Rapeseed Production and Research Progress in Shanghai

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Rapeseed *(B. napus* L.*)* is the main oil crop in the suburbs of Shanghai. Rapeseed production has been developed rapidly since 1949. With the development of rapeseed production, research on it is progressing. The studies on rapeseed breeding, rapeseed cultivation and genic male sterility in *B. napus* are engaged in.

Rapeseed Production in Shanghai

The rural area of Shanghai suburbs is divided into 10 counties. The cultivated land covers 349,900 hectares. Rapeseed is grown in each county. Rapeseed is the main oil crop in the suburbs of Shanghai. Generally, rapeseed rotates with rice (Table 1).

Table 1 – Rapeseed rotates with other crops*

The first pattern	rapeseed – single rice
The second pattern	rapeseed – early rice – late rice
The third pattern	rapeseed – cotton

* The planted patterns of rapeseed, rice and cotton are transplanted.

Before 1949, the area of rapeseed was small and it was extensively cultivated. The yield was only 375 kg/ha. Since 1949, the rapeseed has been expanded, the yield per unit area and the total output have been increased. The yield per hectare was lower than 750 kg in 1950's, but it was more than 1,125 kg in 1960's. The average yield per hectare exceeded 1,800 kg in 1970's (Table 2). For successive years Shanghai has been self-sufficient in edible oil.

Because the Government carries out the policies which encourage the farmer to develop rapeseed production, such as the preferential purchase policy, and selection and popularization of good varieties *(B. napus)*, and the improvement of cultivation technique, such as rationally dense planting, applying more fertilizer, controlling diseases and pests, the rapeseed yield has been increased.

Table 2 – The area and yield of rapeseed in Shanghai (1974-1983)

Year	Area (ha)	Yield (kg/ha)
1974	53,073	2,130
1975	52,360	1,650
1976	49,840	1,477
1977	51,060	1,177
1978	50,386	2,280
1979	50,760	2,325
1980	49,313	1,807
1981	63,733	2,047
1982	63,066	2,355
1983	52,746	1,785

Rapeseed Breeding

Selection and popularization of good varieties is the important cause in rapeseed production development.

B. campestris was planted in the suburbs of Shanghai, most of which were local cultivars before 1957. These local cultivars were characterized by short growth period, early maturity and saving manure, but they were not resistant to diseases and the yield was low. Variety "Sheng Li" *(B. napus)* was introduced in 1957. It was tolerant to fertilizer, cold-resistant, disease-resistant with more siliquae, more seed, high yield and oil content than *B. campestris* in all-round way and the output was increased rapidly.

The double cropping system was adopted in 1960's. There was not a strict requirement for rapeseed maturity, the rapeseed breeding was aimed at developing late ripening variety with high yield and diseases-resistance in 1960's. "Sheng Li Qing Geng", "Sheng Li 52", "Ai Qi Sheng Li" and "Hu You 4" were released one after another by pedigree selection and hybridization breeding at that time. In 1970's, the triple cropping system, rapeseed – early rice – late rice, was popularized rapidly, the old varieties must be replaced by new varieties with early maturity and bumper yield. Medium and early varieties were developed, such as "No. 23", "Shao Ye Qing", "Hu You 9" and "Chang Hu Zi". They are being grown in the suburbs of Shanghai and other provinces now.

The main aim of growing rapeseed is to gather seed and to press for oil, so good or poor qualities of oil and meal influence the utilization value of rapeseed directly. With the development of rapeseed production and the rise of the living standards of the people, improving rapeseed quality has been put forward now. At present, the rapeseed varieties which are planted in Shanghai contain lower linoleic acid and high erucic acid in oil and higher glucosinolate in meal (Table 3). Developing rapeseed quality breeding will exert a great effect on increasing rapeseed oil nutritive value, improving people's health and developing animal husbandry, therefore, rapeseed quality breeding with high oil content, low erucic acid and low gluconisolate as the main objective is one of the important contents in improving rapeseed variety in Shanghai in the near future. This research work has been developed since 1981. The collection, evaluation and utilization of rapeseed variety resources has been studied (Table 4, 5). Under the direct help from Canadian I.D.R.C., the laboratory for rapeseed quality analysis has been established and put into use. A group of line with low erucic acid have been bred by hybridization (Table 6). They will be applied in rapeseed production after experiment.

Table 3 – Fatty acid composition in oil and glucosinolate content in meal of the main varieties in rapeseed in Shanghai suburbs (1984)

Variety	Oil (%)	Fatty acid composition (%)						Glucosinolate (mg/g)
		$C_{16:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:1}$	$C_{22:1}$	
S.Y.Q.	42.64	3.46	14.70	14.48	7.88	9.32	50.17	10.35
No. 23	40.42	3.87	11.70	14.96	9.87	6.94	52.66	7.62
H.Y.9	43.60	2.83	13.90	13.60	8.83	11.27	49.57	10.89
S.L.Q.G.	44.02	3.45	14.44	14.28	9.52	8.16	50.15	6.43

Table 4 – Quality materials of rapeseed planted in parent nursery in 1984

Sources	Numbers
Domestic introduction	17
Foreign introduction	210
from Canada	42
from Australia	12
from New Zealand	7
from six European countries	149
Superior plant rows	73
Total	300

This program has been paid a great attention to by our Government, and has got great help from foreign organization and scientists too, such as Canadian I.D.R.C., France, West Germany. I wish to take this opportunity to thank the foreign scientists who help us all.

Study on Rapeseed Cultivation

On the basis of summarization of the farmer's getting high yield experience in rapeseed, the growth and development target, "Strong in Winter, Growing in Spring, Firm growth and Ripening well", for high yield and the important morphological characters during the different developing periods in *B. napus* in Shanghai and the relative cultivated techniques were proposed. It provides the theoretical basis for getting high yield and promotes rapeseed production forward.

According to previous studies, the patterns of the differentiation and formation of floral organs in *B. napus* were observed by using light microscope and scanning electron microscope. On the basis of the morphological changes of the floral buds, the differentiation phase can be divided into 8 stages and 17 sub-stages. At the same time we noted that the initial formation of floral organs was closely related to the leaf stage.

Study on Genic Male Sterility of *B. napus*

As to the utilization of genic male sterility of *B. napus*, it was reported at 6th International Rapeseed Conference. For last 10 years, the inheritance of genic male sterility in *B. napus* has been studied. It is considered that the genic male sterility in *B. napus* is controlled by two pairs of dominant genes with interaction and one pair has epistatic dominance to the other (Table 7). The genetic model with the ratio of sterility to fertility of 1:1 can be found in the complex fertility expressions. It provides the theorotical basis for "Two-line Method" for F_1 seed production (Fig. 1). Presumptions on "Three-line Method" are also proposed (Fig. 2).

Table 5 – Quality analysis on parent materials of rapeseed harvested in 1984

Oil content		Fatty acid		Glucosinolate		Double low
%	numbers	composition	numbers	%	numbers	numbers
42.0	62	erucic acid < 1 % linoleic acid > 30 %	326 76	0.3	81	75

Table 6 – The main characters of tested strains (1984)

Strain	Erucic acid (%)	Seed yield (kg/ha)	Growth duration (day)	Cold resistance		Sclerotinia	
				incidence (%)	index	incidence (%)	index
82-2529	2.841	1534.5	247	20.0	5.0	28.5	13.8
82-2504	0.268	1637.3	247	12.0	3.0	17.0	5.9
82-2524	4.120	1591.5	247	26.0	6.5	22.0	7.1
82-2551	0.330	1475.3	247	10.0	2.5	26.5	8.0
H.Y.9	49.120	1909.5	246	23.0	5.8	21.0	7.5
S.Y.Q.	48.210	1516.5	245	40.0	10.0	28.5	11.4

Table 7 – Hypothesis on inheritance of GMS in rapeseed
(Li et al. 1985)

GMS is controlled by	sterile plant	The genotypes for	
		restorer plant	maintainer
MS_1-MS_2-	$MS_1MS_1ms_2ms_2$ $MS_1ms_1ms_2ms_2$	$MS_1MS_1MS_2MS_2$ $MS_1ms_1MS_2MS_2$ $ms_1ms_1MS_2MS_2$	$MS_1MS_1MS_2ms_2$ $MS_1ms_1MS_2ms_2$ $ms_1ms_1MS_2ms_2$ $ms_1ms_1ms_2ms_2$

Fig. 1 – The F_1 seed productive model of homozygous "double purpose line"
(Li *et al.* 1985)

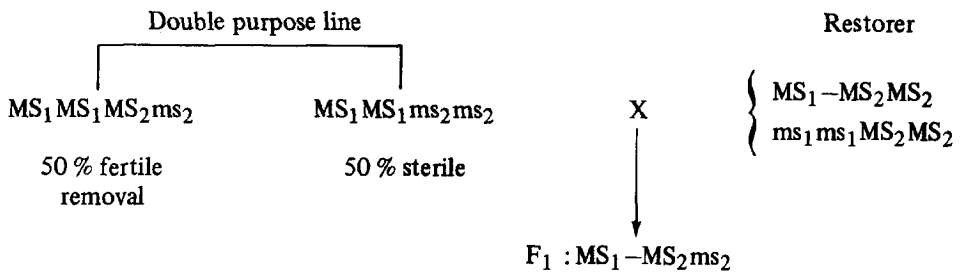
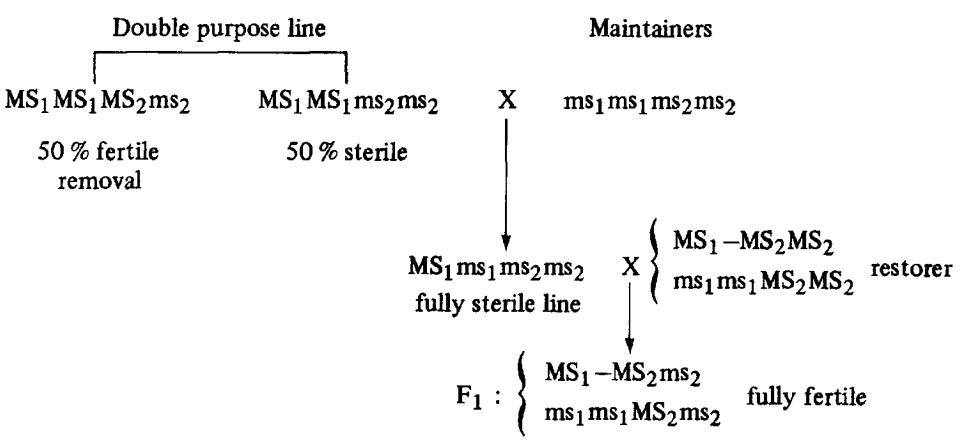


Fig. 2 – The hypothetic model of "Three-line" on GMS for hybrid seed production
(Li *et al.* 1985)



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