Canadian varieties, Span and Torch, are found to be frost tolerant.

(v) Drought tolerance

In *Brassica juncea*, a number of strains, CSR-814, CSR-975, CSR-212, CSR-838, CSR-257/RH-781, have been developed by selection which possessed tolerance to drought. In *B. campestris*, strains PT-30, PT-40 and PT-42 have been found to perform well under rainfed situations.

(vi) Salinity/Alkalinity tolerance

A variety NDR-8501 of *B. juncea* giving an average seed yield of 1333 kg/ha under irrigated conditions in the Central Zone (Uttar Pradesh and Madhya Pradesh) has also shown promise in saline soils. Besides, a number of strains have been identified to be promising in salt affected soils. These strains are NDR-8604, DIRA-344, DIRA-329, CS-209, DIRA-361, CSR-394, CSR-52, CS-12, CSR-50, BEC-199, BEC-218-218 and BEC-222. They are in advance stage of testing.

(vii) Shattering resistance

Efforts are also being made to develop shattering resistant lines. Some of the entries like RH-8130, RLC-1021, RH-8131, L-114-5-6-1, RH-30 and 1-117-5-6-2 are found to show moderate degree of resistance to shattering besides possessing high yielding ability. These entries are being evaluated in multilocation testing.

(viii) Breeding for other economic traits

Apart from these, strains/lines of *B. juncea* having a very bold seed size (9 g/1000 seed wt.), long pod, more number of seeds per siliqua, yellow seed coat, and high oil content have been developed and are under testing.

In *B. campestris*, apart from developing high yielding varieties, toria maturing in 70-85 days has been developed. Attempts are being made to develop varieties having bold seed size, multilocular siliqua in toria and brown sarson.

(ix) Development of varieties for late sown conditions

Attempts to develop suitable varieties of rapeseed-mustard for late sown conditions have resulted in identification of strain RH-7859 giving 1981 kg/ha compared to 936 kg/ha of Kranti in North Western Zone. In Central Zone, Pusa bold

gave the maximum seed yield (793 kg/ha) as against 698 kg/ha of Kranti. A variety RLM-619 was found to give the maximum seed yield (606 kg/ha) compared to Varuna (466 kg/ha) in Eastern Zone.

(x) Rapeseed-mustard in non-traditional areas of Southern States

In an effort to improve the productivity of rapeseed-mustard in non-traditional areas, experiments with promising/elite strains of rapeseed-mustard were laid out in Maharashtra, Tamil Nadu, Andhra Pradesh and Karnataka States. In Maharashtra at Phaltan (on the basis of 3 years average) RLM-619 recorded the maximum seed yield (999 kg/ha) followed by 990 kg/ha and 989 kg/ha of Pusa Barani and RLM-514, respectively. Mustard trials were also conducted at 6 locations (Akola, Washim, Nagpur, Amgaon, Amravati, Buldhana) in Maharashtra during 1986-87 and 1987-88. On the basis of 12 locations average, Varuna was observed to record the highest seed yield (1324 kg/ha) as against 740 kg/ha and 680 kg/ha of Kranti and Krishna, respectively. In Tamil Nadu, on the basis of 9 locations average, B-85 (Seeta) exhibited the highest seed yield of 802 kg/ha compared to 491 kg/ha and 327 kg/ha of Kranti and Varuna, respectively. In Andhra Pradesh, a strain TM-21 attained the maximum seed yield (1452 kg/ha) compared to 1284 kg/ha of Kranti. Besides, Kranti was also sown at farmers' fields at 62 locations and an average seed yield of 985 kg/ha was recorded.

(xi) Introduction of rapeseed-mustard as a summer crop at high altitude

In an attempt to introduce rapeseed-mustard as a profitable summer crop at high altitude in hills and valleys, promising varieties were evaluated in Himachal Pradesh, Jammu and Kashmir. In H.P., toria variety TL-15 was found to be the most promising and was accordingly recommended in 1988 for pre-release multiplication. In Kashmir valley, mustard varieties KBS-150, Seeta and RH-30 are superior in performance in comparison to other improved varieties of mustard.

Production Technology

Improved cropping systems and other agronomic practices, both for rainfed as well as irrigated areas have been developed for different agro-climatic conditions of the country. Planting technique studies have conclusively established that pure crop of rapeseed-mustard is the most remunerative. Further, line sowing with recommended spacing, seed rate, fertilizer and thinning 15-21 days after sowing gives the best return. Mustard is predominantly grown as a mixed crop with wheat. The yield of mustard under such situation is usually poor. Cultivation of mustard intercropped with wheat in 1:9 ratio has given the highest net return. Likewise, growing mustard and gram in rows under rainfed conditions gives higher net return. Similarly, intercropping of toria/mustard in Autumn-planted sugarcane, intercropping mustard/yellow sarson in potato, and intercropping toria in gobhi sarson are more remunerative.

Transplanting of gobhi sarson gives more yield and economic returns than direct-seeded crop. It is likely to be a substitute for late sown poor yielding wheat. The advantage with transplanted crop is that it requires no thinning and has less weed problem.

In order to maintain the optimum plant population and to economize the use of seed and fertilizers, proto-type seed-cum-fertilizer

drill (bullock drawn) and a manual seed drill have been fabricated. These are under advance stage of testing.

Rapeseed-mustard is responsive to Sulphur and boron application. Application of sulphur (20 kg/ha) along with born (1 kg/ha) gave more yield over control in deficient soils.

Weed control studies have established that pre-plant incorporation of Fluchloralin @1.25 litre/ha as well as pre-emergence application of Pendimethalin @1.25 kg/ha give an effective weed control and better crop yields. If the weed emerges late after planting, use of Isoproturon @0.75 kg/ha after 30 days of planting is recommended. These herbicides may be effectively used where manual weeding is not possible.

Studies on the optimum stage of harvesting of toria have shown that toria, if harvested at a stage when 75% of the pod turn yellow, can ensure timely sowing of wheat.

Studies on the effects of various technology package on seed yield of mustard and toria have demonstrated that an increase in seed yield ranging from 66.7 to 189.8% can be obtained by adoption of full technology package over the local practices in mustard under irrigated conditions. In toria, under rainfed conditions, the yield increase ranged between 118.2 to 198.9%. Amongst the individual factors of production, fertilizer application has been found to be more critical.

Extensive field demonstrations of rapeseed-mustard during 1987-88 indicated that seed yield ranged between 920 to 1357 kg/ha in Toria, 1250 to 1538 kg/ha in yellow sarson and 1214 to 3300 kg/ha in Indian mustard at various locations, Table 2.

Table 2. Field demonstration of rapeseed-mustard during 1987-88

State	No. of demonstrations	Seed yied (kg/ha)	
		Maximum	Minimum
Mustard			
Haryana	441	2344	1214
Punjab	3	1650	-
Gujarat	78	3300	1400
West Bengal	10	1544	-
Toria			
Assam	161	1357	920
Yellow Sarson			
West Bengal	7	1538	1250

Management of diseases

The major fungal diseases affecting rapeseed and mustard crops in India are Alternaria blight, white rust, downy mildew, powdery mildew and phyllody. Alternaria blight (*Alternaria brassicae*) characterized by brown or greyish spots on leaves, stems and pods is the most destructive and wide-spread disease. Compared to mustard, sarson is more prone to this disease. Moist and warm weather favours the disease. Spraying with Mancozeb-5 at intervals of 15 days, 40-45 days after sowing is recommended. This fungicide is cheap and helps in reducing the intensity of another important disease, i.e., white rust, which is characterised by white postules of *Albugo candida* on the lower surface of the leaves in the early stage, i.e., when plants are 45-50 days old. Later, the malformation of the floral parts takes place, which is known as stag-head formation stage. Apron 0.2% as seed dresser along with three sprays of Dithane M-45 @0.2% is recommended for reducing white rust and simultaneous occurrence of downy mildew (*Peronospora parasitica*) incidence at seedling stage. Sprays of Dithane M-45 or Zineb also helps in minimizing the severity of all the above three diseases on leaves and pods. If Apron is not available, spray of Dithane M-45 should be continued.

When there is attack of powdery mildew (*Ersyiphe cruciferarum*) which is characterised by white powdery mass on stem and leaves at later stages of plant growth, spraying with Wettable Sulphur (0.30%) has been found to be beneficial. Delay in sowing should be avoided to protect from different diseases.

Management of Insect-pests

Mustard aphid, mustard sawfly, painted bug, Bihar hairy caterpillar and leaf miner regularly appear and are of high economic value. Data generated on mode of damage, economic threshold and management of these major pests are discussed below:

(a) Mustard aphid (*Lipaphis erysimi* Kalt.)

The mustard aphid is pale-green soft bodied and about 1-2 mm long. The nymphs and adults suck the cell sap from various parts of the plant and live in colonies. Due to the sucking of plant sap, plants remain stunted, leaves show curling and yellowing, pods shrivel up and seeds do not develop in the infested pods. The infestation due to mustard aphid is more serious during the end of December to the middle of March. Their number becomes innumerable, covering inflorescence and pods.

In order to control the pest, the following measures are found to be more effective.

i) Wherever the aphid problem is serious and acute, the mustard varieties may be sown instead of rapeseed varieties which are more susceptible to the pest.

ii) Early sowings, i.e., in the first fortnight of October, escape the mustard aphid infestation.

iii) The removal of early infested twigs bearing stem mothers by the end of December is very useful.

iv) Spraying the crop with 0.025% Methyl Oxydemeton (Metasystox 25 EC) or 0.03% Diamethoate (Rogor 30 EC) or 0.025 Qunalphos (Ekalux 25 EC) mixed in 625, 850 and 1000 litres of water per hectare, respectively, depending upon the crop growth stages. Spraying should be done thrice at 15 days intervals starting from the end of December to early January when 9-19 aphids per plant are observed. Number of sprays may be reduced depending upon the severity of the pest. The above mentioned quantity of water is for high volume sprayer such as foot sprayer.

i) If the crop is to be used for 'Sagg' (Leafy vegetable)/ fodder purpose, it may be sprayed with 0.05% Malathion 50 EC (500 ml Malathion 50 EC mixed in 500 litres of water/ha) five times at 10 days intervals. Do not pluck the leaves within seven days after spraying.

ii) Spraying of insecticides should be done in the afternoon to avoid any adverse effect on pollinators.

iii) The quantity of water will be approximately one tenth of the normal spray of liquid if the motorized sprayer is used. However, the quantity of insecticides will remain the same.

b) Mustard sawfly (*Athalia proxima* Klug)

The adult fly is orange yellow with smoky wings and black veins. The

young larvae is green having black head and about 4 mm long. The full grown larva is greenish-grey having five strips of black dots on the lower side of the body and about 1 cm long. Larva attacks the young crop. All leaves are damaged in case of heavy incidence. The pest appears in the month of October and causes more damage during October/ November.

Application of 10% BHC dust @25 kg/ha or spraying the crop with 0.2% BHC 50 wp (2 kg of BHC WP mixed in 500 litres of water/ha) controls the pest.

c) Painted bug (*Bagrada cruciferarum* Kirk)

The nymphs have a number of pale, brown and red markings on their bodies. The adults are pretty looking with yellow and orange markings. The nymphs and adults suck the cell sap from the foliage and pods causing drying up. The sucking of the leaf sap causes white blotchy spots. Its high population becomes a nuisance at threshing floor also. This pest appears at seedling stage and again at pod formation stage.

Application of 10% BHC dust @25 kg/ha at seedling stage or spraying the crop with Malathion 50 EC (0.05%), i.e., 500 ml Malathion 50 EC mixed in 500 litres of water/ha at seedling stage controls the pest. Second round of spraying with Malathion 50 EC may be given in March (after pod formation), if necessary.

d) Bihar hairy caterpillar (*Spilosoma obliqua* Walker)

The abdomen of the moth is bright-red with black spots. The thorax, antennae and eyes are black. The fore-wings have reddish tinge and the hind wings have dark brown spots. The newly hatched larvae are brown and feed gregariously (in groups) on the leaves of few plants. The fully grown caterpillars are about 4-5 cm long and have numerous dark brown long hairs on the body. The mature caterpillars spread to the whole field and cause huge loss to the crop. The pest is more serious on toria during droughts.

In order to control the pest, the affected leaves should be destroyed in the initial stages of infestation. This would reduce the spread of the pest. Destruction of the larvae in gregarious phase is quite easy and effective. The young caterpillars can be killed easily by dusting the infested crop with BHC 10% (25 kg/ha). Spraying the crop with 0.07% Endosulfan (Thiodan 35 EC) 1200 ml or 0.05% Dichlorvos (Nuvan 70 EC) 300 ml mixed in 600 litres of water/ha controls the pest.