

THE BREEDING OF NUCLEUS+CYTOPLASM TWIN-MS LINE IN B. NAPUS

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ABSTRACT

All of the rape pol-cms lines being applied in current rape production had the problem that their fertility varies with temperature. To overcome the problem, an artificially synthesized nucleus+cytoplasm twin-ms line was developed through seven generations of breeding based on a systematic study of the change in fertility of nucleus and cytoplasm male sterile lines (nms and cms). Half the plants of the new sterile line maintained the features of the Pol cms lines while the other half showed the features of nms lines, which exhibited a 100% sterility and not affected by temperature variation. An initial observation showed that the nms genes could express correctly in pol cms genes system and a little interaction existed. The genetic composition of the new sterile line and the prospect of its utilization are discussed.

Key words: Rape--sterility--nucleus+cytoplasm twin-ms line

INTRODUCTION

Up till now, no marking characters linked tightly with sterility of nms lines have been found, so half of the fertile plants must be pulled up in the blooming stage of nms lines in their hybrid seed production, the work makes production cost of seed increase and it is difficult to ensure the seed purity; while sterility of pol cms lines could be affected greatly by temperature, the trace pollen of the cms lines should cut down the hybrid seed purity. In the last ten years, the fertility of polima cms lines, dominant nms lines and recessive nms lines had been observed through the sowing trials in different seasons, in different areas and in different periods, and through the treatment of artificial climate boxes. These trials' results showed that the sterile degree of the sterile plants in nms lines almost was 100% and without obvious effect of temperature, and that the rate of sterile plants of pol cms lines could reach 100%, and their sterile degree was 70%--90% (the variance between years). If synthesizing the advantages of nms and cms lines, a new fine sterile line would be created.

According to the thought, through the breeding of seven generations, we have got a nucleus+cytoplasm twin (NCT) -- ms line and have got its maintainer and restorer. The primary observations were reported as follows.

MATERIALS AND METHODS

In spring of 1991, three pol cms lines were selected as females parents to cross with the fertile plants of ten two-recessive nms lines, some crossing progenies with high sterile degree were selected to self with their own trace pollen, or to backcross with the fertile plants of nms lines, the sterility of these progenies were observed in Chongqing (200 metres above sea level) and in Kunming (1890 metres above sea level), some sterile plant lines with high sterile degree were selected to backcross continuously with fertile plants of nms lines. The rate of cms plants and nms plants in two of the plant lines was 1:1 (in spring of 1994).

RESULTS

Expression of NCT-ms line

The two NCT-ms plant lines with 1/2 nms plants had been observed in spring (in Chongqing) and in summer (in Kunming) of 1994, the results showed that the leaf shape and colour of NCT-ms line were identical with its maintainer (two recessive nms line), the new ms line in bolting stage was similar to its maintainer, no difference between nms plants and cms plants of the new sterile line. In the early blooming stage, the sterile features of the nms plants were distinct, their petals were circular, big and overlapping, they had normal stigma and fully degenerated stamen with no pollen; the petals of cms plants were bigger and more circular than that of polima cms line, and not overlapping, the anther shape and colour were similar to normal flower, the anther had trace pollens which could be dyed normally by C₁₅H₁₆N₃SCI, the stamen was lower than the stigma.

In the full blooming stage, the flowers of nms plants were still fully sterile; the flowers of cms plants were little smaller than that in early blooming stage, the petals were separate, the stamen was fully degenerated, the anthers were white triangle and had no normal pollen.

In the last blooming stage, the petals of nms plant became smaller and almost not overlapping, the stamens of few flowers extended and had narrow anther with no pollen or trace abnormal pollen; the flower of cms plant was similar to the flower in full blooming stage, few flowers had some abnormal anthers with some abnormal pollen.

Above results showed that the ms genes could express in polima cms genes system and the sterile degree of nms plant could reach 100%, but the expression of nms plant in the last blooming stage seemed there was little interaction between nms and cms genes. Because the sterile degree of cms plant in twin-ms line was 70%-80% and that of nms plant was 100%, the mean sterile degree of twin-ms line could reach 85%-90% which was satisfied with the needs of hybrid production.

Genetic composition of NCT-ms line

To suppose that the recessive nms genes are m₁m₁m₂m₂ and the ms gene in the nucleus of polima cms line is s₁, and that N is fertile cytoplasm and S is sterile cytoplasm, so the genotype of the polima cms line used in the experiment would be S(M₁M₁M₂M₂s₁s₁), and the genotype of the sterile plant in two recessive nms line would be N(m₁m₁m₂m₂s₁s₁) and the genotype of the fertile plant in two recessive nms line would be N(m₁M₁m₂m₂s₁s₁) or N(m₁m₁M₂M₂s₁s₁), the breeding model of NCT-ms line would be: $[1/2S(m_1m_1m_2m_2s_1s_1) + 1/2s(m_1m_1M_2M_2s_1s_1)]$, the maintainer genotype of NCT-ms line would be N(m₁m₁M₂m₂s₁s₁) or N(M₁m₁m₂m₂s₁s₁), they are the fertile plants of the two recessive nms line, the restorer genotype of NCT-ms line should be a useful material for above study.

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