Analysis of self-compatibility in *Eruca sativa* Mill*

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Abstract

Thirty-four materials of *Eruca sativa* Mill. from different regions were tested for self-compatibility by bagging selfing and bud-pollinated selfing. The results indicated that the self-compatibility index (SCI) of *E. sativa* Mill. ranged from 0.00 to 4.84, and belonged to highly self-incompatible type in cruciferae plants.85% of the tested cultivarswas self-incompatible, with the SCI ranged from0.00–to 0.73. 15% of the tested cultivars were self-compatible, with the SCI ranged from 1.04 –to 4.84. The 34 materials can be divided into 3 types according to SCI: highly self-compatible type (SCI >4.00); self-compatible type (SCI was 1.00-4.00) and self-incompatible type (SCI <1.00. The differences of self-compatibility were also existed among individuals of the same cultivar. Self-incompatible plants in self-compatible cultivars and self-compatible plants in self-incompatible cultivars were found. It is completely possible to breed self-compatible lines from self-incompatible population of *E. sativa* Mill.

Key words:*E. sativa* Mill., self-compatibility, self-compatibility index

Introduction

Eruca. sativa Mill. is a minor crop worldwide. For a long time it was ignored by agricultural researchers. In the last few decades, plant breeders started to realize the importance of genetic diversity. As a result, there has been a growing interest in minor crop species such as *E. sativa. E. sativa* is well-known for its outstanding resistance to drought, barrenness and diseases. In addition to breed for better cultivars of *E. sativa*, research on this species may also lead to improved yield, quality, resistance and environmental benefits of its related crops such as rapeseed and cabbage because *E. sativa* is considered a genetic resource for all crops in the tribe *Brassiceae* (Gómez-Campo, 1980; Sun, 2000). Being of self-incompatibility (SI) and long-term cross-pollination, its population had become an allometrosis composed of individuals with different genotypes, so its potential yield were limited and it is also difficulty in using it as breeding resources. Therefore, the studies on self-compatibility (SC) in *E. sativa* has important significance for obtaining and maintaining the genetic purity of the plant lines and in the improvement and utilization of *E.sativa* Mill..

To date, studies on self-compatibility (SC) in *Brassiceae* have been mostly on three *Brassica* species, i.e. *B. rapa* (=*B. campestris*) and *B. napus*. Research on SC in *E. sativa* is very limited. Variations have been observed among *Brassica* species on SC. For example, Qi et al. (1997), Sun et al. (2006) demonstrated the existence of SC in *B. rapa*. This study focused on analysis of SCI in *E. sativa* Mill., and data presented in this paper add to our understanding of the SC in *E. sativa* and may lead to a better use of this genetic resource.

Material and methods

Totally, 34 materials of *E. sativa* Mill.were used in the study, and 14 from Gansu, 2 from Xinjiang, 1 from Qinghai, 2 from Ningxia, 3 from Shaanxi, 3 from Shanxi, 1 from Inner Mongolia, 1 from Hebei, 1 from Sichuan, China, 3 from Iran and 1 from Pakistan. The trials were conducted in the experiment farm of Gansu Agricultural University.

Plants were grown under field conditions. At flowering stage, 30 plants in each material and 10 flowers per plant were selected for bagging selfing, bud-pollinated selfing and open pollination, respectively. The treated plants were harvested at maturity stage. Numbers of pods and seeds produced from the treated flowers were collected and the self-compatibility was evaluated based on self-compatibility index. The self- compatibility index was calculated using the following formula:

Self compatibility index (SCI) = number of plump seeds / number of treated flowers.

Results

Difference of self -compatibility(SC) among cultivars

The study shown that the self compatibility in *E. sativa* Mill varied greatly among cultivars although it was highly self-incompatible. The self-compatibility indexes of 34 materials were 0.00~4.84. Amongist, 29 materials had self-compatibility indexes ⩽1, which accounted for 85% of the total. The self-compatibility indexes of 4 materials were 1.00-3.99, and 1 was >4. All of these indicated that the difference of self-compatibility among cultivars was obvious, and different self-compatibility types existed in *E.sativa* Mill..

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The self-compatibility indexes of 11 materials in 29 self-incompatibility materials were 0.00 by bagged-selfing, but their self-compatibility indexes based on the bud-pollinated selfing varied from 0.00 to 3.72. The differences of self-compatibility degree were also existed among the materials with highly self-incompatibility (Fig. 1).

The tested materials could be divided into 3 types according to their self-compatibility index: self-compatible type (self-compatibility index >4, such as Sichuan-2); weak self-compatible type(self-compatibility index >1, <4.00, such as Zhangbei, Sanying, Machang etc＝ and self-incompatible type (self-compatibility index <1, including 29 materials).

Individual difference of self compatibility within cultivars

The difference of self-compatibility of *E.sativa* Mill. existed not only among different cultivars, but also among different individuals within the same cultivar, and the phenomena was detected both in the self-compatible population and in the self-incompatible population. For example, in Hezheng, which was of self-incompatible (average self-compatibility index was 0.23), 1 out of the 10 self pollinated plants was self-compatible (self-compatibility index was 2.70). Whereas in Sichuan-2, a type of self-compatible (average self-compatibility index was 4.84), 6 out of the 10 self pollinated plants were self-incompatible (the self-compatibility index >1) (Fig. 2). The same phenomena was found in Zhangbei, Machang and Sanying. Thus the self-compatibility varied greatly within the cultivar because of the genotype difference of the individual. Generally, the higher the average value of self-compatibility index for a cultivar, the higher the frequency of genotype of self-compatibility in its population. It maybe easier to select genotypes with high self-compatibility from cultivars with high self-compatibility indexes.

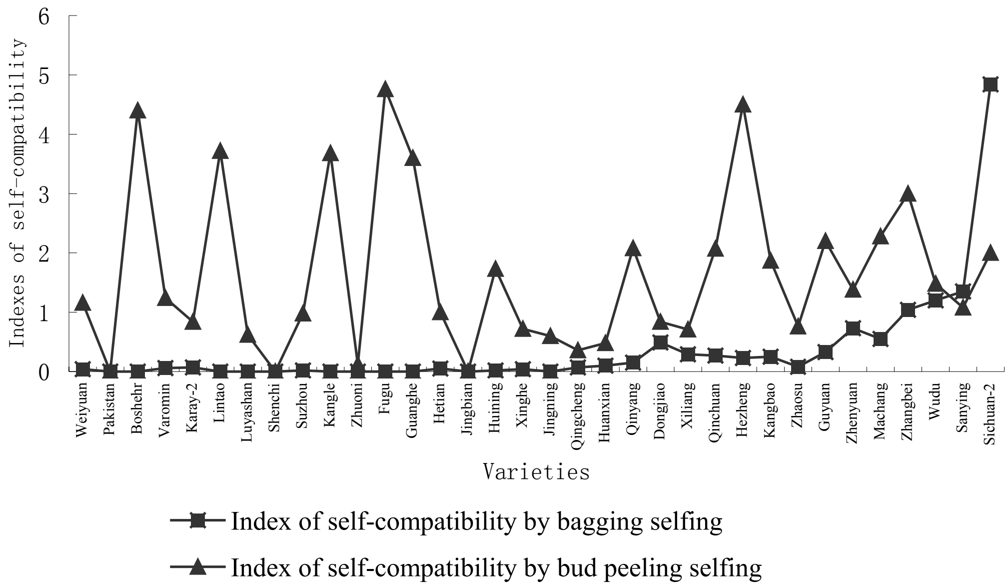

Fig. 1 Indexes of self-compatibility by bagging selfing and bud peeling selfing in different cultivars.

Discussion

This study showed that *E. sativa* Mill was of high self-incompatibility, however, there were genotypes of self-compatibility in it. The self-compatibility varied among the cultivars and individuals based on their genotypes. QI et al. (1997), Sun et al. (2006) gained the same results in *Brassica rapa*. According to the self-compatibility index, the tested materials could be divided into 3 types: self-compatible type (the self-compatibility index >4, such as Sichuan-2); weak self-compatible type(the self-compatibility index >1<4.00, such as Zhangbei, Sanying, Machang etc.＝ and self-incompatible type (the self-compatibility index <1＝. These differences of self-compatibility among individuals and cultivars are closely related to the developing and evolving environment (Zhang, 2003, Zhang, 2001). The difference of genotypes may come from the self-incompatibility and long term cross pollination, and it was possible to select self-compatibility type from self-incompatible plants.

Conclusions

The results indicated that: (1) *E. sativa* Mill. belongs to the type of high self-incompatibility. Of the tested cultivars, self-compatibility indexes ranged from 0.00 to 4.84, and most (85%) of them were of self-incompatibility (self-compatibility index <1＝. (2) The self-compatibility existed in *E. sativa* Mill and varied among the cultivars and individuals based on their genotypes. (3) The tested cultivars can be divided into 3 types based on self-compatibility index: 1＝ self-compatible type, their self-compatibility index >4; 2) weak self-compatible type, their self-compatibility index was 1.00-4.00; 3) self-incompatible type, their self-compatibility index <1; (4) It is possible to select self-compatible types from a self-incompatible population in *E. sativa* Mill.

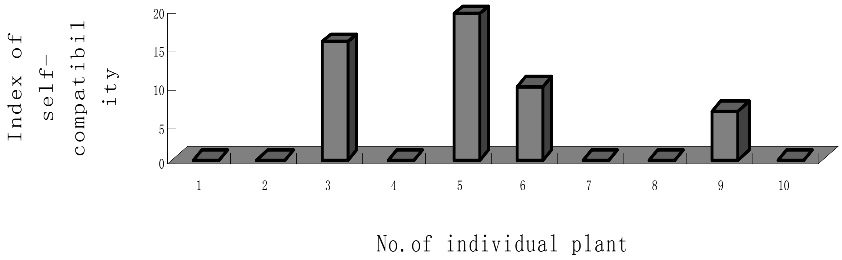

Fig. 2 The difference of self-compatibility among Sichuan-2 Yunjie

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