STUDIES ON THE BREEDING OF YELLOW-SEEDED BRASSICA NAPUS

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SUMMARY

In 1975, some seeds of yellow-seeded B. napus had been firstly found in China from interspecific hybrids which were originated from the cross between B. napus and B. campestris. Since then, such materials had been traced from 1975-76 until to 1981-82 about seven years. By continuous selting, sib-mating and interline crossing in comparison with open pollination as standard, certain lines have been bred true in yellow-seeded B. napus. But such kind of yellow color in seedcoat with different shades of dark color is quite different from the bright yellow or deep yellow color of B. campestris and B. juncea. The frequencies of these lines with yellow seeds in occurrence being about 26% were reached or nearly reached 100% in large samples. The oil contents analyzed from the individual plants of these lines were gradually raised from average 40% to 50% or more than 50%, and the samples of the population coming from trial blocks were also raised from 38% to above 45% in average. Now, we are just starting for yield tests between different yellow-seeded lines, and also some tests are carrying on to overcome the degeneration by continuous selting of certain lines.

In 1975, the yellow-seeded Brassica napus had been firstly discovered in China from the mixture of seeds coming from the offsprings of Huayu No. 3. Since then, we checked out all the breeding materials including various intervarietal hybrids, different interspecific crosses, and also ordinary cultivars or introductions from other countries. A few of yellow-seeded materials were discovered from these materials every year. But the frequency of yellow-seeded materials was quite low in occurrence in ordinary cultivars with dark color seeds in comparison with interspecific and intraspecific hybrids.

From the beginning of 1976 and later on, these materials were treated by selfing and sib-mating during the flowering stage and also they were crossed between the yellow-seeded and dark-seeded types in B. napus L.
The results from selfing were obtained as follows :

Table 1 : The average and highest frequency of yellow-seeded types in occurrence in the population by continuous selfing (1976-1982)

year	1976	1977	1978	1979	1980	1981	1982
Generation of selfing	S_0	S_1	S_2	S_3	S_4	S_5	S_6
Average frequency	26	40	46	60	75	80	85
Highest frequency	38	60-70	80	85	90-95	98	100

Table 2 : The frequency of yellow-seeded plants in occurrence in the same line by continuous selfing (1982)

Origin	yellow	non-yellow	Total	Frequency %
Samples from single pod per plant	103	3	106	97.17
Samples from plants by selfing	32	1	33	96.97
Samples from isolated plot*	303	55	358	84.64

* *Open pollination in isolated plot.*

The frequency of yellow-seeded types in occurrence from open pollination was 26% in average (as Table 3). During the flowering stage, the offsprings from the first generation of selfing were selfed again. But the first lateral branches in the same plants were harvested as standard, which were open-pollinated as usual. Then the comparison between the plants coming from selfing and open pollination had been made. The results indicated that the frequencies of yellow-seeded plants in occurrence by selfing were quite higher than by open pollination (as Table 4).

Table 3 : The frequencies of yellow-seeded plants in occurrence coming from open pollination (Liu Hou-Li, etc. 1979)

Year	No. of lines	Plants with			frequency (%)	
		Yellow	Non-yellow	Total	Range	Average
1976-1977	10	39	106	145	12.50-37.50	26.90
1977-1978	4	13	42	55	12.50-30.77	23.64
Total....	14	52	148	200		26.00

Table 4 : The comparison between the frequencies of yellow seeded B. napus by selfing and open pollination in 77-78.

Treatment	No. of lines observed	Average (%) frequency	frequencies over 50 %	
			Line	%
Selfing........	32	39.06 ± 18.30	10	31.25
Open pollination .	30	31.33 ± 15.50	4	13.33

As showing above, the tendency was quite clear that the longer the generations of selfing, the higher the frequencies of yellow-seeded plants in occurrence (as Table 1). Five to six generations of selfing were necessary for the yellow-seeded materials to be bred true. Until now, certain lines of breeding material have been all reached or nearly all reached 100% in yellow-seeded in appearence (as table 5).

However, the yellow color in the seedcoat in B. napus is quite different from the appearance of seed color in B. campestris and B. juncea. The yellow color of the former appears different shades of seedcoat color, from light yellow to deep yellow, even to black-spotted yellow within the same population coming from the same plants with the same genetic background (as photo 1). Otherwise, the latter were usually pure bright yellow or deep yellow without any difference between different plants in large samples.

Line	Yellow	Non-yellow	Total	Frequency (%)
1	109	17	126	86.51
2	204	9	213	95.77
3	171	31	202	84.65
4	175	30	205	85.37
5	185	13	108	93.43
6	177	32	209	84.69
7	197	6	203	97.04
8	172	42	214	80.37
9	206	11	217	94.93
10	184	4	188	97.87
11	190	39	229	82.87
12	207	6	213	97.18
13	217	1	218	99.54
14	177	11	188	94.15
15	184	3	187	98.40
16	192	1	193	99.48
Total......	2,947	256	3,203	92.01

Table 5 : The frequency of yellow-seeded plants in occurrence in different lines by single plant selection in 6th generation.

From the beginning of 1980 and later on, the analysis of oil contents of different breeding materials were carried on for three years by using YG-2 type soxhlet's extractor which had been developed by Chinese Oil Crops Institute (1970). The tendency was also quite clear that the more the generations of selfing, the higher the frequencies of yellow-seeded plants in occurrence, the higher the oil contents (0.98-5.07%, 3.09% in average) of yellow-seeded materials through positive selections year by year, and also the dark-seeded materials in the same pooulation as the selections for higher oil contents were keeping on in every generations. But the oil contents of yellow-seeded materials were always higher than those of dark-seeded materials within the same populations (as tables 6, 7, 8).

The possibility may be stated that in order to breed the new strains with higher oil contents by continuous single plant selections, the color of seedcoat may be used as a best indicator. Mr. Xiao (1982), one of our graduate students, had worked along this line for three years. He had also made sure that the lighter the color of seedcoat, the thinner the seedcoat, and the higher the oil contents (1.54-4.26%). The negative correlations between the color of seedcoat and oil content (as table 8), the thickness of seedcoat and oil content were highly significant. The regression coefficient being 0.65% was also highly significant.

During the course of these studies, a phenomenon should be mentioned that the degeneration of offsprings by continuous selfing is quite prominent. From the beginning of the third generation, especially in 5th and 6th generations, a series of degenerations had occurred, from the presentation of various grades of yellow cotyledons, slow development of seedlings, clustered branches, twin-branched or trifid-branched in the main stem, fasciate stem with numerous flowers and pods, variable flowers with small and separating petals, dwarf plants with few branches, and so forth. These materials were low yield in seed production. Another fact should be pointed out that such degenerations might be overcomed by sib-mating or interline crossing or open pollination in isolated plot in the same genetic background. It indicates that the degeneration occurring from continuous selfing might not be the difficulty for the breeding of new strains with high oil contents.

The studies on the genetical behavior of yellow-seeded <u>B. napus</u> and correlation relationship between different characters concerned are still carrying on. The yield tests between different yellow-seeded lines are also designed and practiced in field experiment.

<u>REFERENCE</u>

1. Liu Hou-Li, etc. 1979. The discovery of yellow-seeded <u>B. napus</u> and preliminary investigation on its genetical behavior (Abstract) Acta Genetica Sinica 6,1:54.

2. Liu Hou-Li, etc. 1981. Preliminary report about the breeding of high oil content on yellow-seeded rape of <u>B. napus</u> L. (in Chinese with English summary). Journal of Huazhong Agricultural College 1981, 1: 13-20.

3. Xiao Dar. Analysis on the correlations between seedcoat color and oil content of <u>B. napus</u> L. Acta Agronomica Sinica 8,4: 245-254.

Table 6 : Biometrical tests for the significance of oil contents among three groups (Liu Hou-Li, etc. 1981).

Group tested	Type	No. of samples observed	Mean	S.D.	S.E.	d	t
A	Yellow	170	39.42	2.22	0.17	0.28	1.1480
	Non-yellow	83	39.14	1.66	0.18		
B	Yellow	146	41.17	2.86	0.24	1.16**	3.5752
	Non-yellow	127	40.01	2.59	0.23		
C	Yellow	79	43.49	2.65	0.30	3.35**	7.0750
	Non-yellow	25	40.14	2.32	0.46		

** *Significant in 1% level.*

Table 7 : The comparison of average oil contents between different lines by statistical tests (Liu Hou-Li, etc. 1982)

Line	Replication	Yellow	Non-yellow	Difference
1	I	43.82 ± 2.92	41.00 ± 2.82	2.82**
	II	46.00 ± 2.18	45.00 ± 1.41	1.00**
	III	45.81 ± 2.14	43.20 ± 1.67	2.61**
2	I	45.76 ± 2.46	45.40 ± 2.49	0.36
	II	44.23 ± 2.53	43.23 ± 2.00	1.00**
	III	42.43 ± 3.24	43.00 ± 1.41	−0.57
3	I	47.89 ± 2.67	45.43 ± 1.41	2.46**
	II	47.53 ± 2.34	45.31 ± 3.41	2.22**
	III	46.76 ± 1.84	45.91 ± 1.35	0.85**
4	I	45.00 ± 1.87	42.88 ± 3.22	2.12**
	II	45.64 ± 1.79	43.07 ± 2.88	2.57**
	III	46.43 ± 2.27	44.78 ± 1.49	1.65**
5	I	47.73 ± 2.60	44.60 ± 1.73	3.13**
	II	49.92 ± 2.34	48.11 ± 1.89	1.81**
	III	46.33 ± 2.83	41.67 ± 2.00	4.66**
6	I	48.38 ± 2.77	45.25 ± 2.65	3.10**
	II	48.33 ± 2.31	47.00 ± 2.83	1.33**
	III	46.50 ± 2.77	44.50 ± 2.81	2.00**
7	I	45.83 ± 2.83		
	II	44.81 ± 3.48	43.73 ± 2.72	1.08**
	III	47.14 ± 2.33	43.22 ± 3.06	3.92**

** *Significant in 1% level.*

Table 8 : The correlation analysis between seedcoat color and oil contents from the samples of population with the same genetic background (Xia Daren, 1982).

Population samples	No. of plants analyzed	Average oil content (%)	r	r^2
1	72	41.78	−0.317**	0.100
2	50	40.22	−0.417**	0.222
3	39	41.28	−0.565**	0.319
4	41	39.66	−0.414**	0.171
5	42	40.39	0.07	0.005
6	37	40.52	−0.317**	0.138
7	156	40.70	−0.333**	0.111
8	167	41.23	−0.299**	0.089

** *Significant in 1% level.*