The discovery of a new kind of cytoplasmic male sterility accession in *Brassica napus* L.

LI Aimin, ZHANG Yongtai, HUI Feihu, ZHOU Rumei

Jiangsu Lixiahe District Institute of Agriculture Sciences, Yangzhou, 225002, China. Email: yzlam@126.com

Abstract

One male-sterile plant was discovered in rapeseed (*BRASSICA NAPUS* L.) in 2002. Compared with fertile plants, the male sterile plant was charactered by stamen like halberd, no pollen in anther, the long stamens of some flowers together, and normal pistil. The YZA CMS was gotten by backcrossing with rapeseed (*B. NAPUS* L.). Compared with Pol CMS and GMS, the YZA CMS' stamens are higher, and the proportion of pistil vs. stamen higher too. The testcross offspring and backcross offspring with Pol CMS maintainer and restorer are all sterile. We thought that the YZA may be a new kind of cytoplasmic male sterile accession.

Key words: YZA, GMS, Pol CMS, stamen, pistil

In present rapeseed heterosis use, because Pol CMS and S2A CMS, MICMS are sensitive to temperature in flowering season, they are easy to produce the trace amount of pollen grains under the low temperature[1], while the genic male-sterile line must wipe out 50% fertile plants in breeding [2], which increase the breeding cost. If leaked, some sterile plants may appear in the hybrid, it will be dangerous to the rape breeding and planting. Therefore the development of the new sterile sources was still important foundation in the rapeseed heterosis use. In the flowering season of 2002, we discovered one natural male sterile plant in breeding progeny (*Brassica napus* L) with halberd-like stamen, no pollen in anther and fused long stamens of some flowers but normal pistil, and its sterility is stable. The further research indicated that, the flower structure of this sterile plant is different from that of genic sterile lines, Pol CMS, with also different restoring and maintaining genes with Pol CMS.

1 Material and method

1.1 Materials

YZA is obtained from the offspring of the natural sterile plant testcross and backcross with B2 which was discovered in 2002. The stamens were like halberd with no pollen in anther, the long stamens of some flowers were fused two by two (Figure 1), while pistils were normal and the sterility was stable. Yang A2 is a Pol CMS, B1, B2 are Pol CMS B-line, R1, R2, R3, R4,R5, R6 are Pol CMS R-line. 1002AB is double recessive genic sterile line.

1.2 Methods

In 2003, we obtain F_1 hybrid by crossing with YZA as female parent, B1, B2, R1, R2, R3, R4,R5, R6 as male parent, investigated the sterility of the hybrid F_1 in 2004, and backcrossed with the hybrid F_1 as female parent, and B1, B2, R1, R2, R3, R4,R5, R6 as male parent, investigated the sterility of the backcrossing hybrid F_1 in 2005.

In 2006, we took 100 flowers of B2, YZA, 1002AB, and Yang A2 each, on the main axle, survey lengths of various part of flower.

2 Results and analysis

2.1 Flower shape and structure of YZA, Pol CMS and GMS

2.1.1 Flower shape of YZA, Pol CMS and GMS

In Fig. 1, besides the B2 stamen, other sterile stamens are lower than the pistil, in which relative positions YZA stamen are higher, the 1002AB sterile stamen is lower than the pistil, the Yang A2 stamen lowest.

The anther has very large difference in the shape. The B2 anther is full of pollen grains. YZA anther is extremely similar with 1002AB, like halberd with no pollen inside or outside. The Yang A2 stamen degenerates obviously with the anther like triangle, no pollen inside or outside.

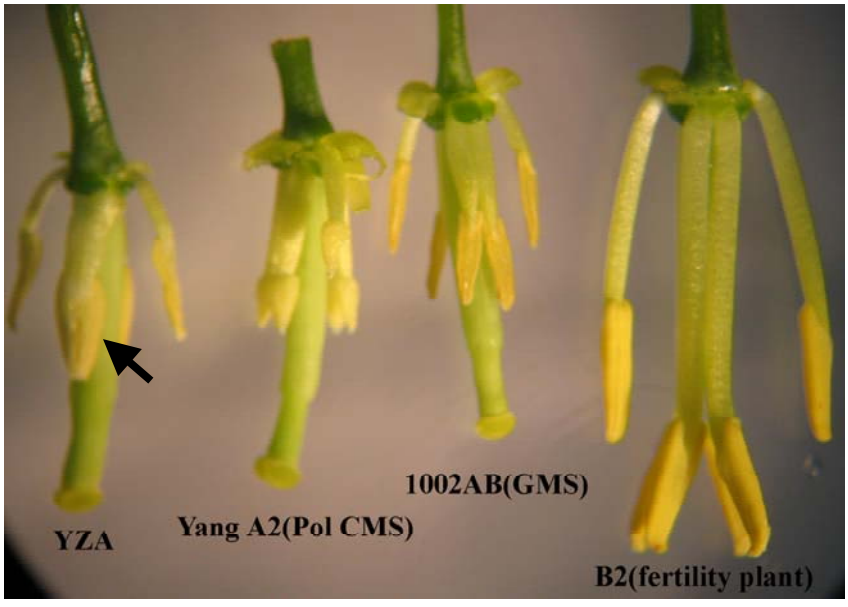

Fig. 1 Comparison of the height and shape for stamen and pistil

2.1.1 Length of various part of flower for YZA, Pol CMS and GMS

Table 1 Comparison the length of various part of flower

Lines	Petal/cm		Sepal length/cm	Stalk length/cm	stamen length/cm		Pistil length /cm	Long stamen/pistil
	Length	Width			Long stamen	Short stamen		
B2	1.50	0.83	0.80	1.88	1.00	0.88	0.95	1.05
YZA	0.93	0.55	0.55	1.97	0.56	0.44	0.71	0.79
1002AB	1.05	0.68	0.70	1.88	0.50	0.35	0.93	0.54
Yang A2	0.97	0.46	0.59	1.27	0.35	0.27	0.72	0.49

Table 2 Fertility expression of F_1 by testcross

Combination	Total plants	Fertility plants	Sterile plants	Percent of sterile plants(%)
YZA×B1	41	0	41	100
YZA×B2	35	0	35	100
YZA×R1	38	0	38	100
YZA×R2	32	0	32	100
YZA×R3	43	0	43	100
YZA×R4	36	0	36	100
YZA×R5	44	0	44	100
YZA×R6	38	0	38	100

With YZA as the female parent, with Pol CMS' B-line, R-line as male parent, the offsprings are all completely sterile. So, YZA is a kind of male sterility source different from Pol CMS.

Table 3 Fertility expression of BCF_1

Combination	Total plants	Fertility plants	Sterile plants	Percent of sterile plants(%)
(YZA×B1)BCF_1	36	0	36	100
(YZA×B2)BCF_1	44	0	44	100
(YZA×R1)BCF_1	38	0	38	100
(YZA×R2)BCF_1	39	0	39	100
(YZA×R3)BCF_1	41	0	41	100
(YZA×R4)BCF_1	32	0	32	100
(YZA×R5)BCF_1	39	0	39	100
(YZA×R6)BCF_1	41	0	41	100

As seen in Table 1, the B2 flower is larger than sterile flower. Several sterile flower petals are similar in length and width, in which 1002AB is slightly larger than the others. The sepal length of YZA and Yang A2 is shorter than B2 and 1002AB, besides the Yang A2 stalk is shorter than B2, YZA, 1002AB. The long stamen and the short stamen of YZA is longer than 1002AB and Yang A2. The pistil length of YZA and Yang A2 is close, and the pistil length of B2 and 1002AB is close. The YZA proportion of pistil vs. stamen is highest, and Yang A2 is lowest.

2.2 Inheritant analysis of YZA

2.2.1 The fertility expression of testcross hybrid F_1 of YZA

Backcrossed with respective male parents to testcross hybrid F_1, the descendant fertility situation is listed in table 3. Backcross progeny is also sterile with 100% sterile plants. So, YZA can not be the GMS. Because if YZA is dominant genic sterile, there will be fertility and sterile plants in the backcross F_1; If recessive genic sterile, it will be all fertility to plants in the backcross F_1 [1].

3 Discussion

The test results indicated that there were many difference in flowers of YZA, 1002A and Yang 2A. The results of testcross and backcross showed that YZA was different from Pol CMS and GMS, may be a new cytoplasm male sterility source. Certainly, the existing evidence is also insufficient to prove whether YZA is different with Ogu CMS [3], Nap CMS [4] and so on, its real status also does wait for further experiments to determine.

Since the discovery, after the careful observation, YZA sterility has not changed along with the temperature change, the anther inside and outside dose not has the pollen among the entire flowering season, the anther shape is similar with GMS. We had not discovered restoration gene for YZA, we will further enlarger the testcross scope, and seek restoration gene, and analyze its genetic pattern, and breeding safe hybrid to apply in the rape planting.

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