CHARACTERISTICS OF CMS *POL* AS A SYSTEM CONTROLLING HYBRID SEED PRODUCTION IN WINTER OILSEED RAPE

I.BARTKOWIAK-BRODA, W.POPŁAWSKA, A.LIERSCH, B.GAZECKA

Instytut Hodowli i Aklimatyzacji Roślin, Plant Breeding and Acclimatization Institute
Oil Crop Department, ul. Strzeszyńska 36, 60-479 Poznań, Poland

ABSTRACT

In Oil Crop Department in Poland two maintaining double low winter lines of rapeseed have been selected — PN 410/88 and PN 4315/89 assuring in CMS *pol* lines over 90 per cent of plants with stable expression of male sterility. To obtain the maintaining lines with a set of analogous recessive genes determining male sterility in homozygous stage doubled haploids have been obtained by androgenesis from line PN 410/88. The genotypes of obtained dihaploid lines were investigated in test crosses with CMS*pol* lines in F_1, BC_1, BC_2 progeny. From the investigated 33 dihaploid lines four determined the occurrence only of male sterile plants during the whole flowering period in F_1 as well as in BC_1 and BC_2 progeny.

Also heterosis effect was studied in hybrids with lines possesing in genotype restorer gene originating from variety Italy and restorer gene originating from partially male fertile plants (pMF).

INTRODUCTION

In the yield of oilseed rape high heterosis effect occurs in the range 20 to 40 per cent (Bartkowiak-Broda, 1977; Lefort-Buson, 1982; Lefort-Buson, Dattee, 1982; 1983; Grant, Beversdorf, 1985). This level of heterosis and the discovery of pollen control systems stimulate interest in the development of hybrid oilseed rape cultivars.

Gene-cytoplasmic male sterility CMS*pol* found in oilseed rape spring variety Polima in China (Fu, 1981) is one of the most promissing CMS forms which can be used for creation of hybrid varieties. First hybrid varieties of summer oilseed rape have been already created by the use of CMS*pol* system. However, instability of male sterility expression as well as low frequency of maintaining and restoring genotypes in *B. napus* species limit the possibility of utilization of CMS*pol* for hybrid seed production. In addition some results suggest that the biological cost associated with *polima* cytoplasm relative to another sterile cytoplasm as *napus* and to normal cytoplasm is high and because of that hybrids are less performant (McVetty *et al.*, 1990; Chamberlain *et al.*, 1991).

EXPERIMENTAL

In Oil Crop Department in Poland CMS*pol* system is developed in winter rapeseed form and there have been selected:

- male sterile plants with Polima cytoplasm in genotype of double low oilseed rape,
- two maintaining double low winter lines of oilseed rape — PN 410/88 and PN 4315/89 assuring in CMS*pol* over 90 per cent of stable male sterile plants,
- two sources of restorer genes:
  - — double low winter rapeseed line PN 5297/86,
  - — forms selected from partially male fertile plants (pMF).

Also genotype of traditional spring variety Italy possesing dominant restorer gene of male fertility for CMS*pol* was introduced into genotype of double low winter oilseed rape.

To obtain the maintaining lines with a set of analogous recessive genes determining male sterility in homozygous stage 33 doubled haploids (DH) have been obtained by androgenesis in vitro from line number PN 410/88. The genotypes of these dihaploid lines were investigated for ability to maintain stable male sterile forms in test crosses with CMS*pol* lines in F_1, BC_1 and BC_2 progeny. Observations were made in greenhouse conditions for all generations on ten plants from each combination as well as in field conditions for F_1 and BC_1 progeny on 20–30 plants for each combination. In greenhouse before and during the flowering period the day length was 16h and day/nigth temperature from 20°C/10°C to 25°C/15°C. Pollen production was observed during the whole flowering period and seed set on bagging branches.

Out of investigated dihaploid lines in hybrids with CMS*pol* in F_1, BC_1 and BC_2 generations four have been selected as complete maintainers (Table 1). It seems that it is possible to improve the stability of male sterility expression by the use of fully homozygous maintaining lines. But these results need to be confirmed in different climatic conditions.

Heterosis effect was also studied in field trials in hybrids with lines possesing in genotype restorer gene originating from variety Italy and lines with restorer gene originating from partially male fertile plants (pMF).

It was stated that with the use of CMS*pol* the selection of hybrids with high heterosis effect is possible (Figure 1). It was the confirmation of earlier studies on CMS*pol* hybrids with another genetical background (Bartkowiak-Broda *et al.* 1994). Generally hybrids with restoring lines possesing restorer gene from Italy variety gave higher heterosis effect.

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TABLE 1. Ability to maintaining CMS*pol* by some doubled haploids originating from line PN 410/88

Number of line	Type of plants obtained in progeny with CMS*pol* lines		
	F_1	BC_1	BC_2
PN 5756/5	MS	MS,pMF	MS
PN 5793/1	MS	MS	MS
PN 5793/2	MS	MS,pMS	MS
PN 5793/6	MS	MS, pMS	MS
PN 5793/7	MS, pMS	MS, pMS	MS, pMS
PN 5793/10	MS	MS, pMS	MS, pMS
PN 5794/3	MS	MS	MS
PN 5794/6	MS,pMS	MS, pMS	MS, pMS
PN 5794/8	MS	MS, pMS	MS, pMS
PN 5794/13	MS	MS, pMF	MS, pMS
PN 5795/1	MS, pMF	MS, pMF	MS, pMS, pMF
PN 5796/1	MS, pMS	MS	MS, pMS
PN 5796/3	MS	MS	MS
PN 5796/4	MS,pMS, pMF	MS	MS, pMF
PN 5796/6	MS	MS	MS
PN 5796/7	MS	MS, pMF	MS, pMS

MS — male sterile plants; pMS — partially male sterile plants; pMF — partially male fertile plants

Figure 1. Heterosis effect in yield of F1 hybrid progeny