Genetic reconstruction of Brassica napus and its adoption as a new oleiferous crop in India

SHYAM PRAKASH and R.N. RAUT

Division of Genetics,
Indian Agricultural Research Institute
New Delhi-110012
India

Rapesed or Brassica napus is not a commercial crop in India. Being highly productive amongst crop Brassicas, it was thought desirable to introduce it. However, various attempts to cultivate exotic cultivars since 1965 failed primarily because of their being very late flowering leading to few or no seed set. Thus, for evolving suitable types for Indian conditions, amongst several approaches priority was given to generate variations through artificial synthesis. This program which is the only one attempted in India so far, started in the year 1967 (Prakash, 1980) and a large spectrum of synthetic alloploids was obtained by hybridizing early indigenous constituent parents (Prakash and Raut, 1982 1983). Non-homologous recombinants of allosyndetic origin were also obtained directly from sterile interspecific hybrids. Alterations in the plant type for achieving still higher productivity were accomplished by resorting to hybridization amongst synthetic and exotic cultivars. As a result of these three approaches, several strains have been isolated which are early and productive and these form the basis of this report.

Artificial synthesis of alloploids

Brassica napus (2n - 38, AACC) is a natural alloploid between *B. campestris* (2n - 20, AA) and *B. oleracca* (2n-18,CC). There exists tremendous variability amongst three commonly cultivated Indian ecotypes of *B. campestris* ssp. *oleifera* viz. brown sarson, yellow sarson and toria. Alloploids were obtained by hybridizing early strains of brown sarson with early cauliflowers (*B. oleracea* var *botrytis*). Resembling natural *B. napus* in general morphological characteristics, they were highly pollen and seed sterile and had irregular meiosis (0-3 quadrivalents persisted upto A_2) in the initial generations. Continuous selection for high pollen and seed fertility for five consecutive generations resulted in a marked degree of improvement accompanied by stabilization in chromosome pairing. The synthetic alloploids were, in general, self-fertile. However, a few self-incompatible forms were also noticed.

Non-homologous recombination

Although not exploited extensively in the genus *Brassica* the phenomenon of non-homologous recombination holds tremendous possibilities. It was first suggested as a way to generate morphological and physiological variations in *B. Juncea* (Prakash, 1973). It was observed that 19-chromosome AC hybrids set some seeds which give rise to variants. These hybrids form a large number of bivalents at meiosis, the maximum being 9 and a good number of these are allosyndetic. Chiasma formation and recombination between non-homologous chromosomes lead to very small translocations relative to original chromosome structure. The formation of a

restitution nucleus and subsequent chromosome doubling give rise to homozygous duplication - deficiency types(2n= 38) and are the source of variants. As a result, a range of morphological and physiological variations was obtained. One of the notable recombinant is Bo-15 which has a long main branch (upto 117 cm) with a large number of pods (upto 126).

Yielding potentiality

The major objective of this program was to evolve early maturing high yielding types of B. napus which can be suitably adjusted in the cropping pattern of Indian agriculture. As a consequence of continuous selection for earlines and yield contributing characters, a good number of lines were isolated in generation A_{12}, and later subjected to preliminary yield trials. Some of the best lines along with their characteristics in generation A_{16} are given in the following Table:-

Strain	Height (Cm)	Yield potential (q/ha)	Maturity (days)
Na-12	1.85	26.0	141
Bo-15	1.95	26.0	147
B0-54	1.85	28.1	155
Bo-55	1.60	23.8	146
Bo-57	1.60	24.7	152
B.juncea RLM-198	2.10	17.8	155

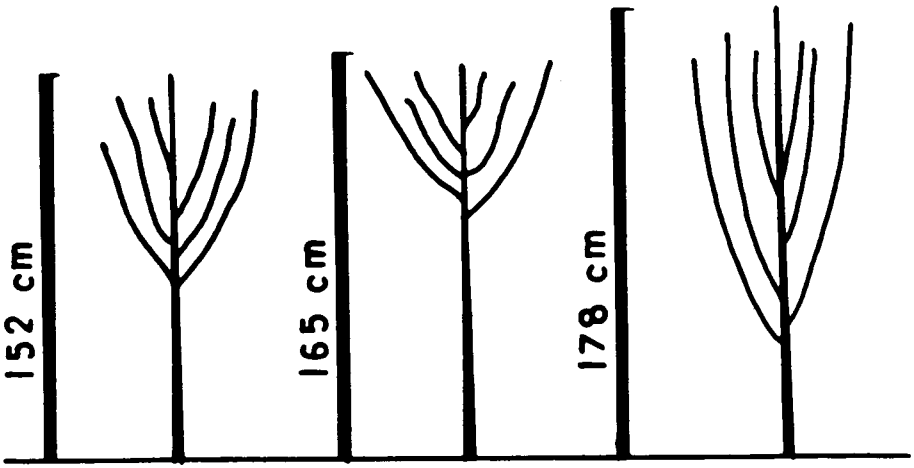
As evident, these strains are of either medium or late maturity and compare well in their duration with B. Juncea cultivars but are better productive.

Contrary to existing Indian Brassicas, synthetic B. napus strains flower only after 60-65 days of sowing and are relatively more determinate which results in a better partitioning of photosynthates.

Aphids (Lipaphis erysimi), alternaria blight and white rust are the three major pest and diseases on Brassicae in India causing considerable losses. These strains are highly tolerant to aphids and have high degree of resistance to alternaria blight and white rust.

Reconstruction of plant type

The synthetic alloploids, in general, are tall with 7-9 primary branches and are of spreading type. The leaves are quite big (the basal ones reaching upto 71 cm) which invariably wilt in the afternoons. This plant type limits the number of plants to a maximum of $15/m^2$. However to accomodate high number of plants to realise more yield the plant type is to be suitably altered. Extensive physiological studies indicate that an ideal plant type should have a height of 1.5 m with only 5-6 primary branches at an angle of $30\text{-}45^{o}$ arising at 60-70 cm from the base. At the same time, it should have fewer number of small and thick leaves a charcter which is associated with higher photosynthetic and NR activity. To obtain such types, the best synthetics were hybridized amongst themselves and with exotic cultivars like Brutor, Cresor and Maris Haplona. Suitable segregants approaching the ideal type were isolated and in generation F_5, the following types are available with us :



All these types have small leaves (upto 31 cm), which, are thick and dark green. The major features of some of the strains are given in the following table :

Characters/Strains	ISN-11	ISN-106	ISN-120	ISN-122	ISN-129
Height (cm)	167	192	187	188	165
No. of primary	6	6	8	8	7
No. of pods on main	76	79	76	70	80
Yield potential (Q/ha)	30.6	33.9	32.2	33.9	34.4
Maturity (days)	143	147	145	147	151

* ISN - Improved synthetic napus.

Prospects :

The existing Indian cultivars of B. juncea and B. campestris seem to have reached a plateau in regard to their productivity. Resistance genes for alternaria and white rust are also practically non-existent. Synthetic B. napus forms have high degree of resistance to both the diseases and have a seed yield potential of about 30 q/ha. Because of these advantageous features, it has spread to around 20 thousand hectares in north-western India within a short period of 3 years. The reconstructed plant type devoid of any secondary and tertiary branches enable them to be more productive under high population pressure and are likely to be cultivated on a substantial area in the near future.

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