RESEARCH ON BRASSICA OILSEEDS IN INDIA : STEPS TOWARDS PRODUCTIVITY BREAKTHROUGH.

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There are 9 main oilseed crops - groundnut, rapeseed-mustard, sesamum, safflower, niger, soybean, sunflower, linseed and castor, cultivated over an area of 18.67 million hectares in India. These crops produced 12.06 million tonnes of oilseeds during 1981-82. Except for linseed and castor, other seven crops yield edible oil and amongst the latter, 81 per cent of edible oil is obtained from groundnut and rapeseed-mustard crops only. Looking into the acute shortage of edible oilseeds in the country, the Government of India has proposed a target of 14 million tonnes of oilseeds production by the end of VIth Plan (1984-85) to meet the domestic demands. Rapeseed-mustard has to share the quantum of 2.6 million tonnes of the total oilseeds in the country.

Reorientation of Research Goals

Although the research work on the improvement of rapeseed-mustard crops started in the beginning of this century, its activities got a fillip when the Indian Council of Agricultural Research (ICAR) took a step forward in 1967 by launching a comprehensive multi-disciplinary research programme on improvement of oilseeds in the country. The distinctive features of the All India Coordinated Research Project on Oilseed lie in multi-disciplinary approach in identifying and analysing the constraints limiting the productivity of oilseeds and developing suitable varieties and relevant production technology for different agro-ecological regions through a network of research and testing centres. At present, the rapeseed-mustard project has 26 cooperating regional research centres and 24 regional testing centres located in selected agro-climatic regions of the country. Of these cooperating research centres, 18 are financed by the ICAR while the remaining centres are financed either by the Central or the State Government.

Soon after the inception of the All India Coordinated Research Project on Oilseeds, the research strategies on rapeseed-

rapeseed-mustard were reoriented. Problem oriented and location sepecific research programmes, both long term and short term, were formulated to achieve the objectives envisaged.

Raising the yield plateau

Although there was a significant positive trend in growth rate of productivity of rapeseed-mustard in the past three decades (Kumar, 1981), a perusal on year wise percent rate of change in area, production and productivity during 1950-51 to 1979-80 reveals a fluctuating trend. This has been attributed to aberrant weather conditions and the damage caused by diseases, pests and frost injury. Such results brought to the fore the need for not only stabilizing the productivity but also improving the same to bridge the gap between the demand and supply of oil in future.

As the available technology is capable of giving more than 5 percent of growth rates of production (Singh, 1979), however, if some of the important basic as well as the location specific applied problems are taken care off, it would be possible to get a quantum jump in productivity of rapeseed-mustard in the country. It is in this context that the research programmes were reviewed and reoriented in 1981.

Thrust in research

Crop improvement: Introduction of specific resistance, namely *Alternaria* blight, aphid and frost injury ; development of toria (a catch crop) varieties with 75-80 days maturity ; heterosis breeding ; development of plant ideotype for specific agro-ecological regions ; development of thermo-insensitive varieties ; breeding for salt resistance ; introduction of exotic *Brassica* cultivars and breeding for quality characters.

Production technology : Extensive field demonstrations of new technology ; integrated disease and pest management ; design of agricultural implements ; adjustment of cropping system ; increasing the cropping intensity and the effect of phyllospheric bacteria.

Seed Production and seed technology : Studies on isolation distance, production of breeder seed and maintenance of seed viability during storage.

MAJOR ACCOMPLISHMENTS

Crop Improvement

Status of germplasm : At present 10,712 accessions in the germplasm of the genus *Brassica* and its allies are available (Table 1). These are being maintained and evaluated. Efforts are being made to collate and catalogue available information.

Improved varieties : Using the modern and the conventional methods of breeding, 12 improved varieties of mustard, 5 varieties of

toria, 3 varieties of yellow sarson, 2 varieties of brown sarson and a variety of taramina developed during 1967-82, have either been released or recommended for general cultivation at national level or State level. Of these, six mustard varieties, viz., Varuna, Kranti/Pant Rai-15, RLM-198, Pant Rai-18, RLM-514, Pusa Bold and Prakash possess the potential of giving 32-40 q/ha seed yield under ideal management conditions. Under rainfed conditions, the varieties Varuna of mustard and T-27 of taramina have given 20.4 and 16.1 q/ha seed yield in comparison to 18.3 and 3.2 q/ha of wheat in U.P. and Haryana States, respectively, and thus identified as efficient crops for Dryland Agriculture (Venkateshwarlu, 1983).

Resistance breeding : One of the major constraints limiting the production of rapeseed-mustard in the country is the absence of cultivars resistant to Alternaria blight, white rust and downy mildew diseases ; aphid and leaf-miner pests, frost injury and drought situations. In order to provide greater stability to these crops, major emphasis was given on identifying the sources for resistance and their utilization in resistance breeding programmes. The following genotypes were found to possess resistance/tolerance to diseases, pests, frost injury and drought situations.

Alternaria blight : RC-781, RC 1401, YRT-3 and KRV-Tall Brassica Juncea, Torch (B. campestris) ; Tower, Norin-4 and Guliver-2 (B. napus) ; B. alba and B. carinata.

White rust and Downy mildew : RC 781 (B. juncea), Pant Toria 77, 82, Bharbari and 811 (B. campestris).

Mustard aphid : T-6342, RC-736, RC-574, RC-978, RLM-198, RH-7846, RH-7847 (B. juncea).

Leaf-Miner : RC-1008 (B. juncea).

Frost resistant : BDS-I (B. campestris var. brown sarson) and RW-175 (B. juncea).

Drought resistant : Pant-Toria-30, Pant-Toria-40 and Pant Toria-42 (B. campestris var. toria).

Breeding for Alternaria blight resistance : Some of the strains-KRV-Tall, YRT-3, RH-8113, RH-8115, RH-8114, RH-8119, RH-8116, and RH-8120 showing moderate resistance to Alternaria blight disease at pod stage have been developed by Kanpur, Pantnagar and Hisar centres. The seed yield of these strains range from 19.2 to 26.6 q/ha. One of the strains, RH-8121 with seed yield of 22 q/ha has 44 percent oil content (Ann., 1982). Three lines (RH-30 x RC 781, RK-10 x RC 781 and SPS-Multicross) have been identified as tolerant under Berhampore (West Bengal) conditions.

Breeding for aphid resistance : Breeding materials at most of the centres are in F_3 or F_4 generation. However, strains RH-7846, RH-7843 and RH-7847 have been found to be moderately resistant to aphid pest. The seed yield of these new strains are 22.5, 20.9 and 19 q/ha, respectively (Ann., 1982). Three lines (B 85 x Glossy, Varuna x Glossy and RW 351 x Glossy) have been identified as highly tolerant under Berhampore conditions.

Breeding for shattering resistance : Four shattering resistant strains, RH-8131, RH-8133, RH-8123 and RH-8132 and RH-8123 with seed yield ranging from 25.6 to 26.5 q/ha have been developed at Hisar centre (Ann., 1982).

Development of plant types : The cultivation of rapeseed-mustard as mixed crop with wheat still predominates throughout the country. The State like U.P., occupying 56 percent of the total area of rapeseed-mustard of the country has 81 percent of the area under mixed or intercropping. There is no suitable plant-type for such a cropping pattern. A plant type in brown sarson which is ideally suited for such a situation has been reconstructed from a cross between (BSH-1 x DS 17M) in such a way that the spreading and bushy growth habit of BSH-1 variety could be reduced and made compact and erect so as to accommodate more number of plants per unit of land. In the preliminary yield trial, this particular strain has given significantly higher yield (19 q/ha) than the local variety BSH-1 (15.5 q/ha) under irrigated and low fertility conditions (Kumar, 1982 b).

In toria, a plant type with a strong-still stem, compact branching habit and closer arrangement of siliqua is required. Incidently, a new source of dwarfing gene showing monogenic inheritance with a number of modifiers has been obtained at Pantnagar from the natural population of experimental 'Toria Composite-I'. The plants show compact and close arrangement of siliqua on branches (B. Rai, Personal communication).

Development of bold seed size : Efforts are made to develop bold seeded varieties of mustard by backcross breeding method. At Kanpur, a strain KRV-Bold has given 6.98 g test weight as against 5.34 of variety Varuna. The seed yield of KRV-Bold (15.33 q/ha) is significantly superior than the national check variety Varuna (11.73 q/ha).

In brown sarson, a strain BS-19-6 of lotni type having very bold seed size (7.8 g test weight) as against 3.9 g of BSH-1 (standard variety) has been developed following irradiation of seeds at 100 kR dose of gamma rays (Kumar, 1982 b).

Production Technology

Crop production practices suitable for specific agro-ecological regions have been worked-out. The recommended package technology when tested at farmer's field, led to significant increase in productivity of rapeseed and mustard crops. In states of U.P. and Rajasthan, an increase in yield of mustard ranging from 10 to 216 percent was recorded during 1980-81 at farmer's plot where recommended package of practice was adopted (Kumar, 1981). Likewise, trials conducted at Hisar (Haryana) and Ludhiana (Punjab) gave an average 324.6 and 137 percent higher yields of mustard, respectively, when full package of practices was adopted. Similarly in toria, 43.5 percent increase in seed yield under Pantnagar conditions was demonstrated in comparison to the locally adopted practice. During 1981-82, similar type of 102 demonstrations were laid at farmer's field in Delhi, Rajasthan, Haryana, West Bengal and U.P. States. The average yield of

demonstrations indicated the high potential of the existing improved varieties of rapeseed-mustard. During 1982-83, a number of farmers of Mehsana District of Gujarat engaged in cultivation of mustard were contacted. The data relating to the yield and economics of cultivation received so far from two of them revealed that these two farmers produced 29.8 and 33.34 q/ha seeds of mustard and earned a net profit of Rs. 7344.8 and Rs. 5226.4, respectively.

Dry farming package technology : Studies carried out for ten years revealed that it was possible to get double the yield (13.3) of mustard in comparison to the traditional method of farming (5-6 q/ha) when dry farming package technology was properly adopted (Kumar, 1 982 a).

Inter-cropping mustard in various crop sequence

Inter-cropping of mustard in the following crop sequence has recently been developed (Rathi, 1982).

(i) Intercropping of mustard with potato.
(ii) Intercropping of mustard in autumn planted sugarcane.
(iii) Intercropping of potato + mustard with autumn planted sugarcane.
(iv) Intercropping of mustard in autumn harvested cane ratoon.
(v) Increasing mustard production in intercropping of sugarcane by border method.

The practice of raising mustard with potato has been developed with a view to securing an additional production of mustard seed and much higher net profit than pure potato without any appreciable increase in the cost of cultivation. In the new sequence, one row of mustard (Variety Varuna) is adjusted at the place of 4th ridge of potato (variety Kufrichandra-mukhi) and mustard crop is raised with all the inputs of potato without any additional cost. The yield levels of these two crops in association are given in Table 2. In this intercropping, about 87 percent yield of tuber and about 70 percent yield mustard with a land equivalent ratio of 1.57 is obtained without any additional cost, effort or labour (Rathi, 1981).

Increased production :

The researches carried out under the All India Coordinated Research Project on Oilseeds generated valuable data and information on various aspects of crop improvement and production technology. The impact of this knowhow coupled with transfer of technology by development agencies resulted in an overall boosting of the production as well as productivity of rapeseed-mustard in the country. The area and production which stood at 3.0 million hectares and 1.2 million tonnes at the time of initiation of the project in 1966-67 reached to a record level of 4.3 million hectares and 2.4 million tonnes during 1981-82. Likewise, the average productivity increased from 414 kg/ha in 1966-67 to 610 kg/ha in 1981-82.

Table 1. - Status of Germplasm in India.

S1. No.	Crop	No. of cultures[1]
1.	Brassica juncea (Mustard)	6090
2.	Brassica campestris (Toria)	1606
3.	Brassica campestris (Brown Sarson)	916
4.	Brassica campestris (Yellow Sarson)	728
5.	Brassica campestris (Exotics)	47
6.	Eruca sativa (Taramira)	210
7.	Brassica napus (Gobhi Sarson)	960[2]
8.	Brassica nigra (Banarasi rai)	26
9.	Brassica carinata (Karan Sarson)	40
10.	Other exotic species (wild/cultivated)	89
	Total	10712

(1) May include a good number of duplicates.

(2) Include exotics.

Table-2 : Average yield of potato tubers and mustard seed intercropping at Kanpur, 1974-81.

Crop sequence	Pure cropping	Potato + Mustard
Potato (q/ha)	286.74	248.66
Mustard (q/ha)	29.91	21.04
Relative yield of crops in intercropping :		
Potato (%)		86.72
Mustard (%)		70.84

Source : Directorate of Oilseeds Development, 1982.

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