RAPESEED AND MUSTARD BREEDING IN RAJASTHAN

A. KUMAR and D.K. SAXENA
Agricultural Research Station, Durgapura, Jaipur.

Oilseed crops are very important for India because these are the sources of edible oil which is the main cooking medium used in the country. India is the largest producer of oilseeds in the world. These occupy nearly one-tenth area (16.9 million ha.) of cultivated land of India with an annual production of 9.0 million tonnes of seed valued around 2400 crores of rupees. About 14.0 million persons are engaged in its cultivation. The oil industry consists of 2,30,000 village ghanies, 50,000 power driven ghanies, 15,000 expellers and 200 solvent extraction units which cater employment to about 0.5 million persons. The following are important traditional oilseed crops of the country.

1. Groundnut (Arachis hypogaea L.)
2. Rapeseed and Mustard (Brassica Spp.)
3. Sesamum (Sesamum indicum L.)
4. Linseed (Linum usitatissimum L.)
5. Niger (Guazotia abyssinica)
6. Coconut (Cocus spp.)

Rapeseed-mustard are believed to be the crops of great antiquity to India and this country is second largest producer after China. These crops occupy nearly 22.0 per cent of area (3.6 m.ha.) with an annual production of about 27.0 per cent (2.42 m. tonnes) of seed. Its cultivation is mainly confined to northern states including Rajasthan, which is the second largest state in area (0.36 m. ha) and production (0.45 m. t.). The average production of these crops is around 6.0 Qt./ha., which is more or less at par with the national average of 6.13 Qt./ha., but is quite low in comparison to the average yields obtained in countries like Sweden, Canada and Germany. The reasons for this low production are as below.

1. These energy rich crops (5k Cal/g) are largely cultivated (65.8 per cent) under energy starved conditions, almost on marginal and sub- marginal lands adopting the traditional package of practices.

2. Majority of the area (92.0 per cent) is rainfed and water stress at critical stage of crop growth adversely affects the yield.
3. White rust (Albugo candidus) and Alternaria blight (Alternaria Brassicae) diseases; Aphids (Lipaphis erysimi) and sawfly (Athalia proxima) pests and frost cause severe damage to these crops.
4. In major areas it is grown as a mixed crop with wheat which delays its normal sowing period and adversely affects the crop yields.
5. Due to want of seed cum fertilizer drill, the desired distance between plants (10-15 cm) is generally not maintained. It results in sub-optimal plant population and consequently low yield.

In Rajasthan state the cultivation of Rapeseed and mustard is confined to the following crops.

1. Brassica juncea (L) Czern and coss. - Indian mustard
2. Brassica campestris var Dichotoma - Brown sarson
3. Brassica campestris var toria - Indian rape
4. Eruca sativa Lamm. - Rocket

Out of these, Brassica-juncea is the predominant crop followed by Eruca Sativa, B. campestris var dichotoma and B. campestris var toria. Thus from breeding point of view also the emphasis is largely on B. juncea and Eruca sativa.

BREEDING OBJECTIVES:

The following objectives are aimed at for genetical improvement in order of priority.

1. High yield
2. High oil percent
3. Resistance/tolerance to diseases (White rust and Alternaria) insects (Aphids), frost and drought.
4. Bold seed
5. Yellow seed
6. Earliness
7. Non-shattering siliqua
8. Long siliqua and
9. Marker gene introduction.

ACHIEVEMENTS:

Pure line selection in Brassica juncea and mass selection in Brassica campestris var dichotoma and Eruca sativa has resulted in the development of following varieties.

S. No.	Variety	Height (cms)	Maturity (Days)	1000 Seed Wt (gr)	Av Yield (Qt./ha)	Max yield Qt/ha	Oil (%)
1.	Durgamani*	140-150	135-140	3.5-3.6	10-12	25-28	35-36
2.	RS-751	135-140	125-130	3.6-3.7	12-14	26-30	36-83
3.	UUBS	110-115	110-115	4.0-4.1	08-10	16-18	30-32
4.	RTM-1	100-105	90-100	4.0-4.1	07-08	12-13	33-34
5.	RTM-2	105-110	90-100	4.1-4.2	07-08	14-15	35-36

* *A wide adeptable and orobanche resistant variety.*

Hybridisation coupled with pedigree selection produced a number of superior lines out of which the following are promising and being tested in trials at many locations of the country through AICORPO.

S. No.	Variety	Pedigree	Height (cms)	Maturity (Days)	1000 seed Wt. (gr.)	Seed colour	Av. Yield (Qt/ha)
1.	RS-61	Durgamani x RH-30	148-150	145-150	3.9-4.0	Black	20-22
2.	RS-64	Varuna X TM-2	145-150	140-145	3.7-3.8	Black	22-25
3.	RS-65	Durgamani x RIM 198	210-215	145-150	4.0-4.1	Black	22-25
4.	RS-76	RH-30 x YRT1	140-145	135-140	4.0-4.1	Yellow	22-25
5.	RS-77	Durgamani x Varuna	160-165	135-140	4.5-4.6	Black	22-24
6.	RS-79	Durgamani x Varuna	190-200	145-150	3,7-3.8	Black	24-26
7.	RS-81	Durgamani x TM-4	160-170	135-140	4.0-4.1	Yellow	20-22

RESEARCH PROJECT IN HAND: (B. juncea)

With a view to incorporate bold seed size, yellow seed colour, diseases and insect pest resistance, earliness, non-shattering, siliqua character, long siliqua character and gene marker, in otherwise well-adapted high yielding varieties. (Varuna, Durgamani, Prakash, RLM-198, RL-18) the following donor parents are being used in hybridisation and the material is already in different segregating generations.

1. Breeding for bold seed- RH-775, RH-30, Pusa Bold, Pant Rai-15.
2. Breeding for yellow seed- TM-4, YRT-1, RS-36, RS-76, TM-9.
3. Breeding for disease resistance- RC-781, YRT-3.
4. Breeding for aphid resistance- T-6342
5. Breeding for frost resistance- R.W. 175
6. Breeding for earliness- RW-75-123-2, RW 72-20-3, RS-36, RAU-RP-2, TM-2, TM-4.
7. Breeding for non-shattering- RH-30, RID-PR-10, RIK-78-4.
8. Breeding for long siliqua- RH-30A, RH-7859.
9. Breeding for marker gene-RC-781, UUR-57, RH-8116, UUR-66.

MODIFICATION IN BREEDING METHODOLOGY FOR YIELD IMPROVEMENT

It is not difficult to improve upon various plant or seed characters through above mentioned projects. But yield improvement, to the extent of a breakthrough, has not been possible through conventional breeding procedures. The yield barrier could not be overcome possibly due to a very poor harvest index. Recent studies conducted at this location revealed a negative correlation between yield and harvest index (Saxena, 1983). Obviously this resulted in a poor partition of biomass into dry matter and finally a poor harvest of seed. In the inheritance of complex quantitative characters, like yield, the contribution of interacting alleles becomes greater. The exploitation of additive genetic variance is easy since it can be mobilized by the simple method of progeny selection. But at the same time the non-additive variance should also be concentrated and for such a situation, mass, family and progeny selection will be effective. However, the linkage and other limitations make it difficult to accumulate all the desirable genes, if the character is polygenic in inheritance.

Singh (1973), Rawat (1975) and Paul *et al.* (1976) in *B. juncea*, reported that yield is governed by additive type of gene action. Contradicting reports of non-additive gene action for yield were made by Singh and Singh (1972), Chauhan and Singh (1979) and Yadav *et al.* (1981). However, Yadav *et al.* (1974) Labana *et al.* (1975), Tewari and Singh (1975) and Badwal *et al.* (1976) reported that maximum yield in this crop can be attained only through a system which can exploit both additive and non-additive gene action. Hayman (1954) and Griffing (1956) also suggested selection in advance generations for the exploitation of additive and non-additive gene action. Hanson (1959) recommended bi-parental mating followed by reciprocal recurrent selection for increasing the frequency of genetic recombinants and hastening the rate of genetic improvement. In view of these studies, the following breeding programme has been initiated for yield improvement and also for creating maximum variability.

1. Selective diallel mating system.
2. Disruptive selection.
3. Multiple crosses
4. Modified back cross method and
5. Gene pool

FUTURE RESEARCH PROBLEMS:

Some of the hitherto untackled problems for the real breakthrough in this crop also need attention and the following will be dealt in near future.

1. Breeding for salinity
2. Breeding for thermo-insensitive varieties
3. Introduction and exploitation of exotic *Brassica* cv. and species.

IMPROVEMENT OF ROCKET (ERUCA SATIVA) :

Through constant efforts of research as many as 4 high yielding genotypes viz. RTM-9, RTM-12, RTM-13 and RTM-33 have been identified. A composite, JOB-TC-1, has also been developed by using 7 selected lines.

Improved versions of RTM-1 and RTM-2 have also been developed which yield higher by 10-15% over national check T-27. These are early in maturity and their seed contains higher oil content.

The genetic information on heterosis, inbreeding depression and inheritance of economic traits is also being gathered by involving suitable genotypes in a diallel study.

REFERENCES

Badwal, S.S., Singh, M. Labana, K.S. and Chaurasiou, B.D. 1976, General v/s Specific combining ability in Raya. J. Res., (PAU), 13: 319-323.

Chauhan, Y.S. and Singh, D. 1979. Genetic architecture of some quantitative characters in Indian mustard. Indian J. Genet., 39 (2): 255-262.

Griffing, B. 1956. A generalized treatment of the use of diallel crosses in quantitative inheritance. Heridity, 10: 31-50.

Hanson, W.D. 1959. The breakup of initial linkage blocks under selected mating system. Genetics, 44: 857-868.

Hayman, B.I. 1954. The theory and analysis of diallel crosses. Genetics, 39: 789-809.

Labana, K.S., Badwal, S.S., and Chaurasia, B.D. 1975. Heterosis and combining ability analysis in Brassica juncea (L) Czern & coss Crop Imp. 2 (1) : 46-51.

Paul, N.K., Joarder, O.I. and Eunus, A.M. 1976. Analysis of yield and some of its components in Indian mustard. Indian J.Agric. Sci., 46 (11) ; 517-524.

Rawat, D.S. 1975. Genetical studies on yield, oil content and characters related to yield in Brassica juncea coss. Ph. D. Thesis, IARI, New-Delhi.

Saxena, D.K. 1983, Genetic architecture of yield and yield contributing characters in Indian mustard (Brassica - juncea L.) Czern and coss. (Unpublished).

Singh, S.P. 1973. Heterosis and combining ability estimates in Indian mustard (B. juncea L.Czern & Coss.). Crop Sci. 13: 497-499.

Singh, S.P., and Singh, D.P. 1972. Inheritance of yield and other agronomic characters in Indian mustard (Brassica juncea) Can. J. Genet. Cytol., 14: 227-233.

Tiwari, L.P. and Singh, A.B. 1975. Combining ability studies in Indian mustard. Indian J. Agric. Res. 9 (4): 171-176.

Yadav, T.P., Singh, H. Gupta, V.P. and Rana, R.K. 1974. Heterosis and combining ability in Raya for yield and its components. Indian J. Genet. 34A, 684-695.

Yadav, T.P., Kumar, P. and Yadav, A.K. 1981. Genetic architecture for yield and its components traits in Indian mustard. Indian J. agric. sci. 51 (6): 374-378.