Seed pod formation and development in rose breeding

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Abstract. Genetic variation of rose was obtained through conventional breeding. The successful rose breeding depends on the compatibility and incompatibility between parents. The objective of the study was to find some information about compatibility and incompatibility in rose crossing. Some varieties of roses, i.e., Mohana, Sexy Red, Valery, Black Magic, Cold water, Putri, Mega Putih, and Luna, were used as breeding materials. The Average of pod seed formation was about 11.66 until 13 days after crossing. The crossbreeding of Mohana and Luna was obtained for 11.66 days after crossing. It was the shortest time of seed pod formation among other varieties of crossbreeding roses. The total number of crossing was 266, in which 19 crossings were successfully producing seeds and fertile. Seed pod formation was taking time 104 until 131 days after crossing. The failure of seed pod formation in rose might because of crossing incompatibility, in which it appeared on 55 – 106 days after crossing.

1. Introduction
Rose is one of important ornamental plants in floriculture industries. They belong to the family of Rosaceae [1]. Roses are divided into ten sections; four of which were contributed for gene pool of domesticated roses [2]. In history, the cultivation of roses have been existed since thousand years ago (141–87 BC), roses were used as decoration in gardens of royal palace in China. Roses are also used for oil extraction in West Asia and Europe. Roses are also used for perfume and cosmetics industries [3]. Based on the prospect and opportunities of rose industries, the extensive hybridization to create ‘modern rose cultivars’ are existed. Today, the rose hybridization focuses on ornamental plants, as cut flowers and garden ornamental plants [1]. Moreover, rose breeding are selected for several traits such as plant vigor, biotic and abiotic resistance, aesthetic traits, flowers colour, floral scent, prickle formation on stem and leaves, vaselife and fragrance [4–5].

Hybridization of roses enhanced variability of roses and increased their quality. Blooming of roses was formed in the lateral shoots, and from bud until blooming would take several months. New rose flower was occurred after photoperiodesity time [1, 6, 7]. The success of hybridization in roses are evaluated based on the seed formation [8–13], and gene mapping [5-7, 14–17]. Nowadays, the rose hybrid or tea hybrid were derived from Chinese roses. The pedigree was Noisettes (Rosa chinensis), Bourbon, Rosa gallica and Rosa Alba. The study of inheritance of wild tetraploid rose populations showed both disomic and tetrasomic sex]

10-14] behavior [2].

The importants factors in the successful of rose hybridization are parents, pollination, methods of sexual reproduction and insect visitors. Wild rose flowers are fragrance and rose colored. The flowers are hermaphrodite and devoid of nectar [12]. The objectives of the research are to find some
information about compatibility and incompatibility in rose crossing such as seed pod deciduous and average of seed pod.

2. Materials and methods
The research was conducted in Indonesian Ornamental Crop Research Institute, from January to September 2018. Eight cultivars of rose were used as materials. They were Mohana, Sexy red, Valeri, Luna, Black magic, Cold water, Putri, and Mega putih. The crossbreeding methods used reciprocal cross and one way Cross (Table 1).

Table 1. The reciprocal and one way parents in rose breeding.

| Crossing Type | Parents  |
|---------------|----------|
| Reciprocal    |          |
| 1. Sexy red   | Mohana   |
| 2. Mohana     | Sexy red |
| 3. Valeri     | Sexy red |
| 4. Sexy red   | Valery   |
| One way       |          |
| 1. Luna       | Mohana   |
| 2. Luna       | Sexy red |
| 3. Cold water | Mohana   |
| 4. Cold water | Sexy red |

Crossing consisted of several steps, there were:

2.1. Collecting of pollen
Pollens were taken from 30% of blooming flower, when 2-3 petals was opened. Pollens were put on a petridish and placed in storage room or refrigerator.

2.2. Castration
Castration was conducted before collecting the pollen. Castration was done by removing the sepal and pistil. Pollens were taken and put on a petridish, mark each petridish with the name of rose variety. After 2 days, the pollens were mature and ready to use for crossing.

2.3. Pollination
Pollination was done after mature pollens were obtained. Crossing was done from 7 a.m to 11 a.m. Pollens were rubbed on a receptive stigma. We labeled the pollinated rose and wrote the name of female-rose variety cross male-rose variety, the date of crossing and the crossing code.

2.4. Seed pod formation
Seed pod formation was considered successful when the flower basal was swelling. It was about 104 – 131 days after pollination.

2.5. Harvesting
The fruit pods were harvested when the fruit pod turned to brownish or yellowish color and swelled. Harvesting time of seed pod was depend on parents crossing.

Observation data were time of pollination (days), time of seed pod formation (days) and time of harvesting (days). Time of pollination was the time when pollination was occurring. The indicator was the swelling of seed pod in rose crossing, either deciduous or fertile. Time of seed pod formation was the time when mature seed pod occurred. The indicator was browning or yellowish seed pod. Time of harvesting was the total days or months until the harvest of mature seed pod.
3. Results and discussion

Variability of roses were obtained by crossbreeding through conventional breeding. The successful pollination were depend on rose variety, crossing time, compatibility between parents, maturity of pollen, and environment (temperature, humidity, and light intensity) [3]. There were 266 numbers of rose crossbreedings in this current research, in which 247 numbers were failed (Figure 1) And just 19 numbers of them were successfully producing seed pod (Figure 2).

![Figure 1. The deciduous seed pod in rose hybridization.](image)

The crossing failure of roses were more dominantly depend on parents. It means that the genetic factor is dominant to drive the crossing success (Figure 2). Rose cultivar “Luna” is difficult to produce seed pod as a female parents. But as a male parent, it was succesfully producing seed pod (Figure 2). In previous research, there was no correlation between perpetual blooming that was controlled by homozygous loci or recessive alleles with unsuccessful of breeding [18].

![Figure 2. The successful reciprocal cross to produce seed in rose hybridization.](image)

The average of seedpod in rose hybridization was determinated by parents, pollen maturity, compatibilities of crossing and environment (Figure 3). The success of pollination was limited by pre- and post-pollination, there were sterile pollen, immature embryo and decious seed pod. The average of rose crossbreeding series were different, in which 11.6 days was shortest time of pollination, and the longest time was 12.66 days. The key to generate successful pollination was achieved when the pollens were accessed into stigmas at proper time [3].

The previous study showed that crosses among tetraploid roses (both garden and cut flower) were compatible crosses. All of oil rosa species are tetraploid (2n=4x=8) such as R. damascena and R. gallica, R. centifolia and R. rugosa were successful crosses [3].

The decious seed pod or fallen fruit was occurred about 15-21 days after crossing (Figure 4). The rose crossbreedings were 266 series, but just 19 crosses were successful. The symptoms of fallen fruit
were drying pistil, yellowish stem and browning. It because of mature pollens was different time, seed pod was not enough developed even though pollination occurred. Pollen fertility was quite less, it contributed to unsuccessful pollination [19]. Previous research reported that RcSOC1 gen in flower development and their wrong expression have reduced that function of stamen and pistil [20].

Figure 3. The average of seed pod among of parents in rose reciprocal cross.

The average of seed pod harvesting were 104 - 131 days, while in general, seed pod harvesting took 3.5 – 4 months. Some of rose reciprocal crosses series were successful, there were Mohana x Sexy rose (104 days), cold water x black magic (131 days), Mohana x Luna (112 days), Valeri x Luna (123 days) and Mega putih x Luna (125 days) (Figure 5).

Figure 4. The deciduous seed pod in rose hybridization, both of reciprocal and one way cross.

4. Conclusion
Some informations about compatibility of rose hybridization were obtained. There were the average of pollination (11.6-12.66 days), seed pod deciduous (15– 21 days), seed pod harvesting (104– 131 days). The genetic traits of parents were dominant to determine the compatibility and incompatibility in rose crosses. For future studies, it is important to learn more about flower physiology and pollination in rose.
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