STUDIES ON THE CHARACTER OF MULTIPLE SILIQUAE IN *BRASSICA NAPUS* L.

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ABSTRACT

A mutant with 2 to 3 pistils and 10 to 16 stamina in each flower was obtained from the progeny of interspecific cross between *B. napus* and *B. campestris*. Through breeding for eight generations, almost all pistils have developed into siliquae contained seeds and four multiple siliquae lines of *B. napus* and two multiple siliquae lines of *B. campestris* have been bred using this mutant.

INTRODUCTION

The siliqua number of single plant is an important element to influence the seed yield of rapeseed. Therefore, how to increase the siliqua number has been paid close attention by breeders. Researchers had discovered the character of multiple siliquae, which can enhance the siliqua amount, in rapeseed cultivar and the hybrid between *B. napus* and *B. campestris*, mutant induced, etc. (Liu Guanghui, 1980; Liu Houli, 1985; Syed et al, 1990; Hu Baocheng et al. 1994). However, the genetic trait and effective application of this character have not been studied systematically so far. In 1987, we discovered also a mutant bearing multiple pistils and stamina in each flower from the progeny of interspecific cross between *B. napus* and *B. campestris* (Figure 1). In this paper, we report the result of studying and applying this mutant in rapeseed breeding.

EXPERIMENTAL

Discovery and morphologic character of the mutant

A mutant with 2 to 3 pistils and 10 to 16 stamina in a few flowers born on main inflorescence and upper branch was found in the progeny of interspecific cross between *B. napus* and *B. campestris* in March 1987.

The morphologic character of the mutant with multiple siliquae was obviously different from that of common rapeseed only in the constitution of flower organ and the shape of siliquae. There are 10-16 stamina in each flower. A few of these stamina were normal while others were abnormal in the size and the anther shape was various such as triangle, lancet and the form of shoe sole, etc. Some of these abnormal anthers had not pollen, others had a little pollen but faild to split. Each flower bore 2 to 3 pistils. But only part of these pistils developed into siliquae containing seeds and some of the siliquae were wound. The reason why other part pistils could not form siliquae was that the ovaries splited and ovules exposed outside so that ovaries or young siliquae died or fell off as well as pollen amount was not enough for fertilization. Through directive selection and breeding for many generations, 10 stamina, 8 stamina are long and 2 are short, with nearly normal anthers occuring a lot of pollen developed well in each flower. The majority of pistils grew towards normal. The arrangement model of stamina and pistils in the flower appears "三" type. 600 flowers with "

三" type in 4 multiple siliquae lines of *B.napus* were determined for the ability of setting siliqua in the spring of 1994. The result was that all three pistils in this kind of flower had developed into the siliquae with seeds.

Breeding and application of the mutant

The mutant was self pollinated artificially many times and 53 seeds were obtained. In the Autumn of 1987, all the seeds were sown and 46 seeds among them germinated and formed seedlings. The next year, 2 to 3 siliquae on partial pedicels set in 32 plants whereas single siliqua set in 14 plants. At flowering, two kinds of plants were bagged respectively for self-crossing. In the spring of 1989, the percentage of the plant with multiple siliquae in 32 plant lines and 14 plant lines was 40.78—85.63% and 0—30.7%, respectively. Later on, by self -crossing and selecting for 8 generations, 4 multiple siliquae lines of *B.napus*, 90-1 and 90-12, etc., were bred successfuly in 1991 (Figure 2). The percentage of the multiple siliquae plant was 90—100% and the percentage of multiple siliquae on each plant was 40.8—84.2%. In order to transfer the multiple siliquae genes to *B. campestris*, the hybridization between *B.campestris* and multiple siliquae lines of *B. napus*, 90—1 etc., was conducted and two lines of *B.campestris* with multiple siliquae were also bred in 1994.

Utilizing the method of bagging, split bud pollination, natural cross pollination as well as cross pollination between plants within line, etc., the compatibility of multiple siliquae lines in *B.napus* was tested.The result showed that the compatibility was the best by natural cross pollination and the cross pollination between plants. The percentage of setting siliqua was 74% and 78% with 15.25 and 14.15 seeds per siliqua, respectively. It is clear that the character of multiple siliquae is hereditable stably and is transfered easily.

Contribution of character of multiple siliquae to yield elements

In the Summer of 1992, we investigated the relationship between the character of multiple siliquae and yield elements such as siliqua number, siliqua length, seed number per siliqua, weight of 1000 seeds and yield single plant using multiple siliquae lines 90—1 and 90—12 as well as cultivar Zhongyou 821 which has been planted widely in China (Table 1 and 2).

TABLE 1. Yield elements of line 90—12 (1992)

Kinds of siliqua	No. siliqua	Length of siliqua(cm)	No. seed/ siliqua	Weight/1000 seeds (g)
Single	104	5.27±0.39	21.83±2.14	4.13±0.2
Double	156	4.67±0.27	15.30±2.05	3.72±0.18
Triple	207	4.25±0.21	14.25±1.92	3.55±0.15

The data showed that the length of the siliqua, the seed number per siliqua and the weight of 1000 seeds in double and triple bearing on one pedicel were lower than that in single siliqua but the total amount of seeds, which was 29.9 and 42.75 and up to 43.87 and 64.57 partially, was over two times than that of the single siliqua (Table 2). The seed yield per plant in lines 90—1 and 90—12 was also higher than that of Zhongyou 821 (Table 3). It was confirmed that the character of multiple siliquae is very useful to increase seed yield of rapeseed.

TABLE 2. Yield characters of multiple siliquae lines and Zhongyou 821 (1994)

Materials	No.siliqua/ plant	No. seed/ siliqua	Weight/1000 seeds (g)	Seed yield/ plant (g)
90—1	459.3±10.1	14.95±1.4	3.43±0.17	23.1 ±2.85
90—12	504.7±9.8	15.84±1.6	3.42±0.13	26.34±2.17
Zhongyou821	323.8±6.5	19.13±1.1	3.49±0.15	19.15±1.62

Inheritance of the character of multiple siliquae

The reciprocal cross was made between multiple siliquae *B. napus* and single siliqua *B.napus*, cultivars Zhongyou 821 and Huayou 2, as well as single siliqua *B.campestris*, Jinhuang youcai and Candle, etc. to study the genetic model of multiple siliquae character. The character of multiple siliquae was not appearance in *B. napus* intervarietal F_1 hybrids. This reveald that the present of multiple siliquae character was the action of the recessive gene in nucleus rather than the cytoplasmic gene of *B. napus*. Also, in 12 reciprocal crosses with 504 F_1 plants between multiple siliquae *B. napus* and single siliqua *B. campestris*, the character of multiple siliquae was not appearance when single siliqua *B. campestris* as female parent. But when multiple siliquae *B.napus* used for female parent, the average percentage of plant with multiple siliquae was 78.30% and up to 98.21% produced in the best cross. It is evident that the cytoplasmic gene of multiple siliquae *B.napus* has an effect on the expression of multiple siliquae gene in interspecific F_1 hybrids. The studies of the number of the gene controlled multiple siliquae and other traits is in progress.

Use value of the character of multiple siliquae

It was proved that the character of multiple siliquae in *B.napus* is very beneficial for increasing the yield of rapeseed. If this character is thansfered to fine quality cultivar, the problem of low yield existing widely in quality rapeseed will be overcome. In addtion, in heterosis breeding the character of multiple siliquae would be beneficial to enhance the seed yield of parents (lines), hybrids made and F_1 hybrids. This character would be also useful to improve other crops in cruciferae when its gene is located, cloned and transfered to them. Meanwhile, the plants (lines) with this trait is a good basic material for studying reproduction and developmental biology.

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