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Analysis on Combining Ability for Characters of Male Sterile Lines in Rapeseed (*Brassica napus* L.)

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Abstract: The male sterile line is very important in the hybrid breeding program of rapeseed. This study was conducted to evaluate the combining ability of many characters of male sterile lines in *Brassica napus* L. Ten recessive genetic male sterile (RGMS) lines were used as parents to produce 45 single cross hybrids by using a half diallel cross method. These 45 crosses and their 10 parents were evaluated at Guiyang during 2007-2008. The results showed that both general combining ability (GCA) and specific combiing ability (SCA) effects were important for all characters, but additive gene effects were more predominant than non-additive gene effects. Qianyou 8AB and You 2894AB gave respective highly significant GCA effects of 230.94 and 127.65 kg·hm^{-2} for seed yield. Lines You 2894AB, QH303-4AB, You 157AB and You 2341AB gave highly significant GCA effects for oil content of 0.99, 1.62, 1.20 and 1.53%, respectively. The crosses among lines Qianyou 3A×Qianyou 8B, Qianyou 8A×You 2894B, You 2894A×Qianyou 6B, Qianyou 8A×QH303-4B and Qianyou 8A×Qianyou 6B gave high SCA effects of 616.29, 398.71, 356.48, 394.24 and 303.79 kg·hm^{-2} for seed yield, respectively. All these crosses also gave high seed yield indicating that these crosses could be used in the breeding program.

Key words: *Brassica napus* L., male sterile line, combining ability, character

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Introduction

China is the largest producer in both the planting area and total production of rapeseed. Among three main species of rapeseed, *Brassica napus* L. accounts for about 95% of total planting area in China (Wang *et al*., 2007). Prior to 1985, pure lines were grown with a commercial scale. Until recently, more than 70% of planted areas are grown to hybrids (Zhou and Fu, 2007; Li, 1999). Many research institutes in China have been working on the development of hybrid varieties to replace pure line cultivars.

For breeding of hybrid varieties in rapeseed, one of the most important materials is male sterile line. This is because rapeseed is largely a self-pollination and androgynous crop (Rakow and Woods, 1987), and it is difficult to obtain hybrid by emasculation. Therefore, using of male sterile system is the most practical method in the production rapeseed hybrid seeds. Male sterile line could be found in nature or might be induced by mutation. It could be transferred from one species or one cultivar to another by backcrossing. For example, Ogu cytoplasmatic male sterile (Ogu CMS)

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in rapeseed was transferred from a male sterile radish (Barnnerot *et al*., 1974), Pol CMS was found in a rapeseed variety named Polima (Fu *et al*., 1995). After the CMS system had been found, several other systems of male sterility such as genetic male sterile (GMS), ecotype sensitive male sterile or environment sensitive male sterile (EMS), gametocide (GC) and self-incompatible (SI) systems were developed or reported (Yu and Hu, 2007).

Now male sterile system is widely used in the production of hybrid in rapeseeed. The CMS system is the most popular system. However, in Guizhou Province, China, GMS system is more popular than CMS system. The GMS lines used are of two types, recessive genetic male sterile (RGMS) and dominant genetic male sterile (DGMS). The RGMS is more widely used than DGMS, because RGMS has extensively restorers. Therefore, in the breeding for hybrid varieties, it is necessary that the combining ability of RGMS lines have to be evaluated. These are general combining ability (GCA) and specific combining ability (SCA).

The objective of this study was to evaluate the relative importance of additive and non-additive genetic effects and the combining ability of the RGMS lines of rapeseed (*Brassica napus* L.) for oil content, seed yield and other characters related to them.

Materials and Methods

Plant materials

Plant materials used in this study consisted of 10 RGMSs with low erucic acid and glucosinolate contents and varied oil contents. These lines were IIAB, Qianyou 3AB, Qianyou 5AB, Qianyou 7AB, Qianyou 8AB, You 2894AB, Qianyou 6AB, QH303-4AB, You 157AB and You 2341AB. These parents were planted in Sept. 2006, and crossed in a half diallel (Griffing, Method 2) in spring 2007. A total of 45 F_1 crosses and 10 parents were obtained.

Field experiment

Experiment was carried out in a randomized complete block design with three replications in Guiyang, Guizhou, China, during Sept., 2007 to May, 2008. Plots consisted of two rows of 5-m in length with 45-cm inter-row and 33.3-cm intra-row spacings. Plots were prepared carefully and 600 kg·hm^{-2} N, P and K fertilizers and 15 kg·hm^{-2} borax were applied in hills before sowing. All the 45 crosses and 10 parents were planted in hills on 27, Sept., 2007, and thinned to two plants per hill within 45 days after planting. Each plot contained 60 plants. The total amount of 375 kg·hm^{-2} urea was used by applying in hills for two times, pesticide application was done three times, and weeding was made twice during growing period of rapeseed. Supplement irrigations were made as needed. The crosses and parents were harvested from May 7 to May 19, 2008.

Data collections

Ten plants, five male steriles and five male fertiles, were selected randomly and tagged for each plot at flowering. These 10 tagged plants were measured for plant height, branches per plant, pods per plant and seeds per pod at maturity. Means of these characters were used for data analysis. 1000-seed weight was measured by using a bulk of seed from each plot. Days to flowering, days to maturity, and yield were based on plot observation. Oil content was analyzed by using open pollinated bulked seeds. Data for characters were recorded as the followings:

Days to flowering (DF): days from sowing until 50% of the plants flowered.

Days to maturity (DM): days from sowing until 90% of the pods matured.

Branches per plant (B/P): productive branches originating from the main stem.

Pods per plant (P/P): productive pods borne on all branches of a plant.

Plant height (PH): main stem length measured from the cotyledonary node to the top of the plant.

Seeds per pod (S/P): Every seed of 12 individual pods per plant.

1000-seed weight (TSW): weight of 1 000 seeds