OIL CROPS: BRASSICA SUBNETWORK

PROCEEDINGS OF THE THIRD WORKSHOP, QUALITY TRAINING, AND CHINESE PROJECT REPORTS, HELD IN SHANGHAI, PEOPLE'S REPUBLIC OF CHINA, 21–24 APRIL 1990

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Oil Crops: Brassica Subnetwork

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OVERVIEW OF RAPESEED PRODUCTION AND RESEARCH IN CHINA

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In the recent 10 years, rapeseed production showed a tremendous expansion in China with nearly 2-fold increase of cultivation area and over double increase of the total output, Table 1. As a main oil crop in China, rapeseed spreads almost all over the country and occupies 40-45% of the total area of oil crops -except soybean- and 37-39% of the total production of edible vegetable oil. Rapeseed meal is traditionally used as fertilizer and feed. In addition, it is also very important in crop rotation because of a lot of nitrogen left-over from the rapeseed leaves, petals and roots.

Table 1. Area, production and yield of rapeseed in China.

Year	Area ('0000 ha)	Production ('0000 t)	Yield (Kg/ha)
1980	2841.4	238.40	838.3
1981	380.1	406.50	1,069.5
1982	412.2	565.60	1,372.1
1983	366.9	428.70	1,168.4
1984	341.3	420.50	1,232.1
1985	449.4	560.70	1,247.7
1986	491.6	588.10	1,196.3
1987	526.7	660.51	1,260.0
1988	493.6	504.40	1,020.0
1989	533.0	540.00	1,013.0

With the improvement of the living standard of the Chinese, we have a great potential market for edible vegetable oil. This year, the purchasing price of rapeseed will be increased. It will give farmers a big encouragement to expand their rapeseed production effectively.

ACHIEVEMENTS AND PROGRESS IN RESEARCH

1. Double-low quality breeding

There are four institutions involved in the Sino-Canadian Rapeseed Breeding Project: Wuhan and Shanghai located in winter rapeseed area, and Qinghai and Xinjiang situated in spring rapeseed area. The general objective of the project is to breed new varieties of the three *Brassica* species for:

a) high yield,
b) maturity adaptable to each cropping system,
c) high oil content with erucic acid below 1%, and
d) good quality meal with glucosinolates content below 30% μmol/g for animal feed.

Materials from Canada and Europe with low erucic acid and glucosinolates have been used for crossing several cultivars and new lines. Three low erucic varieties of winter *B. napus*, Zhong Guo Di Jie No.1, 2, and 3 have been developed by Institute of Oil Crops Research, Wuhan (IOCR, CAAS) which can grow in different ecological regions of the upper and middle Yangtze River Valley with maturity suitable for 2-3 cropping sequences. They have been registered by several south-western provinces and listed as released varieties, Table 2.

Shanghai Academy of Agriculture Sciences (SAAS) has successfully selected, demonstrated and produced commercially sufficient quantities of the double-low *B. napus* line 84-24016. The oil with low erucic acid has already been tested in some consumer products (salad oil, margarine and cookies). The meal containing low glucosinolates is being used for broiler feeding trial in comparison with high glucosinolates rapeseed and soybean meals. But the seed yield of 84-24016 is 10% less than that of the normal varieties, so it is still being improved. Single-low strain, 8701 was put into the National Variety Performance Test in the lower reach of the Yangtze river in 1989. Its seed yield has reached the production levels of local commercial varieties. The oil content is 41.0% with erucic acid less than 1%. Symptoms of virosis and sclerotinosis developed slightly.

Table 2. Fatty acid and oil contents of low-erucic acid cultivars.

Cultivar	Composition of Fatty acid(%) C16:0	C18:0	C18:1	C18:2	C18:3	C20:1	C22:1	Oil Content(%)
Zhongyou 1	5.49	2.93	58.61	21.24	10.63	1.11	0.0	39.1
Zhongyou 2	3.56	1.19	63.24	22.13	9.09	0.76	0.0	42.6
Zhongyou 3	3.25	1.51	64.94	20.56	8.66	1.08	0.0	41.0
24016	4.24	-	52.20	27.25	13.52	1.92	0.87	39.2
8701	4.87	-	59.71	22.01	11.97	1.18	0.25	41.0
Ganyou 5CK	3.57	-	15.15	13.95	9.49	10.87	47.06	39.4
Xinyou 4	5.27	0.51	44.82	35.57	13.44	0.39	0.0	37.8
Xinyou 5	4.95	-	44.62	36.87	13.44	0.12	0.0	37.6

Two varieties of *B. campestris*, Qingyou Nos. 11 and 13, low in erucic acid have been bred and released in Qinghai Academy of Agricultural Sciences (QAAFS). They are adapted to high altitude areas with short growing seasons. It has proved that they are suitable to other areas of north-western China.

Xinyou 4 and 5 are the two *B. juncea*, with low erucic acid content which have been developed by Xinjiang Academy of Agricultural Sciences (XAAS).

2. Substantiation for Genic Male Sterility (GMS) Hypothesis

A. Inheritance of heterozygous GMS ,Table 3:

Genetic model of heterozygous GMS

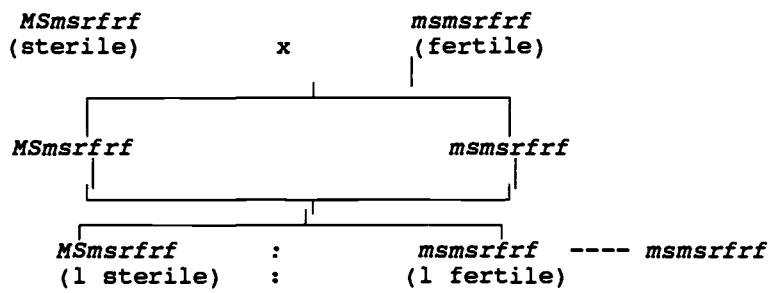

Table 3. Segregation of heterozygous 9AB sib-mating and 9B selfing.

Year	Sib-mating (9A x 9B) fertile	sterile	x^2 (1:1)	9B Selfing fertile	sterile
1984	491	503	0.1217	282	0
1985	317	290	1.1140	479	0
1986	218	207	0.2353	305	0
1987	162	159	0.0125	204	0
1988	239	237	0.0020	300	0
1989	169	148	1.2680	203	0

B. Inheritance of homozygous GMS,Table 4:

Genetic model of homozygous GMS

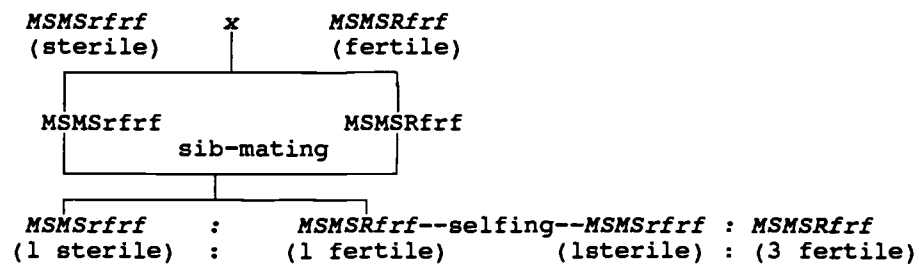

Table 4. Segregation of homozygous 6AB sib-mating and 6B selfing.

Year	Sib-mating (6A x 6B) fertile	sterile	X^2 (1:1)	6B Selfing fertile	sterile	X^2 (3:1
1984	16	17	0.0000	16	5	0.0159
1985	40	36	0.1184	94	22	1.9425
1986	316	329	0.2232	658	223	0.0306
1987	600	628	0.5936	952	318	0.0000
1988	842	813	0.4737	1154	376	0.1255
1989	325	340	0.2940	503	158	0.3676

C. Inheritance of temporary maintainer, Table 5:

Genetic model of temporary maintainer

MSMSrfrf (sterile) x *MSMSrfrf* (fertile)

↓

MSmsrfrf (fully sterile)

Table 5. Sterility of homozygous 6A x temporary maintainer 9B.

Year	Total plants	Sterile plants	Sterility %
1985	157	154	98.1
1986	614	614	100.0
1987	11,371	11,207	98.6
1988	1,233	1,227	99.5
1989	778	773	99.4

D. Restoration test:

Three different genotypes of sterile lines were crossed with the two restorer lines and the F_1 was fully restored, Table 6. This indicates that the materials have *RfRf* gene responsible to develop the restorer line.

Table 6. Restoration Test.

Type of sterility	Cross	Total plants	Fertile Plants	Restoration (%)
heterozygous	9A/4190	150	150	100.0
	9A/Ribao	121	121	100.0
homozygous	6A/4190	132	132	100.0
	6A/Ribao	38	38	100.0
fully sterile	fully st./4190	70	70	100.0
	fully st./Ribao	157	157	100.0

3. Rapeseed biotechnology

Anther-and pollen-cultures were carried out in Shanghai (SAAS) from 1987 to 1989. The anthers of F_1-F_4 are from single or double-low winter *B. napus*. The result shows:

a) Anthers from different genotypes have different induction frequencies of pollen embryoids,
b) 10% sucrose in the medium is the best one, and
c) B5 medium added with 0.1 mg/l 2,4-D and 0.1 mg/l NAA performed good.

Fifty-eight haploids were planted in the field for selection and crossing in 1990.

4. Studies on diseases

Three main diseases which severely affect rapeseed in China are virus, *Sclerotinia* and white rust. SAAS has carried out experiments, for several years on the isolation and identification of virus as well as the selection of resistant materials in rapeseed. Four kinds of viruses (TuMV, TMV, CMV and Ribgrass mosaic virus) have been found. TuMV in rapeseed could be differentiated to 3 strains and CMV to two strains. There is no variety or material which has been found immune or resistant to viruses. However, some materials tolerant to viruses were selected and utilized in breeding. IOCR uses a number of *B. napus* and their crossing progenies to study tolerance to *Sclerotinia*. The selection for resistance and tolerance has been made under artificial inoculation in the greenhouse and natural infection in the fields. So far, they have already obtained a number of single-and double-low *B. napus* with high tolerance, and also provided good methods of identification and selection for high yield, good quality and resistance breeding.

DISCUSSION

Mundel: What stage the *B. napus* varieties were at when winter temperatures dropped to - 15°C.

Zhang/Fang: *B. napus* which survives these temperatures is at the 7-10 leaf seedling stages. (Some discussion followed which ensured that - 15°C was the extreme of cold and that in general water temperatures would be warmer than this).

Kumar: Which varieties were low?

Zhang/Fang: Xin You 4, Xin You 5 (*B. juncea*) and Qin You 11, Qin You 13 (*B. campestris*).

Qazi: Where did the restorers for the genetic male sterility system came from?

Zhang/fang: The restorer lines came from Japan, from Shiga's material via the Chinese germplasm collection at the Oilseed Crops Research Institute in Wuhan.

Islam: What was the reason for the low production levels in 1988?

Zhang/Fang: This was due to bad weather conditions. There is no shattering tolerance in *B. napus* and the *napus* varieties are harvested by hand when 80% of the plants are mature.

Downey: In order to judge correctly, one must not look at pods but at the seeds, and determine the proportion of the seeds which are changing colour. The exact stage at which the crop should be cut will vary from area to area but it should be based on seed colour change.

Singh: How much area was presently sown to F_1 hybrids in China?

Zhang/Fang: About 16% of the total area is presently sown to F_1 hybrids. this is 0.8 million hectares. The main hybrid is Qing You 2.

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