Some fundamental problems conducted from the studies on the breeding of yellow-seeded Brassica napus L.

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Since 1975, We discovered yellow-seeded B. napus from the 13th generation of interspecific hybrid between B. napus CV. 363 and B. chinensis CV. Qi Xin-jian. Since then, we followed on the same way for the search of yellow-seeded rapeseed coming not only from ordinary cultivars introduced from Canada, West Germeny, Sweden and Austrilia, but also from intraspecific and interspecific hybrids. Through the more wider search of yellow-seeded B.napus in our country, we found a lots of different kinds of yellow-seeded B. napus from Shanxi, Gzizhou, Jiangsu, Sichuan provinces. Now, the genic pool of germplasm resources, including B. campestris, B. juncea, and also B. napus, had been established in our country. Studies on the fundamental problems and breeding procedures were carried on in different institutes and universities. We will introduce briefly about some fundamental problems conducted in our institute.

A. Degeneration occurred by continuous selfing on yellow-seeded rapeseed.

Owing to the discovery of yellow-seeded rapeseed from B. napus CV. Huayou 3, We had kept on selfing for many generations. After 4th generation, several aberrations occurred in the later progeny such as twin seedlings, bushy branches, stem fasciation, bushy leaves, bushy flowers and pods, dwarf plants, less branches, small flowers, petal separation, shorter pods, less number of seeds per pod, etc, As we have pointed out(1983) that the discovery of yellowish cotyledon of seedlings in 4th and 5th generations in several lines was quite significant, But the degrees of yellowing were quite different in different plants in the same line, The influence of yellowish cotyledon to the agronomic characters was also quite significant (as follows).

Table 1 The influence of yellowish cotyledon to different agronomic characters

Grade	0	1	2	3
plant height (cm)	139.38	111.39	87.68	77.08
number of primary branches	5.90	3.69	4.13	2.50
length of main raceme (cm)	38.88	32.88	25.43	22.43
length of siliqua (cm)	5.02	4.42	3.93	3.39
number of seeds per pod	20.2	19.4	13.9	10.9
yield per plant (g)	6.93	2.79	1.72	0.60

Note: 0-normal green cotyledon;
1-yellowish part covered over the whole cotyledon less than ½;
2-yellowish part cevered over the whole cotyledon more than ½;
3-two cotyledons appearing yellowish color as a whole, but the growth of seedling very slowly;
4-two cotyledons appearing whitish yellow, no green part at all, and death of seedling in the very early stage.

The histological and ultrastructural observation by electron mieroscope were carried on by Dr. Ming (1984, as showing in another scientific paper). Studies on the over-come of the degeneration by continuons selfing and increasing the vigor of selfing progeny were kept on from different ways.

B. Preliminary studies on the genetical basis of genic system controlling the genetical behavior of yellow seedcoat in rapeseed

Since 1976, we carried on some research program for the determination of genetical behavior of yellow seedcoat. From the crossing between yellow-seeded and black-seeded strains, we got F_1 all black seeds and only averaging 1.63% yellow-seeded plants (theoretical value 1.56%) occurring in F_2 in different progeny. From such results, we may say that the genetical behavier of yellow seed coat may be controlled by triple genes. But if we let F_1 free-pollinated, we got the frequency of yellow-seeded plants, we got the frequency of 0.96%. If we backcross F_1 with yellow-seeded plant,

yellow-seeded plants 23.85% in 1st backcross. It means that the genic condition of yellow seedcoat is much more complicated.

Since then, our graduate students have carried on some research programs from different points of view:

1. Xiao Daren 1982, Analysis on the correlations between seedcoat color and oil content of Brassica napus L.

2. Li Yun-chang 1984, Genetic studies on the seedcoat studies on seedcoat color and oil content.

3. Chen Bao-ynan 1985, Studies on the intererlationship of the thickness of seedcoat and seedcoat color in relation to economic characters, flower initiation and oil content.

4. Wang Han-zhong 1986, Correlation studies on the thickness of seedcoat, seedcoat color and oil contents in yellow-seeded B. napus.

From such studies, they have classified the seedcoat color of rapeseeds according to the degree of yellow color as to 8 grades: from grade 1 to grade 5 (no significant between different grades) being different degrees of yellow seedcoat, and from grade 6 to grade 8 (Significant between later and former grades) being different degrees of black (or dark brown) seedcoat. AS to B. napus, there may have two or there pairs of genes controlling the color of seedcoat. But there may have no cytoplasmic effects. The influence of environment may be quite significant.

C. A new proposal on the mechanism of unpurification by continuous selfing on yellow-seeded rapeseeds.

On the courses of the purification of yellow-seeded B. napus, we discovered a very prominent phenomenon, that is, as we kept selfing for more than 4th or 5th even more generations, the frequency of yellow-seeded plants in the small population may be 100%. But if we increase the population from 20-30 plants, to more than 50 or 100 plants, even if to 200-300 plants, the frequency of yellow-seeded plants may be decreased to 95% or less than 95%. The appearance of small proportion of black seeds may still keep on for many generations. That means the unpurification of yellow-seeded B. napus is a peculiar fact. Such unstable mode of the inheritance of yellow-seeded B. napus in quite different from others. By preliminary observation on the surface of the seedcoat of yellow-seeded B. napus

under binocular microscope, Mr. Wang (1986) discovered there exist different kinds of black or brown spots on the surface of the yellow seedcoat: (1) no spot; (2) several small, round black spots distributed along the seedcoat surface irregularly, but with smooth surface; (3) several irregular large black spots, but with smaller seeds and with rough seedcoat surface; (4) large reddish brown ringlet spot passing through the hilum regularly. How to explain such phenomena from the point of genetic view is now still quite defficult.

A new proposal has been presented by our student Mr. Wang (1986). There may exist the transposable element for the presentation of black spots regularly or irregularly, smooth or rough, even forming reddish brown ringlet spots on the surface of yellow seedcoat, just like the same cases occurring on the surface of corn seeds as proposed by Dr. B. McClintock (1947). It may be the main reason why we can't purify the yellow-seeded progeny by continuons selfing, and also why the mode of the inheritance of seedcoat color is quite unstable in its expression. But how to explain the different kinds of spot pattern, it is still unknown. And also how to identify the inheritance of different shade of spots being just as the same genic system or jumping genes in corn, it may need a lots of time to be proved. If so, we may satisfy to utilize this phenomenon to improve or regulate the quality characters in rapeseed breeding.

D. Problems conducted from the quality oreeding of triple low lines in yellow-seeded rapeseed.

Since 1975, we have been carrying on the breeding program for yellow-seeded B. napus for twelve years. Before 1980, we kept on the normal program for the breeding of high oil content taking yellow seedcoat as an indicator. In 1985, we offered two new strains; the first one is 955 with oil content 46.69% as compared with the standard (38.40%) being higher 21.59%; the second one is 2328 with oil content 42.94%, being 11.82% hiyher than standard. But the yield of the latter is 24.3% over-yield than standard, and the former being higher 21.14%.

After 1980, we started the quality breeding for the transformation of quality characters from ordinary single or

double cultivars to yellow-seeded B. napus. Until now, we have bred low erucic acid lines, low glucosinolate lines and double lines totalled 649, including a series of better lines with more than 90% frequency of yellow-seeded plants. For example, yellow-seeded double low line 83014 with low erucic acid 0.623% and with low glucosinolate 0.261%; anotner one 84-Yβ-437 with low erucic acid 1.046% and with low glucosinolate 0.185%; the third one 84-2326-4 with low erucic acid 0.364% and with low glucosinolate 0.282%. As to the breeding of high oil content, we get stable lines 443 with more than 50% oil content (NMR), including 3 plant lines with more than 58% oil content.

During the course of triple low line breeding, the first problem is the frequency of the occurrence of triple low line is quite low. For instance, from F_2, B_1 and B_2 generations of combination crossing yellow-seeded line with black-seeded double low cultivar, we have selected only one plant of 1528 plants. That means the chance of the occurrence of triple low characters may be $\frac{1}{\wedge}$ out of 10 thousands. The second problem is the yield of yellow-seeded triple low line is quite lower than the yield of black seeded double low line. And also the adaptation and resistnce to diseases and pests and various bad conditions are also lower than normal. How to solve such problems? It will be the main subject to meet with by Chinese breeders in the near future.