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Rapeseed Varieties and Improvement in China

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Abstract: *Brassica napus* cultivars account for about 80-85% of the total rapeseed acreage in China, *Brassica campestris* about 10-15% and *Brassica juncea* about 5-10%. 43 cultivars with single low or double low quality were officially registered during 1981—1995. 35 hybrids were officially registered during 1985—1996, of which 13 were double high, 12 were single low and 10 were double low. At present, hybrids account for about 20% of total rapeseed acreage in China. The mean yield of F1 hybrid seed multiplication is about 750-800kg/ha. In 1995, the planting acreage of double low cultivars was 1.12 million hectares, accounting for 16.2% of the total rapeseed in China.

Key words: Rapeseed-Variety-Breeding-Seed multiplication.

1. Species of the Chinese rapeseed varieties and germplasm import.

In China, about 80-85% of rapeseed cultivation acreage is *Brassica napus* L., 10-15% is *Brassica campestris* L. and 5-10% is *Brassica juncea* Coss.

Rapeseed is mainly concentrated in three large regions in China (very little is distributed in the other regions). (1) The Yangtze River Valley winter type rapeseed region (accounting for about 80% of the total Chinese planting acreage). The cultivars in this region are semi-winter type rapeseed, and most of them are of *Brassica napus*. (2) The Yellow River and Huai River winter type rapeseed region (accounting for about 7-8% of Chinese rapeseed). Most cultivars in this region are of winter or semi-winte type of *Brassica napus*, and only a few are of *Brassica campestris*. (3) The northeast and northwest spring type rapeseed region (accounting for about 8-10%). All cultivars in this region are of spring type. They are of *Brassica campestris*, *Brassica*

juncea or *Brassica napus*.

The native species of rapeseed in China are *Brassica juncea* and *Brassica campestris*. the species of *Brassica napus* is imported from overseas. Our experiences of importing foreign germplasm of Brassica napus are as follows:

(1) In the past, varieties of *Brassica napus* imported from Japan are relatively more adaptable in the middle to down region of Yangtze River and Yellow River-Huai River region.

(2) The quality varieties of spring type *Brassica napus* imported from both Europe and Canada can directly be used in the northeast and northwest region.

(3) The quality varieties of winter type *Brassica napus* imported from Europe have much longer growth period and are susceptible to the disease of *Sclerotinia* when they are planted in the Yangtze River Valley. The quality varieties of spring type *Brassica napus* imported from both Europe and Canada have a longer growth period than the native semi-winter type cultivars, and are susceptible to the disease of *Sclerotinia* and have lower seed yield. Therefore, both winter type and spring type varieties of *Brassica napus* imported from both Europe and Canada are not adaptable in the Yangtze River Valley. But the weak winter type varieties of *Brassica napus* from the south Europe are adaptable in the Yellow River and Huai River region.

(4) The quality varieties of spring type *Brassica napus* imported from Australia have suitable growth period but lower seed yield compared with the native cultivars in the Yangtze River Valley. Therefore, it is possible to screen out useful varieties for cultivation in the Yangtze River Valley via a series of selections.

2. Rapeseed variety improvement in China

China has been facing two reforms in rapeseed cultivars. One is to replace double high cultivars (high erucic acid and high glucosinolates) with double low cultivars (low erucic acid and low glucosinolates). The other is to change open-pollinated (OP) cultivars to hybrids.

Since 1975-1978, China began to introduce quality varieties from overseas. In 1981, the Chinese government began to support the quality rapeseed cultivar breeding programmes. After three five- year plans, i. e., 1981—1985, 1986—1990, 1991—1995, many single low (low erucic acid or low glucosinolates) or double low (low erucic acid and low glucosinolates) cultivars have been released into production.

Table 1. The situation of quality cultivars registered in China

Year	The number of quality cultivars			
	Low erucic acid	Low glucosinolates	Double low	Total
1981—1985	4	0	0	4
1986—1990	18	1	8	27
1991—1995	3	0	9	12
total	25	1	17	43

Table 1 shows that most cultivars registered during 1980—1990 are low erucic acid, and the cultivars registered after 1990 are mainly double low. Therefore, double low rapeseed cultivars were only introduced into production after 1990. But by 1995, the planting acreage of double low cultivars is still less than 20% of total rapeseed.

Most of the bred cultivars in China are *Brassica napus* . A few research units conduct the quality breeding programme of *Brassica juncea* and *Brassica campestris*, and have made some progress. For example, Xinjiang Academy of Agricultural Science has released two double low cultivars Xinyou No. 7 and Xinyou No. 8 of *Brassica juncea*.

Studies on male sterility of rapeseed were started in the mid -1960s. Huazhong Agricultural University in Wuhan firstly discovered the polima cytoplasmic male sterility (pol CMS) in 1972 (Fu, 1981). The first double high hybrid Qingyou No. 2 was released in 1985, and has been used in production on large scale (Li, 1986). This means that

hybrid breeding in China has come to a new period. But because of the later start of quality breeding, the first low erucic acid hybrid was released only in 1989 and the first double low hybrid in 1993. From

Table 2. The situation of rapeseed hybrids in China

Year	The number of hybrids	Double high	Low erucic acid	Double low
1981—1985	1	1	0	0
1986—1990	3	1	2	0
1991—1995	23	8	9	6
1996	8	3	1	4
Total	35	13	12	10

Table 3. The acreage of rapeseed hybrids in China (1000 hectare)

Year	1992	1993	1994	1995	1996
Acreage	73.0	80.0	120.0	100.0	153.0
%	12.0	15.1	20.8	15.0	21.9

1985— 1996, totally 35 hybrids have been registered in China. Several were double low hybrids, such as Huaza No. 3 (CMS hybrid), Youyan No. 7 (GMS hybrid) and Shuza No. 6 (GMS hybrid). The yield of these double low hybrids is usually 10% higher than that of the OP double high cultivars and 15% higher than that of the OP double low cultivars. Because of the introduction of quality rapeseed hybrids with high yield into production, the acreage of hybrids will increase gradualy and steadily. It is anticipated that the percentage of rapeseed hybrid acreage will be over 50% in the year 2003.

At present, the main aims of rapeseed breeding in China are to increase the yield further, to improve the tolerance to the disease of

Sclerotinia, to decrease the content of glucosinolates further and to increase oil content of rapeseed seed.

3. Multiplication of rapeseed hybrid seed

The main ways of hybrid breeding in China at present are by using cytoplasmic male sterility (CMS) and genic male sterility (GMS). Recently, the acreage of F1 hybrid seed multiplication is about 4000 hectares, the mean yield per hectare is about 750-800kg (about 600-750kg/ha in the south part and 750-800kg/ha in the north part of the Yangtze River Valley, 1500kg/ha in the northwest China of high moutainous regions planting spring type rapeseed) , and the total production of F1 seed is about 3-3.5 million kg in 1995—1996. In the practice of F1 seed multiplication, we have obtained the following useful experiences:

(1) The pol CMS lines which are completely sterile in the condition of relative higher temperature but partially sterile in the condition of relative lower temperature are very useful for F1 seed production in the spring type rapeseed region, producing much purer hybrids with 5-10% less male sterile plants than in the winter type rapeseed region.

(2) In the Yangtze River Valley, the parental ratio of male: female is generally 1:2(or 2:4) to 1:3 (or 2:6) for CMS system and 1:5-6(2:10-12) for GMS system in F1 seed multiplication. The reason for GMS system with a larger parental ratio is that the male sterility of GMS is very stable and complete. At present, a few breeding institutions use GMS system for F1 seed production, and they usually removed about 50% male fertile plants in the female GMS lines before blossoming time. The F1 seed yield of GMS is almost the same as that of CMS because of GMS having a larger parental ratio. But the costs of GMS hybrid seed are higher than that of CMS, as more labour is required to remove the male fertile plants in female GMS parents.

(3) About adjusting the blossoming time. There are two ways of adjusting the blossoming time of both male and female parents. One is

to sow the two parents on different days, and the other is to cut the shoots (usually cut the shoots of early parent at shooting stage). Even when the two parents have the same blossoming time, we still cut one plant shoot by every one or two plants of male parents to prolong the flowering period. This is due to the longer flowering period of female parents. Cutting shoots can make the male parent have a longer flowering period for providing enough pollens for later pollination.

(4) Testing quality of hybrid seed: Two methods are adopted to check up the purity of hybrid seed produced in China. One is to check the esterase isoenzyme bands of F1 seed individuals, because hybrid usually has its specific bands. The other is to check the male fertility of F1 plants by summer sowing following the harvest. Usually in May of every year, the hybrid seeds are sampled and sowed in Qinghai or Kunming City or in high mountain field with about 1000-1500 meter of altitude level. The plants usually can blossom in July to August. The hybridity and restoration ratio can be checked during this time.

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