Breeding of a thermo-insensitive polima cytoplasmic male sterile line YN04252A (*Brassica napus* L.)

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Abstract

YN04252A, a Polima cytoplasmic male sterile (Pol cms) line without production of pollen, was bred by means of improvement of a Pol cms line YN02A with a maintainer line 3511B although YN02A produced trace pollen under high temperature condition. The investigation on the fertility of YN04252A showed that the Pol cms line was stable with 100% plants being male sterile and 100% sterility level for 5 years. YN04252A shared the restorer-of-fertility resource with the YN02A and had some desirable agronomic traits and a high open pollinating rate in which 86.0% siliques were effective compared with the maintainer or restorer lines.

Key words: Pol cms, YN04252A, thermo-insensitive sterility

Introduction

Rapeseed is an important oil crop in Yunnan province, with annual production of over 50 thousand tones, predominantly for local markets. A key objective of the Yunnan Provincial *Brassica* Improvement Program and the Yunnan Domestic-tech Cooperation Project has been to develop line or hybrid varieties adapted to a range of environments in Yunna, with emphasis on increasing seed yield and reducing hybrid growing costs. Breeding for high yield hybrids has been an effective strategy to meet the domestic markets in China as well as in Yunnan province, and the improvement of rapeseed varieties has successfully been achieved through shifting from high erucic and high glucosinolates to low erucic and low glucosinolates, and from open pollinated varieties to hybrid cultivars (Wang et al. 2004).One of the further objectives for oilseed rape variety improvement is to fully exert the potentiality of heterosis as well as to increase oil content and improve resistances to biotic or abiotic stresses (Fu et al. 2004). Breeding of hybrids is an effective procedure to significantly improve seed yields. Although there are a number of different types of CMS systems with distinct genetic features Pol cms hybrid system is one of the most valuable approaches for producing more seeds than conventional way. However, breeders have been puzzled by trace-pollen problems of Pol cms lines (Fu et al. 1987, 1989; Yang et al. 1987, 2000). In this paper, the breeding of a thermo-insensitive sterile line is reported.

Material and methods

YN02A sterile line was bred by the Institute of Industrial Crops, Yunnan Academy of Agricultural Sciences, which was a quality trace-pollen Pol cms line, and more than 440 genetic resource lines were used for wide testing crosses to screen new maintainer lines. As female parent, YN02A crossed with male parents respectively and the fertility of F_1 was determined by observing the functional pollen quantity of the anthers. The complete sterile plants in the F_1 populations were selected and backcrossed with corresponding male parents continuously. Flower's morphology of the F_1 plants also was studied for selecting high open-pollinating sterile lines.

Results

Breeding procedure

Though wide testing crosses and determination of fertility of the subsequent generations, it was observed in 2000 that one of the 440 testing male parents which numbered 3511 could maintain the Pol cms line YN02A well with non functional pollens and some of the test cross F_1 plants showed desirable flower morphologic traits for ensuring adequate pollination during blooming periods. Favorable sterile plants in the F_1 population were selected and continuously backcrossed with 3511 lines next years. After 8 backcross generations, YN04252A Pol cms line was bred in 2004 and the corresponding recurrent paternal parent became its maintainer line YN04252B after continuous selfing.

Flower morphological traits and fertility of the YN04252A

Morphological observations showed that YN04252A plants were complete male sterility under all environments for 5 years. YN04252A bore smaller flowers than that of corresponding maintainer line, with shorter floral shoot length and petal length, shorter filament length, longer pistil length, slimmer but straight stigma and transparent triangle anthers. The flowers of YN04252A produced as much nectar sugar as its maintainer line did and its petals stretched normally with bright light yellow color, thereby keeping more attractive to insects than YN02A. Studies also showed that there were 2.1% ineffective flowers under the early spring environments in Kunming in this Pol cms line, which adversely affect the hybrid seed yield (Table1 and

Table2).

Table1 Flower morphology of the sterile lines(in Kunming, length and width/mm)

CMS lines	Length of floral shoot	Length of petal	Width of petal	Length of pistil	Width 0f stigma	Length of anther	Length of filament
YN04252A	7.80	9.02	4.54	8.24	0.94	2.18	3.32
YN02A	11.63	9.70	6.45	7.14	1.08	2.34	4.27

Table2 Flower posture and fertility of the sterile lines (in Kunming)

CMS lines	Abnormal buds	Petal posture	Pistil posture	Petal color	Functional pollen	Nectar sugar	Fertile stability
YN04252A	2.1%	stretched	straight	light yellow	none	normal	stable
YN02A	0.2%	wrinkled	curved	brownish yellow	trace	normal	unstable

Agronomic traits of the YN04252A

YN04252A is a medium to early maturing *Brassica napus* Pol cms line with high open pollination rates, which exhibited about 86.0% effective pod numbers relevant to either of the maintainer line and restorer lines and shared the same restoration lines with YN02A. Its plant height is about 167cm with about 8.3 main branches per plant. The number of pods per plant and the number of seeds per pod were 377 and 15.7 respectively with average 1000-seed weight 3.52g.

Table3 Agronomic traits of the sterile lines

CMS lines	Plant height/cm	Branches/plant	Pod number/plant	Seeds per pod	1000seeds Weight/g	Maturing days
YN04252A	167	8.3	377	15.7	3.52	189
YN02A	189	8.2	385	9.33	3.14	188

Conclusion

Utilization of Pol cms hybrids has had appreciable economic value in Yunnan province. Within *B. napus* genetic recourses, there is a considerable variation for keeping sterility of Pol cms lines but only a limited number of genotypes have potentialities to ensure Pol cms lines to be complete sterile under different environments. Pol cms also brings about abnormal pistils and less nectar sugars under some genetic background. Breeders must be faced with these difficulties before releasing hybrid cultivars. GMS+CMS is a creative strategy to crack the problem(Yang et al. 1993) but there are still several obstacles. Conventionally, wide test crossing is an effective way to improve Pol cms system.

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