NRCRM

वार्षिक प्रतिवेदन
Annual Report

1993-94

भाकृ अनुप
ICAR

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PREFACE

It is my pleasure to bring out the First Annual Report of the newly established National Research Centre on Rapeseed-Mustard. Immediately after taking over the charge, efforts were made to renovate the existing office-cum-laboratory complex, residential quarters and bring maximum possible area under rapeseed-mustard crop during the first crop season itself. Need based trials of All India Co-ordinated Research Project on Rapeseed-Mustard, germplasm, breeding and agronomic experiments were laid and data recorded. Plans for construction of boundary wall of the research farm and metalled approach road were prepared.

I most sincerely express my deep sense of gratitude to Prof. V. L. Chopra, Secretary, DARE and Director-General, ICAR; Dr. K. L. Chadha, DDG (CS) and Dr. D. P. Singh, ADG (OP) for their valuable suggestions and help extended from time to time.

I wish to express my sincere thanks to the scientists namely, Dr. Parkash Kumar, Sr. Geneticist; Dr. Dhiraj Singh, Scientist (Plant Breeding); Dr. Hari Ram Rohilla, Sr. Scientist (Entomology); Dr. P. P. Gupta, Sr. Scientist (Plant Pathology); Dr. S. L. Mehta, Scientist (Statistics); Dr. Naveen Chandra, Research Fellow; Sh. S. R. Pundhir and Sh. M. C. Kamboj, Sr. Research Assistants, Project Co-ordinating Unit (R & M), CCSHAU, Hisar for conducting experiments and recording data at Bharatpur.

I also thank Dr. Arvind Kumar, Professor of Agronomy, G.B.P.U.A.&T., Pantnagar for conducting and recording data on agronomic experiments.

P. R. Kumar

(P. R. Kumar)
Director

CONTENTS

सारांश

भारतवर्ष में राई-सरसों का तिलहनी फसलों में महत्वपूर्ण स्थान है और मूँगफली के बाद द्वितीय स्थान आता है। हमारे देश में सम्पूर्ण तिलहनी फसलों के क्षेत्रफल व उत्पादन में सरसों कुल की फसलों का क्षेत्रफल व उत्पादन क्रमशः 23.4 तथा 24.8 प्रतिशत है। पिछले आठ वर्षों में राई-सरसों के उत्पादन में आशातीत वृद्धि (25.7 प्रतिशत) हुई है। वर्ष 1985-86 में 2.68 मिलियन टन उत्पादन व उत्पादकता स्तर 674 कि.ग्रा. प्रति हेक्टयर था जो वर्ष 1993-94 में बढ़कर 5.33 मिलियन टन हो गया व उत्पादकता स्तर भी बढ़ कर 847 कि.ग्रा. प्रति हेक्टेयर हो गया। खाद्यान्न तेलों में वांछित आत्मनिर्भरता का स्तर प्राप्त कर लेने पर खल, तेल व अन्य पदार्थों के निर्यात की विपुल सम्भावनाओं का निर्माण हुआ। जहाँ वर्ष 1984-85 में केवल 6.79 करोड़ रुपयों का निर्यात हुआ था, वहीं वर्ष 1992-93 में 133.43 करोड़ रुपये का निर्यात हुआ।

अखिल भारतीय तिलहनी समन्वित परियोजना के अन्तर्गत अनुसन्धान के कार्यों से उत्पादन व उत्पादकता में आश्चर्यजनक वृद्धि हुई। विभिन्न जैविकों व अजैविकी कारकों के कारण उत्पादन का स्तर एक-सा नहीं रह पाता तथा हमारे देश की औसत उत्पादकता (847 कि.ग्रा./हेक्टेयर) औसत अन्तर्राष्ट्रीय उत्पादकता (1300 कि.ग्रा./हेक्टेयर) से काफी कम है। अतः सोद्देश्यपूर्ण निश्चित बुनियादी व क्षेत्र विशेष की आवश्यकतानुसार अनुसन्धान करने की आवश्यकता महसूस की गयी। इसी परिपेक्ष में राष्ट्रीय सरसों अनुसन्धान केन्द्र को स्थापित करने का उपयुक्त समय आ गया और इस हेतु उपयुक्त स्थान के चयन का बीड़ा एक कार्य दल को सौंपा गया। कार्य दल की अनुशंसा के अनुरूप भारतीय कृषि अनुसन्धान परिषद ने राष्ट्रीय सरसों अनुसन्धान को सेवर, भरतपुर में स्थित ग्राह्य परीक्षण केन्द्र के प्रक्षेत्र को साजो-सामान सहित कृषि विभाग राजस्थान सरकार से अधिगृहीत कर लिया। अधिग्रहण हेतु भारतीय कृषि अनुसन्धान परिषद् व राजस्थान सरकार के मध्य दिनांक 5 अक्टूबर 1993 को परिपत्र पर हस्ताक्षर किये गये। इस प्रकार राष्ट्रीय सरसों अनुसन्धान केन्द्र ने दिनांक 20 अक्टूबर, 1993 को मूर्तरूप में कार्य करना प्रारम्भ किया। स्थापना के साथ ही प्रक्षेत्र के सम्पूर्ण 38.15 हेक्टेयर क्षेत्रफल के अधिक से अधिक भाग में सरसों लगाने के प्रयास किये गये और 25 हेक्टेयर में सरसों बोयी गयी। चौधरी चरन सिंह हरियाणा कृषि विश्वविद्यालय, हिसार के वैज्ञानिकों की मदद से 484 राई-सरसों के जननद्रव्य लगाये गये और आँकड़े एकत्र किये गये। इसके अतिरिक्त अखिल भारतीय समन्वित परियोजना के अन्तर्गत 17 पौध प्रजनन, 2 शस्य विज्ञान, 2 कीट विज्ञान व 2 पौध रोग विज्ञान के प्रयोग परीक्षण लगाये गये व आँकड़े भी लिये गये। 44 उन्नत व नई विकसित किस्मों को खेत प्रदर्शन हेतु भी लगाया गया ताकि उपज क्षमता का समुचित प्रदर्शन हो सके। आनुवंशिक स्रोत प्रबन्ध में देखा गया है कि आर्थिक गुणों के दोहन की विपुल सम्भावनाएँ हैं। 230 भूरी सरसों, 50 पीली सरसों, 61 गोभी सरसों व 60 सरसों

की किस्मों की पहचान उनके अधिकाधिक मूल्यांकन व उपयोग हेतु की गयी। गुणवत्ता सुधार अनुसन्धान के अतिरिक्त समन्वित परियोजना एकक हिसार द्वारा लाये गये विशेष किस्मों से संकरों का विकास एवं अधिक उपज वाली किस्मों के विकास का कार्य किया गया। फिनलैण्ड से प्राप्त ब्रैसिका कैम्प्रेस्ट्रिस से नये संकर भी बनाये गये। ये विशेष गुणवत्ता के गुणों से परिपूर्ण थे।

दस हेक्टेयर में सरसों व तारामीरा का प्रजनन बीज उत्पादन कार्यक्रम चलाया गया और कुल 5084 कि.ग्रा. बीज का उत्पादन हुआ। शस्य विज्ञान के अन्तर्गत सल्फर व नत्रजन व सभी उन्नत तकनीकों का विलम्ब से बुआई पर होने पर प्रभाव का अध्ययन किया गया। उपलब्ध प्रयोगशाला भवन, कार्यालय व आवासीय भवनों तथा चाहरदीवारी आदि का प्राक्कलन भारतीय कृषि अनुसन्धान परिषद, नई दिल्ली में जमा किया गया। केन्द्र ने प्रथम सरसों विज्ञान मेले का आयोजन किया जिसका माननीय श्री बलीराम भगत, राज्यपाल, राजस्थान सरकार ने उद्घाटन किया।

वर्ष 1993-94 में रुपये 83,374 की आय बीज के विक्रय से अर्जित की गयी। तीन बुलेटिन पुस्तिकाओं : **एन. आर. सी. आर. एम., रेपसीड मस्टर्ड इन्टर्स इन न्यू एरा : यलो रिवोल्यूशन** और **सरसों तोरिया-तारामीरा** का विमोचन भी इस विज्ञान मेले में किया गया।

SUMMARY

Rapeseed-Mustard is the second most important group of oilseed crops in India after groundnut. These crops account for 24.8 per cent of the total oilseed production and 23.4 per cent gross cropped area under oilseeds in the country. There has been a phenomenal increase in rapeseed-mustard production (98.9 per cent) and productivity (25.7 per cent) during the last 8 years. The production, which was hovering around 2.68 million tonnes with a productivity level of 674 Kg/ha until 1985-86, increased to 5.33 million tonnes with productivity increasing to more than 847 Kg/ha in 1993-94. Sustainable self-sufficiency has opened new opportunities to earn valuable foreign exchange through export of oil, meal and value added products. The turn over of rapeseed-mustard extraction export which was only Rs. 6.79 crores during 1984-85, reached to a level of Rs. 133.43 crores during 1992-93.

The research work done under the net work of the All India Coordinated Research Project on Oilseeds has shown a substantial improvement in production and productivity. However, many biotic, abiotic and other constraints of production remained unsolved resulting in continued instability and considerably lower (847 Kg/ha) productivity in comparison to international average yield, 1300 Kg/ha. It was, therefore, felt appropriate to address these problems through a mission oriented basic and strategic research. It is in this context that the need for setting up of the National Research Centre on Rapeseed-Mustard (NRCRM) was realized. Accordingly, a Task Force was constituted to select a suitable site for NRCRM. Based upon the recommendations of the Task Force, the ICAR decided to locate the NRCRM at Sewar, Bharatpur after acquiring the farm and other assets of the Adaptive Trial Centre of the Department of Agriculture, Government of Rajasthan. A memorandum to this effect between the Government of Rajasthan and ICAR was signed at Jaipur on October 5, 1993. The National Research Centre on Rapeseed-Mustard subsequently came into operation from October 20, 1993.

Soon after the establishment of the NRCRM, efforts were made to bring the maximum possible area under the cultivation in rabi 1993, itself. More than 25 hectares out of the total 38.65 hectares was brought under rapeseed-mustard cultivation. With the help of scientists of the then Project Coordinating Unit

(Rapeseed-Mustard), CCS Haryana Agricultural University, Hisar, 484 germplasm accessions of rapeseed-mustard were grown and data recorded. Besides, 17 Breeding, 2 Agronomy, 2 Entomology, 2 Pathology trials of the All India Coordinated Research Project on Rapeseed-Mustard were laid and data recorded. In order to demonstrate the potential of released/newly developed varieties of mustard, field demonstrations with 44 varieties/strains (developed by the PC Unit, CCSHAU, Hisar) were laid. In the Genetic Resource Management, it was observed that accessions exhibited substantial variability for economic characters. Two hundred thirty eight promising accessions of Brown Sarson (57), Yellow Sarson (60), Gobhi Sarson (61) and Indian Mustard (60) were identified for further evaluation and utilization. Besides, research programme on improvement of quality characters, development of hybrids and high yielding varieties were also taken up with the material brought from the Project Coordinating Unit, CCSHAU, Hisar. Fresh crosses were also made with exotic *Brassica campestris* genotypes possessing improved quality traits, received from Finland. Breeder Seed Production programme of mustard and taramira was undertaken in 10 hactares and a total quantity of 5084 Kg, seed of mustard and taramira was produced. In agronomy, since there was no scientist, only two agronomic experiments, viz., studies on sulphur and nitrogen fertilization and contribution of different technology components under late sown conditions were planned and laid in the field in consultation with Dr. Arvind Kumar, Professor of Agronomy, G. B. Pant University of Agriculture & Technology, Pantnagar. Data on economic attributes were recorded by Dr. Arvind Kumar. Plans for the renovation of existing office-cum-laboratory and residential quarters and for the construction of boundary wall were prepared and estimates submitted to the ICAR headquarters.

The NRCRM organised its **First Sarson Vigyan Mela** which was inaugurated by His Excellency Shri Baliram Bhagat, the Governor of Rajasthan. Three brochure/bulletins : **NRCRM, Rapeseed-Mustard Enters A New Era : Yellow Revolution** and **Sarson-Toria-Taramira,** were got released at the time of Sarson Vigyan Mela. An income of more than Rs. 83,374 was generated after selling the produce of crop grown during 1993-94.

INTRODUCTION

The Rapeseed-Mustard research work in the country which started by the turn twentieth century at Pusa, Bihar, got a boost when ICAR took a step forward in 1967 by launching a comprehensive multidisciplinary research project for the improvement of oilseeds in the country under the banner of the All India Coordinated Research Project on Oilseeds (AICRPO). To meet the research needs, the ICAR intensified the research by strengthening the individual oilseed crop projects by setting up separate Project Coordinating Unit in the V Plan. The Unit of Project Coordinator (Rapeseed-Mustard) was, accordingly established on January 28, 1981 in the campus of the Haryana Agricultural University, Hisar with the mandate of management of genetic resources in addition to the responsibility of the All India Coordination of the Rapeseed-Mustard research.

Rapeseed-Mustard is a crop commodity consisting of eight cultivated species. *Brassica juncea* followed by *Brassica campestris* and *Eruca sativa* occupy the bulk area under rapeseed-mustard. The research work on these crops suffered on account of inadequate infrastructure necessary for basic research. Realizing that the existing Agricultural Universities and Crop Research Institutes working on rapeseed-mustard are either crop or discipline specific in their functionary involvements, an urgent need for establishment of a National Research Centre on Rapeseed-Mustard as a sound fundamental research base for basic and stategic research on problems of rapeseed-mustard, was realized. The centre would be an ideal and appropriate to address itself to such vital basic problems which would help in breaking the yield barriers. Further, it would differ from traditional multi-disciplinary inter-institutional system in its structure and operational characteristics. It would function as a fulcrum to support the production system research with the basic technologies and breeding materials rather than the development of varieties and perfecting the technologies.

Based upon these considerations, the Quinquinal Review Team (QRT) in 1981, recommended for the establishment of National Research Centre on Rapeseed-Mustard in the VII Plan. A Task Force was constituted in November, 1990 for the selection of a suitable site/location for the establishment of NRCRM in the VIII Plan period. Dr. M. V. Rao, Ex. Special Director General,

ICAR was nominated as the Chairman with late Dr. H. G. Singh, Vice Chancellor, Rajasthan Agricultural University, Bikaner, Dr. Vikram Singh, Ex. Project Director (Oilseeds), ICAR as members and Dr. V. Rangarao, Project Director (Oilseeds) as the Member-Secretary of the Task Force.

The Task Force visited various sites offered by the Govt. of Rajasthan, Madhya Pradesh, Uttar Pradesh and Haryana. The committee in all examined 12 offers received from the Chief Secretary of Rajasthan (9); Uttar Pradesh (1); Madhya Pradesh (1) and Haryana (1). As a result of unsuitability of most of the offers, the committee had to explore at its own alternate sites through discussion with various other officials during the visit and made renewed requests for additional sites in some cases. The committee inspected the new sites offered in the districts of Alwar, Jaipur and Bharatpur in Rajasthan. Besides, the committee took initiative and visited a few additional farms either on its own or on the recommendations of the Vice-Chancellors/Directors of Research of Agricultural Universities of Madhya Pradesh, Rajasthan, Uttar Pradesh and Haryana.

Based on an indepth examination of the various sites offered by Govt. of Rajasthan, Uttar Pradesh, Madhya Pradesh and Haryana in terms of their specific location and other plus points, the committee recommended unanimously the following two sites in the order of priority for setting up of the proposed NRC on Rapeseed-Mustard :

(i) Adaptive Trial Centre, Sewar, Bharatpur, Rajasthan (40 ha)

(ii) Regional Research Station, Raya, Deptt. of Agriculture, Mathura Tehsil, Uttar Pradesh (59.5 ha)

Of the two sites, ATC, Sewar, Bharatpur was identified as the most suitable site for establishment of the NRCRM, Bharatpur. It represents the confluence of principal mustard growing areas of 4 states, namely, Rajasthan on the West, Uttar Pradesh on the North and North-East and Madhya Pradesh (Bhind-Morena belt) on the South-East, which together accounting for more than 62 per cent of the total production of Rapeseed-Mustard in the country.

Accordingly, the ICAR established the National Research Centre on Rapeseed-Mustard at Bharatpur (Rajasthan) in October, 1993.

Location

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Location

The National Research Centre on Rapeseed-Mustard is situated in Sewar, Bharatpur in Rajasthan at 77.30° E and 27.15° N. The centre has a total of 38.65 ha farm land. The region receives an average precipitation of 700 mm annually. Bharatpur is 180 Km South West of the National Capital, Delhi, 43 Km West of holy town Mathura. The centre is 8 Km from Bharatpur Railway Station and 4 Km from Bus Stand on Bharatpur-Jaipur National Highway. The nearest airport is at Agra which is about 60 Km from the Centre. At present, the office and laboratories are functioning in a small building and residential quarters, leased by the State Government.

MANDATE

- National repository of rapeseed-mustard genetic resources and information.
- Basic, strategic and applied research to improve the productivity and quality of oil and seed meal.
- Development of ecologically sound and economically viable agro-production and protection technologies for different situations.
- Generation of location specific inter-disciplinary information based on multi-location testing and co-ordination.
- Establishment of linkages and promotion of co-operation with national and international agencies to achieve above objectives.
- To extend technical expertise and consultancies.

Budget

Eighth Plan outlay : Plan.

Items	(Rs. in lakhs)
Establishment	82.765
T. A.	7.500
Works	154.000
Other charges	105.735
Total	350.000

The head-wise VIII Plan outlay, budget sanctioned and expenditure breakup has been shown in Fig. 1.

Infrastructural Facilities

Farm

The farm has approximately 38.65 ha land. Since the farm was owned by Adaptive Trial Centre, the layout has not been changed. The soil map and the contour map were got made. Fencing around the farm area was initiated to protect the farm from stray animals, encroachment and for proper security. The old tubewells used previously, were repaired and utilized for irrigating the farm area. However, it is proposed to have three bore wells to meet the requirements of irrigation and laboratories besides the residential area. Proper drainage facilities need to be created.

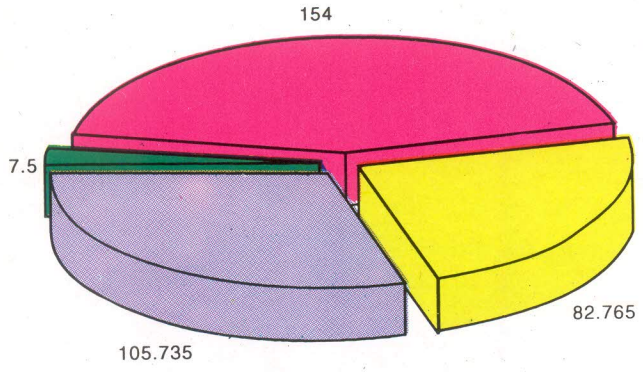
Soil

The soils are mainly in the great groups of ustrochrept and ustifluvents having texture from clay loam to sandy loam and pH 7.6 to 8.8.

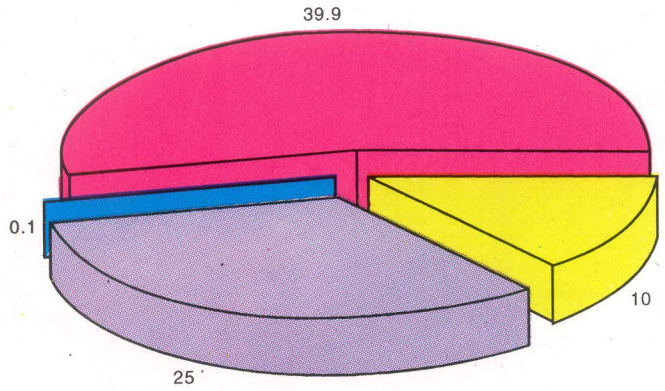
Laboratories

The infrastructure for the laboratories is not available at present. The building acquired on lease is proposed to be renovated for use as office cum laboratory purposes. The type I and II quarters acquired are proposed to be utilized for store/library/laboratory purposes. Steps have been initiated for the renovation of main offfice cum laboratory building and residential complex at the research farm.

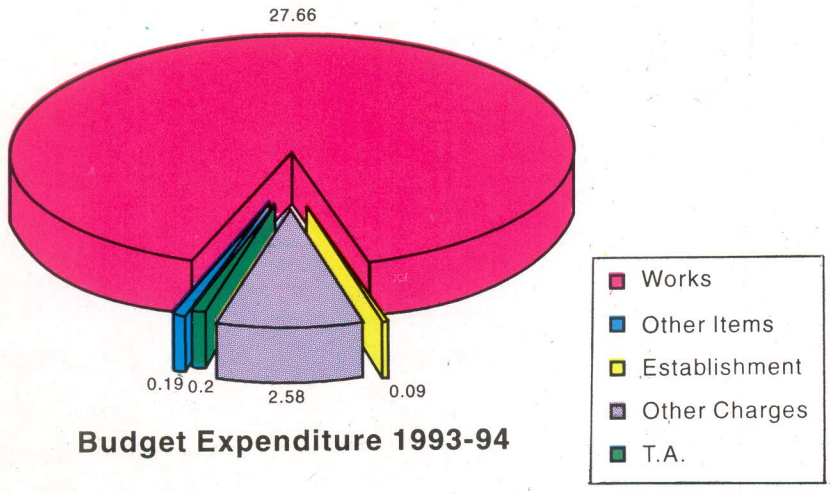
Fig. 1 Ei



Eighth Plan Outlay



Budget Sanctioned 1993-94



Budget Expenditure 1993-94

Fig. 1 Eighth Plan Outlay with Budget Allocation and Expenditure (Rs. in lakhs)

Organisational Set up

The Organisational Set up is given the Fig. 2. The NRC has been provided with the post of a Director, 17 Scientists in different disciplines, an Asstt. Administrative Officer and an Asstt. Finance & Accounts Officer. Details of different posts sanctioned are indicated in Annexure I & II. Efforts are being made to fill up the different posts provided under catagories B, C, and D. The scientific posts were circulated among ICAR institutes for redeployment.

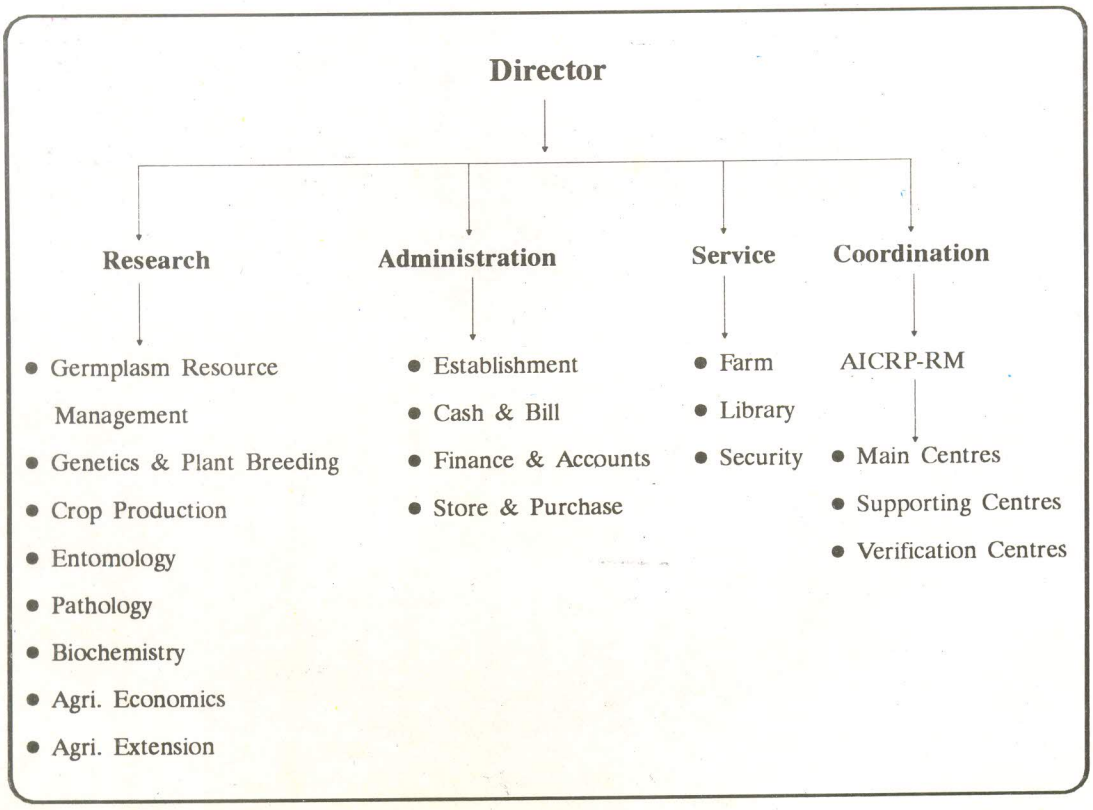


Fig. 2. Organogram of the NRCRM

CROP IMPROVEMENT

Genetic Resource Management

There is a growing concern to conserve rapeseed-mustard genetic resources and their utilization in the cultivar development. The success of such a programme rests on the availability of the resource genes for yield, its components, major biotic and abiotic stresses, oil and seed meal quality. The genetic resources consitute an important reservoir of gene pool, if systematically characterized and catalogued. A vast genetic diversity exists in *Brassicas*. The Genetic Resource Management Unit of the National Research Centre on Rapeseed-Mustard has the responsibility of maintenance, conservation, characterization and cataloguing of both indigenous and exotic accessions of rapeseed-mustard group of crops, apart from channelizing conserved genetic resources into productive use.

Maintenance

Four hundred and eighty four accessions of rapeseed-mustard have been maintained through bag selfing / sib-mating as per the mating system of the crop. Sufficient selfed / sib-mated seeds have been harvested.

Evaluation

Two hundred, 180, 50 and 54 accessions of Brown Sarson, Yellow Sarson, Gobhi Sarson and Indian mustard, respectively, were evaluated in augmented design for days to flowering, days to maturity, plant height, number of primary branches, number of secondary branches, length of the main raceme, siliquae on main raceme, number of seeds / siliqua, 1000-seed weight, seed yield / plant and oil content. The accessions exhibited substantial variability for all the traits except for the oil content. Promising accessions identified for utilization as possible donors for different traits have been presented in Tables 1-4.

Table 1 : Range and five promising accessions of *Brassica campestris* var. Brown Sarson for various agro-morphological traits.

Character	Range		Accessions
	Minimum	Maximum	
Days to flowering	41 (BSC-69)	63 (BSC-2)	BSC-10 (48), BSC-36 (47), BSC-34 (47), BSC-12 (46), BSC-69 (41)
Days to maturity	129 (BSC-4)	148 (EC-332474)	BSC-4 (129), BSC-38 (129), BSC-191 (129), BSC-195 (129), BSC-44 (130)
Plant height (cm)	84.2 (BSC-197)	188.0 (EC-302470)	EC-302470 (188.0), EC-302479 (185.8), EC-302471 (178.8), EC-302474 (160.8), BSC-28 (157.6)
Primary banches/ plant (no.)	2.8 (BSC-92)	10.8 (BSC-153)	BSC-153 (10.8), BSC-115 (9.6) BSC-149 (8.8), BSC-155 (8.8), BSC-14 (8.6)
Secondary banches/ plant (no.)	1.4 (BSC-99)	27.0 (BSC-101)	BSC-101 (27.0), BSC-11 (23.2), BSC-32 (21.6), BSC-33 (21.6), BSC-187 (21.5)
Length of main raceme (cm)	27.2 (BSC-11)	83.6 (BSC-28)	BSC-28 (83.6), BSC-5 (75.0), BSC-114 (67.2), BSC-35 (66.7), BSC-80 (66.6)
Siliquae on main raceme (no.)	17.0 (BSC-197)	77.8 (BSC-28)	BSC-28 (77.8), EC-3339089 (68.4), BSC-16 (63.2), BSC-23 (57.4), BSC-29 (57.4)
Siliqua length (cm)	2.2 (BSC-107)	6.2 (BSC-62)	BSC-6 (6.2), BSC-4 (6.1), BSC-14 (6.1), BSC-56 (5.9), BSC-51 (5.8)
Seeds / siliqua (no.)	4.2 (BSC-182)	29.6 (BSC-6)	BSC-6 (29.6), EC-339092 (18.9), BSC-103 (17.9), BSC-167 (17.9), BSC-4 (16.8)
1000-seed weight (g)	2.3 (BSC-169)	6.8 (BSC-10)	BSC-106 (6.8), BSC-112 (6.2), BSC-148 (6.7), BSC-128 (6.6), BSC-65 (6.5)
Seed yield / plant (g)	7.2 (BSC-165)	36.6 (BSC-29)	BSC-45 (36.9), BSC-29 (16.8), BSC-28 (36.2), BSC-34 (35.6), BSC-49 (30.0)
Oil content (%)	38.6 (EC-302479)	44.9 (BSC-133)	BSC-133 (44.9), EC-339089 (44.7), BSC-57 (44.7), EC-339096 (44.7), BSC-134 (44.6)

* Figure within parenthesis under accessions is the mean value.

Table 2 : Range and five promising accessions of *Brassica campestris* var. Yellow Sarson for various agro-morphological traits.

Character	Range		Accessions
	Minimum	Maximum	
Days to flowering	51 (NDYS-921)	75 (YSC-145)	NDYS-921 (51), SSK-10 (52), YS-4 (56), YSPG-387 (57), RAUDYS-89-115 (57).
Days to maturity	124 (YS-3)	140 (YSC-148)	YS-3 (124), SSK-10 (126), PYS-842 (126), RAUDYS-89-111 (127), NDYS-921 (127).
Plant height (cm.)	86.0 (YSPG-186)	180.4 (YSC-62)	YSC-62 (180.4), YSC-65 (179.7), YSC-61 (176.0), YSC-16 (170.8), YSC-56 (167.0).
Primary branches/ plant (no.)	4.0 (PYS-843)	13.0 (YSC-138)	YSC-138 (13.0), YSC-54 (12.4), YSC-31 (11.4), YSC-39 (11.0), YSC-99 (11.0).
Secondary branches/ plant (no.)	1.0 (YSC-56)	20.0 (YSC-138)	YSC-138 (20.0), YSC-108 (19.0), YSC-17 (17.4), YSC-133 (16.2), YSC-16 (14.4).
Length of main raceme (cm)	33.9 (YSC-99)	73.0 (YSC-138)	YSC-138 (73.0), YSC-55 (68.8), YSC-16 (66.6), SSK-92-16 (65.6), YSPG-187 (64.6).
Siliqua on main raceme (no.)	15.2 (YSC-98)	69.3 (YSC-132)	YSC-132 (69.3), YSC-138 (66.0), YSC-20 (52.6), NDYS-921 (52.2), YSC-16 (47.2).
Siliqua length (cm)	3.2 (YSC-138)	5.6 (YSC-17)	YSC-17 (5.6), YSC-16 (5.4), YSC-7 (5.3), YSC-14 (5.3), YSC-70 (5.1).
Seeds/siliqua (no.)	9.9 (YSC-108)	29.0 (RAUDYS-89-111)	RAUDYS-89-111 (29.0), SSK-10 (29.0), YS-1 (27.2), NDYS-921-89-111 (26.1), PYS-241 (26.0)
1000 seed-weight (g)	2.8 (YSC-123)	6.5 (YSC-34)	YSC-34 (6.5), YSC-71 (6.1), YSC-54 (6.1), YSC-4 (6.0), YSC-60 (6.0).
Seed yield/ plant (g)	3.2 (YSC-98)	26.5 (YSC-31)	YSC-31 (26.5), YSC-69 (24.0), YSC-18 (23.4), YSC-17 (23.1), YSC-67 (20.1)
Oil content (%)	39.5 (YSC-96)	46.9 (YSC-146)	YSC-146 (46.9), YSC-112 (45.8), YSC-3 (45.4), YSC-4 (45.0), YSC-154 (44.6).

*Figure within parenthesis under accession is the mean value.

Table 3 : Range and five promising accessions of *Brassica napus* for various agro-morphological traits.

Character	Range		Accessions
	Minimum	Maximum	
Days to flower	44 (HNS-9202)	98 (Culture-2)	HNS-9204 (44), BN-6 (47), BN-3 (48), PCBN-93-1 (48), BN-4 (49).
Days to maturity	137 (BN-1)	162 (PBGS-93)	BN-1 (137), PCBN-93-1 (138), PBGS-93 (139), BN-2 (140), BN-10 (140).
Plant height (cm.)	96.4 (BN-6)	217.8 (BN-50)	BN-50 (217.8), BN-25 (212.2), ISN-114 (207.2), BN-24 (205.6), BN-45 (201.2).
Primary branches/ plant (no.)	3.8 (HNS-9202)	10.4 (BN-45)	BN-45 (10.4), WFN (G) (10.0), ISN-733-1 (8.0), ISN-602 (7.4), BN-16 (7.0).
Secondary branches/ plant (no.)	4.2 (BN-37)	17.2 (ISN-706)	ISN-702 (G) (17.2), BN-4 (16.0), BN-45 (15.2), PCBN-93-1 (15.2), ISN-602 (13.8).
Length of main raceme (no.)	46.0 (BN-1)	96.8 (BN-12)	BN-12 (96.8), BN-23 (96.6), ISN-114 (95.0), BN-10 (91.8), ISN-602 (89.6).
Siliquae on main raceme (no.)	21.6 (HNS-9202)	99.8 (BN-23)	BN-23 (99.8), ISN-114 (99.4), BN-25 (92.4), BN-45 (86.8), K-225-88 (84.6).
Siliqua length (cm)	3.5 (BN-13)	9.2 (ISN-733-1)	ISN-733-1 (9.2), ISN-733 (7.4), ISN-706 (7.1), BN-23 (6.6), ISN-114 (6.4).
Seeds/siliqua (no.)	14.2 (PSBN-93-1)	27.3 (ISN-1-733)	ISN-733-1 (27.3), GSL-88733-1-51 (27.0), BN-15 (26.8), BN-37 (26.1), BN-29 (26.0).
1000-seed weight (g)	1.44 (BN-13)	4.66 (Culture-1)	Culture-1 (4.66), Westar (4.26), PBGS-93 (4.08), PBGS-91 (3.96), ISN-114 (3.6)
Seed yield/ plant (g)	1.92 (BN-13)	21.5 (ISN-733-1)	ISN-733-1 (21.5), ISN-602 (20.3), BN-45 (17.2), ISN-733 (16.7), ISN-114 (16.1).
Oil content (%)	39.3 (ISN-602)	41.9 (BN-7)	BN-7 (41.9), BN-23 (41.9), BN-19 (41.7), BN-24 (41.7), BN-5-1 (41.5)

* Figure within parenthesis under accessions is the mean value.

Table 4 : Range and five promising accessions of *Brassica junicea* for various agro-morphological traits.

Characters	Range		Accessions
	Minimum	Maximum	
Days to flowering	41 (TM-21)	75 (NDR-389)	TM-21 (41), RN-10 (42), SEJ-2 (43), TM-18-8 (44), PPMS (44)
Days to maturity	121 (SEJ-2)	156 (NDR-381)	SEJ-2 (121), TM-21 (126), PPMS (127), RW-4C-63 (129), TM-18-8 (131)
Plant height (cm)	76.8 (RW-4C-63)	203.0 (RW-28-11-1)	RW-28-11-1 (203), RW-28-11-2 (203), RJ-9 (201), JGM-21 (186.8), NDR-381 (181.2)
Primary branches/ plant (no.)	3.4 (RW-4/86)	7.8 (RSM-151)	RSM-151 (7.8), SKNM-90-4 (18.0), PST-3 (6.4), NDR-381 (6.2), PR-8943 (6.0)
Secondary branches/ plant (no.)	7.2 (RH-8812)	18.4 (PST-2)	PST-2 (18.4), SKNM-90-4 (18.0), NDR-8602 (16.8), TM-18-8 (15.8), PPMS (15.0)
Length of main raceme (cm)	28.2 (RW-4C-63)	86.2 (NDR-8602)	NDR-8602 (86.2), HJ-002 (74.2), RJ-9 (72.0), JMM-90-12 (68.8), RK-8502 (65.8)
Siliquae on main raceme (no.)	20.6 (PPMS)	58.4 (RW-28-11-1)	RW-28-11-1 (58.4), RW-28-11-2 (58.4), NDR-8602 (53.4), RSK-7 (50.8), RK-8502 (45.6)
Siliqua length (cm)	2.4 (RW-4C-63)	5.1 (NDR-389)	NDR-389 (5.1), JMM-90-3 (4.6), TM-18-8 (4.4), RW-9469 (4.4), RH-824 (4.4)
Seeds/siliqua (no.)	6.1 (TM-21)	17.7 (NDR-389)	NDR-389 (17.7), PPMS (14.1), RW-21-59-2 (14.1), JGM-21 (13.4), RN-10 (13.2)
1000-seed weight (g)	2.6 (RW-4C-6-3/II)	7.0 (RW-9186)	RW-9186 (7.0), DIRM-52 (6.9), BCRS-84 (6.5), NDR-8602 (6.2), SJN-191 (6.0)
Seed yield/ plant (g)	3.4 (JMM-90-12)	23.3 (RW-28-11-2)	RW-28-11-2 (23.3), TM-18-8 (23.0), RSM-151 (21.2), JMM-90-4 (18.6), RJ-9 (18.2)
Oil content (%)	33.4 (RH-1184/28)	41.6 (PST-3)	PST-3 (41.6), SEJ-2 (39.9), RJ-7 (39.8), DIRM-52 (39.7), RSM-9007 (39.2)

* Figure within parenthesis under accessions is the mean value.

Dr. N .I. Naashat, RES, Harpenden, U. K.,
looking at the promising material of the Centre.

PG students of MSJ College, Bharatpur being shown the germplasm.

nplasm.

Cultivar Development Programme

To augment the growing demands of oil necessitated by the ever growing population, improved living standard and changes in food habits, efforts have to be intensified for upgrading the yield potential of existing cultivars and also to stabilize the yield by insulating the rapeseed-mustard cultivars against major biotic stresses such as alternaria blight, white rust, aphids and abiotic stresses, namely, moisture deficiency, salinity and high temperature. Exploitation of yield heterosis is also now being viewed as an important avenue to increase yield potential. Besides yield, oil and seed meal quality is also of paramount significance in view of the international trade. The rapeseed-mustard cultivar development programme addresses these issues.

Hybridization

The major objectives of the hybridization programme are to transfer the genes for diseases, pests resistance and '0' (low erucic acid / low glucosinolate content) '00' (low erucic acid and low glucosinolate content) quality traits to the high yielding existing cultivars of Indian mustard (*Brassica juncea*).

High Yield

Forty five fresh crosses were affected with Indian mustard cultivars RH-30, Varuna and PCR-7 as lines and PR 8915, JGM 62, JMM 90-12, JMM 92-6, SKNM 20-13, SKNM 90-4, SKNM 90-13, DM 18-8, YSRL 9, TYS 7-1-2, RC 781, S 3 and RW 2-2 as testers.

Disease Resistance

Twenty crosses were attempted using Indian mustard strains RC 781, DYS 7-1-2, RH 8546 and Domo as donors and promising varieties, namely, Vaibhav, Pusa Bold, Rohini, RH 819 and RL 1359 as high yielding varieties and seeds were harvested.

Aphid Tolerance

Fifteen crosses were attempted using the line / strains of Indian mustard, T 6342, S 3, JMM 926 and RW 2-2 as donor parents and Vaibhav, Pusa bold, Rohini, RH 819 and RL 1359 as varieties with good agronomic base.

Quality

(a) Efforts were made to further improve the exotic strain EC 287711 of mustard possessing low erucic acid and moderately low glucosinolate content. Single plants selected in 1992-93 crop season, were grown in paired rows. The lines showing uniformity for plant height, maturity, seed colour and seed size have been bulked for yield testing.

(b) The following forty fresh crosses were attemped using the exotic strains, viz., EC 287711, EC 322092, EC 322093, and Shiva as donors to transfer 0 and 00 traits into the indigenous high yielding cultivars (Vaibhav, Pusa Bold, Rohini, RH 819, RL 1359, PCR-7, RH 30, Pusa Jaikisan, Varuna and Kranti).

PCR 7 × EC 287711, PCR 7 × EC 322092, PCR 7 × EC 322093, PCR-7 × Shiva, RH 30 × EC 287711, RH 30 × EC 322092, RH 30 × EC 322093, RH 30 × Shiva, RL 1359 × EC 287711, RL 1359 × EC 322092, RL 1359 × EC 322092, Pusa Bold × EC 322092, Pusa Bold × EC 322093, Pusa Bold × Shiva, Rohini × EC 287711, Rohini × EC 322092, Rohini × EC 322093, Rohini × Shiva, Pusa Jaikishan × EC 287711, Pusa Jaikishan × EC 322092, Pusa Jaikishan × 322093, Pusa Jaikishan × Shiva, Varuna × EC 287711, Varuna × EC 322092, Varuna × EC 322093, Varuna × Shiva, Vaibhav × EC 287711, Vaibhav × EC 322092 Vaibhav × EC 322093, Vaibhav × Shiva, Kranti × EC 287711, Kranti × EC 322092, Kranti × EC 322093, Kranti × Shiva, RH 819 × EC 287711, RH 819 × EC 322092, RH 819 × EC 322093, RH 819 × Shiva.

Evaluation

Fifty promising lines were evaluated using checks, namely Varuna, Vaibhav, Rohini and Vardan in augmented design. The lines PR 9024 (3393 Kg/ha) gave the highest yield followed by NC 58278 (3082 Kg/ha), R 96 (2866 Kg/ha), IB-1937 (2817 Kg/ha) and RW-4146 (2600 Kg/ha). Out of all the five checks, Vardan recorded the highest seed yield (2333 Kg/ha).

Hybrid Development

Identification of restorers : A total numbers of 432 F_1 hybrids between *tournefortii* based and 90 F_1's *oxyrrhina* based male sterile lines and promising germplasm lines, were evaluated to identify restorer(s). But none of the germplasm lines showed perfect restoration. Three hundred fresh crosses were attempted to identify restorers for different available CMS systems.

Maintenance of CMS lines : A total of 30 CMS lines were maintained through fifth cycle of backcrossing with *tournefortii* CMS system.

Conversion programme : Efforts continued to transfer *oxyrrhina* CMS system through third cycle of backcrossing to the improved germplasm lines having white rust and aphid tolerance.

BREEDER SEED PRODUCTION

Breeder seed of the following improved varieties of mustard and taramira were produced.

Crop	Variety	Quantity (Kg)
Mustard	Rajat	217
	RH 30	3000
	Varuna	401
Taramira	T 27	1038
	RTM 314	428
Total		5084

CROP PRODUCTION

Production Factors

Late sowing of mustard is inevitable in some parts of the Rajasthan, U. and M.P. due to variations in cropping pattern and prevailing weather condition Information on different technological components under late sown condition lacking. Similarly, information on the nitrogen and sulphur requirement unde these agro-climatic conditions is limited. Realizing the immediate need t identify the constraints limiting production of mustard under late sown conditio experiments were laid out to study the contribution of different technolog components and nitrogen and sulphur requirements soon after the establishmer of NRCRM.

Contribution of Technology Components

The contribution of different technology components, viz., thinnin fertilizer, irrigation and plant protection was studied under late sown condition Fifteen treatments were taken in a RBD with three replications. Sowing w done on November 25th using Vardan variety of mustard. The treatmen included recommended practices and recommended practices without one more technological components.

The seed yield was maximum (1505 Kg/ha) when all the recommende practices (thinning, fertilizer, irrigation and plant protection) were followed. Th broadcast sowing (T_1) gave 17% lower seed yield compared to recom. ende practices (Table 5). Irrigation was the single most important factor as th maximum yield loss (39%) was observed when no irrigation was applied. Th next component after irrigation was fertilizer where the yield reduction was 37 per cent (Table 5).

Exclusion of irrigation and plant protection (T_{12}) caused 60.7 per cent yield loss indicating that this combination is the most important for late sow condition. The next most important combination was fertilizer and plan protection (T_{11}) where the seed yield reduced by 59 per cent. The yiel reduction was mainly due to reduction in branches / plant, siliquae / plant an seeds / siliqua.

Table 5 : Seed yield, yield attributes and oil content of mustard as influenced by different component of technology under late sown conditions.

Treat-ments	Branches/ plant (no.)	Siliquae/ plant (no.)	Seeds/ siliqua (no.)	1000-seed weight (g)	Seed yield (Kg/ha)	Oil content (%)
T_1	15.9	120.5	14.1	4.4	1256.6	39.1
T_2	24.2	219.8	14.5	4.7	1505.6	38.7
T_3	16.4	144.7	12.2	4.6	962.3	39.6
T_4	19.0	144.9	12.7	4.4	937.6	38.6
T_5	14.8	167.5	12.6	5.0	913.0	39.4
T_6	15.7	175.6	12.3	4.8	1110.0	39.8
T_7	15.0	138.9	12.7	4.7	913.3	39.6
T_8	12.3	106.8	10.6	4.9	913.0	40.2
T_9	16.3	117.2	11.4	4.3	690.6	38.8
T_{10}	18.5	98.9	11.6	4.7	963.6	39.5
T_{11}	13.0	104.1	13.2	4.4	611.6	40.8
T_{12}	11.2	83.9	10.9	4.4	592.0	38.9
T_{13}	14.9	100.8	12.6	4.4	765.0	39.0
T_{14}	16.5	147.5	12.4	4.6	666.0	40.8
T_{15}	14.9	127.2	14.0	4.9	689.3	40.0
CD at 5%	6.21	NS	NS	NS	NS	NS

T_1—Broadcast sowing with recommended practices; T_2—Recommended practices; T_3—Recommended practices without thinning; T_4—Recommended practices without fertilizer; T_5—Recommended practices without irrigation; T_6—Recommended practices without plant protection; T_7—Recommended practices without thinning and fertilizer; T_8—Recommended practices without thinning and irrigation; T_9—Recommended practices without thinning and plant protection; T_{10}—Recommended practices without fertilizer and irrigation; T_{11}—Recommended practices without fertilizer and plant protection; T_{12}—Recommended practices without irrigation and plant protection; T_{13}—Recommended practices without thinning, fertilizer and plant protection; T_{14}—Recommended practices without thinning, irrigation and plant protection and T_{15}—Recommended practices without thinning, fertilizer, irrigation and plant protection.

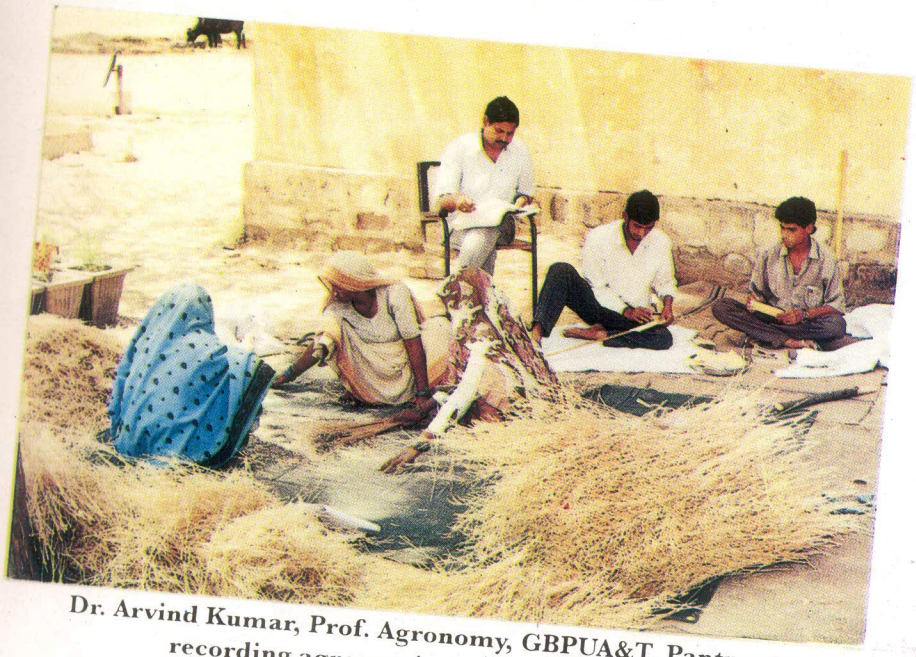
Sulphur and Nitrogen Fertilization

An experiment was laid with five levels of sulphur (0, 15, 30, 45 and 60 Kg/ha) and three levels of nitrogen (60, 90 and 120 Kg/ha) in a factorial RBD with three replications. Planting was done on November 25th, 1993 using Vardan variety of mustard. Application of sulphur upto 30 Kg/ha increased the seed yield. But application of higher levels of sulphur did not enhance the yield further. It is of interest to note that the number of silliquae / plant increased over control due to sulphur fertilization. The response of nitrogen application was obtained only upto 60 Kg/ha. Thereafter, the yield declined (Table 6.).

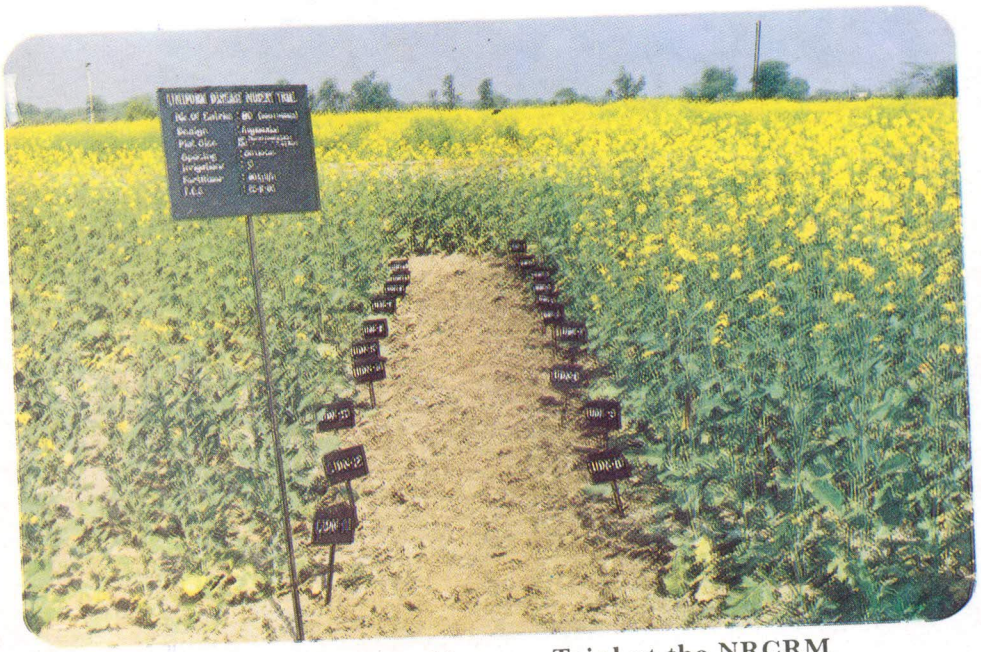
Table 6 : Influence of different levels of sulphur and nitrogen fertilizers on yield attributes and seed yield of mustard under late sown conditions.

Treatment	Branches/ plant (no.)	Siliquae/ plant (no.)	Seeds/ siliqua (no.)	1000-seed weight (g)	Seed yield (Kg/ha)
Sulphur (Kg/ha)					
0	16.3	123.9	11.8	6.0	929.3
15	17.2	144.9	13.2	5.7	929.3
30	18.7	165.4	14.1	5.3	1053.0
45	18.4	169.2	14.6	5.7	962.4
60	18.01	164.3	14.2	5.3	822.6
CD at 5%	NS	NS	23.9	NS	NS
Nitrogen (Kg/ha)					
60	16.3	133.9	13.1	5.5	1076.0
90	17.7	157.2	13.0	5.8	834.0
120	19.3	169.5	14.7	5.4	908.0
CD at 5%	1.8	18.5	NS	NS	NS

Director explaining the features of the newly released mustard variety, Rajat to the DDG



Dr. Arvind Kumar, Prof. Agronomy, GBPUA&T, Pantnagar recording agronomic data at the NRCRM



Uniform Disease Nursery Trial at the NRCRM

Director showing the optimum plant spacing to the farmers

PLANT PROTECTION

All the cultivated species of *Brassica* are highly prone to insect-pests and diseases. Aphid is the most serious pest leading to more than 70 per cent yield losses in rapeseed-mustard group of crops. This is followed by diseases like alternaria blight, white rust, downy mildew and phyllody and which cause yield losses ranging from 10 to 70 per cent. Therefore, there is a need to search for host-resistance against the pests for their effective management.

ENTOMOLOGY

Screening

Out of 87 entries, six entries of mustard, i.e., PR 9302, TM 26, VSL 3, Rohini, PR 8988 and DLM 33 were found moderately resistant. They had the average Aphid Infestation Index of less than 1.5 under moderate aphid infestation. (Fig. 3).

Uniform Pest Nursery Trial

Four entries of taramira, i.e., MTM 1, TMH 52, MTM 2 and MTM 3 escaped the mustard aphid attack. Further, an entry of *B. carinata* (DLSC-2) was rated as fairly tolerant to mustard aphid under the moderate mustard aphid infestation.

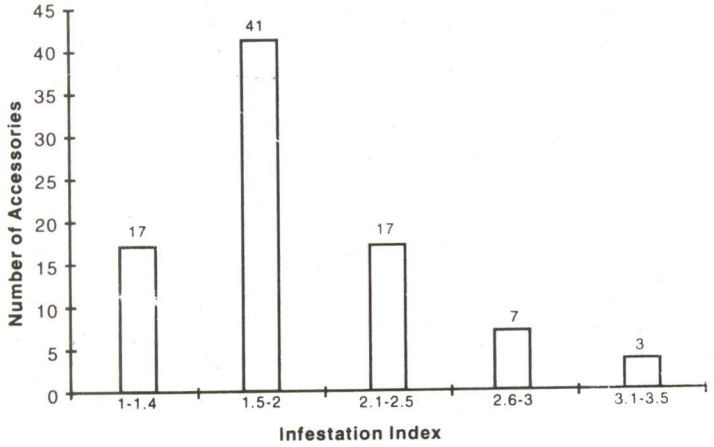


Fig. 3 : Distribution of mustard accessions based on aphid infestation index

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Four entries of taramira, i.e., MTM 1, TMH 52, MTM 2 and MTM 3 escaped the mustard aphid attack. Further, an entry of *B. carinata* (DLSC-2) was rated as fairly tolerant to mustard aphid under the moderate mustard aphid infestation.

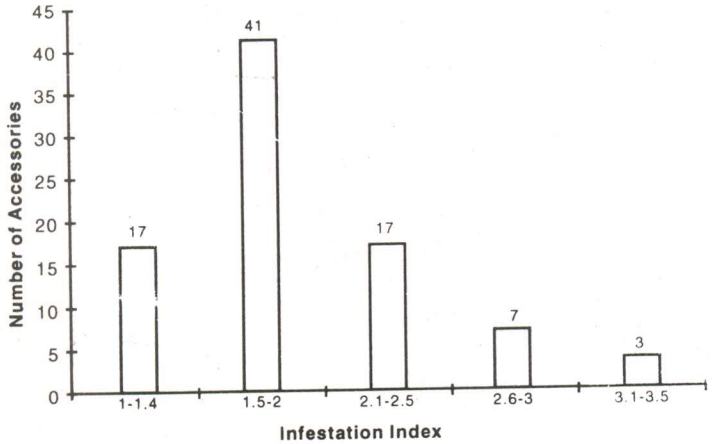

Fig. 3 : Distribution of mustard accessions based on aphid infestation index

PLANT PATHOLOGY

Screening

B. juncea strains : EC 129126, PHR 1; *B. campestris*; YST 151; *B. napus*; GSL 1, Tower, HNS 3 and *B. carinata*; HC 1 and PCC 2 showed resistant reaction against Alternaria blight and white rust incidence.

Eighteen entries were screened against alternaria blight. Tower, a strain of *B. napus* showed resistant/tolerant reaction while EC-174237 and EC-129120 were free from white rust infection both at leaf as well as siliqua stage.

SARSON VIGYAN MELA

The First Sarson Vigyan Mela was organized at NRCRM, Bharatpur on March 24, 1994. His Excellancy Dr. Baliram Bhagat, Governor of Rajasthan inaugurated the Mela. The dignitaries present on this occasion were Dr. K. L. Chadha, DDG (Crop Sciences), Dr. D. P. Singh, ADG (Oilseeds & Pulses)l and Shri Bharat Meena, District Collector, Bharatpur. The main attraction of the event was the demonstration of recently released Rapeseed-Mustard varieties and exhibits displayed by sister organisations, State Department of Agriculture and Private agencies. Seed packets of promising varieties were distributed to the farmers.

EQUIPMENTS

Equipments procured by the Project Co-ordinating Unit (Rapeseed-Mustard), CCSHAU, Hisar have been shifted to NRCRM, Bharatpur. Some of the main equipments are : NMR, NIR, Seed counter, Spectronic 20, Phast System, Trinocular microscopes with photography attachment, Small bundle thresher, pH meter, Seed Germinator, Centrifuge, Laminar flow, BOD incubator, Oven and Seed drier besides PC and PC-AT Computers.

Dr. Baliram Bhagat, Governor of Rajasthan,
visiting experimental fields

Hon'ble Governor releasing NRCRM Brochure

Dr. Baliram Bhagat, Governor of Rajasthan,
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PUBLICATIONS

Technical Reports/Papers

1. **Annual Report :** Promotion of Research and Development Efforts on Hybrids in the Selected Crops : Rapeseed-Mustard (1993), National Research Centre on Rapeseed Mustard, Bharatpur, p. 36.
2. **Rapeseed-Mustard Enters in a new Era : Yellow Revolution** (1994) National Research Centre on Rapeseed-Mustard, Bharatpur. p. 4.

Brochure

NRCRM (1994). Publication of the National Research on Rapeseed-Mustard, Bharatpur. p. 12.

Technical Bulletin

Toria-Sarson-Taramira (1994). Technical Bulletin No. 1 National Research Centre on Rapeseed-Mustard, Bharatpur, March, 1994. p. 6.

Seminars/Symposia/Workshops

Dr. P. R. Kumar, Director participated in the following

1. National Symposium of ISPGR Dialogue on Plant Genetic Resources-Developing National Policy, Organized by the Indian Society of Plant Genetic Resources, NBPGR, New Delhi, December 1-2, 1993.
2. The Rapeseed-Mustard Group Meeting at the National Workshop on "Promotion of Research and Development Efforts on Hybrids in Selected Crops : Rapeseed-Mustard", IARI, New Delhi, December 5-7, 1993.
3. 13th All India Rabi Oilseed Crops Convention, Organized by the Solvent Extractors' Association of India, and presented a special lecture on "Researches on '0' and '00' Rapeseed-Mustard" Chandigarh, March 20, 1994.

DISTINGUISHED VISITORS

Jan. 13, 1994	Dr. D. P. Singh, Assistant Director General (Oilseeds & Pulses), ICAR, New Delhi
Feb. 28, 1994	Sh. R. S. Sangwan, Doordarshan Kendra, New Delhi.
March 10, 1994	Dr. K. L. Chadha, Deputy Director General (Hort. & Crop Sciences), ICAR, New Delhi
March 18, 1994	Dr. G. Hanumantha Rao, Biotechnologist, ITC-Zeneca, Bangalore.
March 24, 1994	His Excellency Dr. Baliram Bhagat, Governor, Rajasthan.