ESTABLISHMENT OF GENIC AND CYTOPLASMIC MALE STERILITY SYSTEMS IN *BRASSICA NAPUS* L.

G. S. Yang, T. D. Fu

State Key Laboratory in Genetic Improvements of Crops, Dept. Agronomy, Huazhong Agri. Univ. Wuhan, 430070, China

ABSTRACT

Two Genic and cytoplasmic male sterility systems, i. e., dominant genic and cytoplasmic male sterility and recessive genic and cytoplasmic male sterility systems, were established by introducing the gene MS_1 of dominant genic male sterility and the genes ms_3 and ms_4 of recessive genic male sterility into polima cytoplasm, respectively.

INTRODUCTION

Male sterility is an important way of heterosis breeding in rapeseed. Theoretically, there are two types of male sterility, i.e., cytoplasmic male sterility (CMS) and genic male sterility (GMS).

There are two sub-types of CMS. The first is the CMS system named as the alien CMS system, such as ogu CMS (Ogura, 1968, Bannerot et al., 1974), mur CMS (Hinata and Konno, 1979). The second is the CMS named as the native CMS system, such as nap CMS (Shiga, 1971, Thompson, 1972) and pol CMS (Fu, 1981), which are the spontaneous CMS in rapeseed.

Ogu CMS might be the most hopeful CMS among the alien CMS systems at present. The problem for utilizing ogu CMS in rapeseed heterosis breeding is lack of restorers with good enough restoring ability. And among the native (or spontaneous) CMS systems, pol CMS may be the most practical CMS system, which has male sterile lines with relatively stable male sterility and restorers with good enough restoring ability for F_1 seed production. The disadvantage of pol CMS is that its male sterile lines are sensitive to temperature. Comparing with ogu CMS, we think pol CMS is more useful than ogu CMS at present in China.

There are also two subtypes of GMS in rapeseed. One is dominant GMS (DGMS)(Li and Zhang, 1983) and the other is recessive GMS (RGMS) (Hou et al, 1990). The advantage of GMS in rapeseed heterosis breeding is their male sterile lines having stable male sterility and the disadvantage of GMS is lack of maintainers. Therefore, about 50% male fertile plants need to be removed in GMS male sterile lines before flowering time in F_1 seed production plots.

In oder to utilize the advantages of both pol CMS and two GMS systems in rapeseed, Yang and Fu (1994) proposed a new way of heterosis breeding in rapeseed, i.e., genic and cytoplasmic male sterility (GCMS). This paper presents the establishment of GCMS in *Brassica napus*.

EXPERIMENTAL

Restoring-maintaining relationship between pol CMS, DGMS and RGMS

The result presented in table 1 showed that pol CMS, DGMS and RGMS have different maintainers and restorers. This implied that their genetic systems are independent. Yi-3AB, 117AB and S45AB could be used as maintainers and 92-5918 and 92-5942 as restorers of DGCMS. And also 117AB and S45AB could be used as maintainers and Restorer 10, Huaye, 92-5918 and 92-5942 as restorers of RGCMS.

TABLE 1. The restoring and maintaining relationship between pol CMS、DGMS and RGMS

Varieties	1141 A(Pol CMS)	Yi—3AB (DGMS)	117AB (RGMS)
1141 B	S	F	F
6830 B	S	F	F
Yi—3AB	S	1/2S+1/2F	F
117AB	S	1/2S+1/2F	1/2S+1/2F
S45AB	S	1/2S+1/2F	1/2S+1/2F
Restorer 10	F	1/2F+1/2S	F
Huaye	F	1/2F+1/2S	F
92—5918	F	F	F
92—5942	F	F	F

Breeding of DGCMS line and its maintainer

For breeding of DGCMS line and its maintainer, Zhongza No.3 was first used as the pollinator to introduce dominant male sterile gene MS_1 into the cytoplasm of pol CMS. And Yi—3AB was used as the recurrent parent to backcross to the DGCMS plants in the progenies continously (Fig. 1). Some obersvations showed that about 50% plants were pol CMS and the other about 50% plants were DGCMS, being completely male sterile.

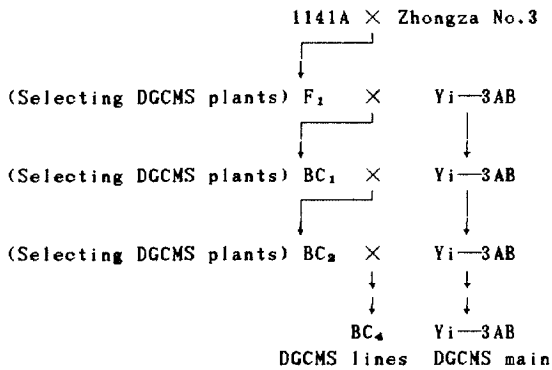

Fig. 1. The breeding procedure of DGCMS line and its maintainer

Breeding of RGCMS lines and their maintainers

As the two RGMS lines 117AB and S45AB could be used as maintainers of

pol CMS, they were used as pollinators to cross and backcross to pol CMS line 1141A up to BC_4 (Fig.2). Two RGCMS lines RGCMS-117A and RGCMS-S45A and their maintainers 117AB and S45AB have been obtained. Some investigations proved that about 50% plants were pol CMS and the other about 50% plants were RGCMS, being completely male sterile.

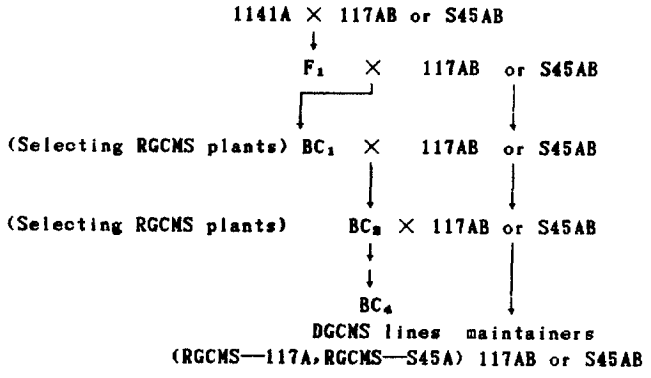

Fig. 2. The breeding procedure of DGCMS lines and their maintainers

Restoring ability of restorers of DGCMS and RGCMS

TABLE 2. The fertility of F_1 plants from the crosses between DGCMS or RGCMS lines and their restorers

Restorers	DGCMS—Yi—3A	RGCMS—117A
Restorer 10	1/2F+1/2S	F
Huaye	1/2F+1/2S	F
92-5918	F	F
92-5942	F	F

The result of Table 2 proved that Restorer 10, Huaye, 92-5918 and 92-5942 can be used as restorers of RGCMS, and 92-5918 and 92-5942 can be used as restorers of DGCMS.

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