The development of the generative sphere, flowering and fertilization *Actinidia deliciosa* (kiwi) in wet subtropics of Russia

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Abstract. The work has studied the characteristics of the flower and the morphobiological development of the reproductive sphere in male (Tomuri) and female (Heyword) plants Actinidia deliciosa (kiwi). The basic phenological phases of development have been identified, significant differences are presented, in relation to flowering time, flowering period, the number of female and male organs, a stylus, and stamens size. It is determined that female varieties bloom later male and have a shorter length of stamens, while the biometric parameters of antipershabi of male plants are higher than female. It is not the functioning of the ovaries in male varieties and the lack of self -pollination in female, since the anthers of their flowers contain sterile pollen. A direct dependence between the quality of fertilization and the size of the fetus is established. It was revealed that in the laboratory conditions, the activity of germination of pollen is due to the varietal characteristics of the pollinator and the time of its workpiece. The viability of the pollen of the male plant of kiwi (Tomuri variety), which has a potentially high degree of fertility at 74.5% of germination, is analyzed. The reduction in the percentage of the germination and the length of the pollen tube in the pollen of the flowers Actinidia deliciosa (kiwi) with an increase in the temperature and storage of pollen, and the reverse dependence between the percentage of the germination and the length of the pollen tube with a shelf life is revealed. It is determined that the main factor in obtaining stably high yields is the selection of female and male varieties with simultaneous flowering.

1 Introduction

Actinidia is a dioecious, deciduous plant that requires about 500 hours of negative temperatures for its development [1] and related to thermophilic cultures of the temperate zone.

The climate of the subtropical zone of the Black Sea coast of Russia is characterized by a high average annual temperature (the summer period when a temperature is observed from +20 ° C to +28 ° C, begins in May and lasts until the end of October. From the beginning of November to the beginning of May, the autumn-spring season with a

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temperature is established with a temperature from + 4 ° C to + 12 ° C), the amount of active temperatures not lower than 3600 ° C - 5515 ° C, average annual precipitation of 1534 mm and a moisture content of 74%, negative temperature in the winter period not lower than -15 ° C [2], which meets the requirements of the CIVI culture to the temperature regime and the provision of moisture.

Actinidia deliciosa (kiwi) is a dioecious species with pale, cream -colored flowers located one by one or groups, depending on the variety. The flowers have five cups and six petals and a diameter of about 3-5 cm in a detailed state. Women's flowers have several functional stigmas in the central area, surrounded by anthers, which produce sterile pollen. Male flowers consist of a rudimentary non -functioning pestle and a large number of stamens with anthers, from which viable pollen grains are formed.

All types of actinidia dioecious, male and female flowers grow on individual plants. For fruiting, pollination, performed mainly by bees [3-6], is necessary. The traditional varieties-pollinators (male) are Tomri (recent -reliable) and matuel (mid -fluent) selected in New Zealand, were classified in accordance with the phenology of the Hayvordo (female) variety, leading industrial grade [5, 7].

In breeding studies, it is usually desirable to receive female plants. However, male plants are also of great importance for pollination.

The purpose of this study was to study the characteristics of the flower and give the morphobiological characteristics of the development of the reproductive sphere in the varieties of Actinidia deliciosa (male plant) and Heyword (female plant) for further breeding studies.

2 Materials and methods

Our studies were conducted on the collection site of the FIC CNC of the Russian Academy of Sciences and at the Adler Experimental Vir for 23 years. The study used varieties and genotypes obtained from varieties belonging to Actinidia Deliciosa [8]. During flowering, phenological observations of male and female genotypes were carried out, which are released in the population, and the stages of the development of flowers were determined. To determine the morphological characteristics, at least 10 flowers of each genotype were used: the number of leaves, petals, male organs, stamens, female organs, and stylus were investigated.

The study of the viability of pollen was carried out according to the methodology of D.A. Transkovsky [9]. Pollen was germinated on an agricultural medium with a content of 1%agar + sucrose (15%) + boric acid (0.06%). The size of the pollen grains measured in different environments; Wednesday (dry state) and on an agricultural environment for germination using a levenhuk dtx 30 microscope with a USB cable (increase x 35 (35-fold increase). The viability of fresh pollen grains of men's flowers and for comparing female were checked. The length of the pollen tube was measured. Photos were saved in Digital Viewer version 3.1.07. Measurements were carried out in 5 fields of view in 3 repetitions in the ImageJ program (μm).

3 Results and Discussion

In the seasonal development of kiwi, the following phenological phases are distinguished: the beginning of the buds of the kidneys, the beginning of flowering, the removable maturity of the fruit and the onset of consumer maturity [10] (Table 1).

Table 1. The main phenological phases of kiwi development.

Varieties	Begin to bloom kidneys (March)	Beginning flowering (May)	Removable maturity of kiwifruits	The onset of consumer maturity (days)
Heyword (Counter)	24-26	26-28	18-20.11	20-25
Monty	19-21	24-26	5-10.11	14-20
Kivaldi	23-25	25-27	18 -20.11	20-23
Heyword K-10	24-26	26-28	18-20.11	20-25
Bruno	20-22	24-26	5-10.11	14-20
Ellison	18-20	19-22	15-20.10	10-17
Matua	20-22	18-22	-	-
Tomuri	24-26	23-26	-	-

Along with the growth of the shoots, the growth and deployment of leaves occurs, greenish-pink buds appear in the sinuses, then phases of complete budding and flowering occur (Figure 1).

Fig. 1. Bottonization of actinidia delicacious.

Flower buds are differentiated in the fall. They become visible in the sinuses of leaves in March, but swelling and development begins later.

Flowering of actinidia delicacious in the subtropics of Russia begins with the third decade of May and ends in the first decade of June. In the inflorescence, the central flower is first revealed and then side. Flowering continues for 10-14 days, then the ovaries in pollinated flowers are formed.

Actinidia flowers are delicious, large, symmetrical 40-60 mm in diameter. 5-6 petals, oval, white-cream color with a weak aroma (Figures 2 and 3). The flowers are located in the sinuses of the first 2-3 leaves of mixed shoots of 3-4 in female plants (less often one at one) and 4-8 in male, depending on the variety. Male have only stamens, for female - both pestles located radially (an average of 20-30 per flower) and stamens (Figure 4). Stamens in female plants are reduced.

Fig. 2. Male flower.

Fig. 3. Women's flower.

In optimal conditions of cultivation on each mixed shoot, there are 7-8 inflorescences, each of which consists of 3 flower buds. The exception is the plants of the Hayword variety, which have a bowl of one flower bud and plants of the Monti variety that form a large number of flowers in the inflorescence; The flowers of such varieties need thinning.

When evaluating the data obtained for a number of 23 years, significant differences were obtained, in particular, in relation to flowering time, flowering period, the number of female and male organs, a stylus, and streaming thread. Female varieties, as a rule, bloom later male varieties, have a shorter stame thread than male. It is also not the functioning of the ovary in male varieties.

The transfer of pollen from men's flowers to female is carried out by insects, possibly a small extent, and by air flows. The latter is sometimes insignificant, because the plantation is deliberately, in order to reduce the dry ones, they protect with green spaces. Therefore, the participation of insects in pollination is extremely necessary. There is a direct dependence between the quality of fertilization and the size of the fetus: with weak fertilization, the fruits are mainly small (weighing two to three times less than with normal fertilization) and irregular shape.

In actinidia delicious, like a dioecious plant, male and female flowers differ morphologically. The female flower in the center has a pestle with a radiant stigm surrounded by numerous yellowish-orange stamens on short threads (Figure 4a). In the center of the men's flower, a reduced ovary, surrounded by numerous stamens (Figure 4b), is barely noticeable.

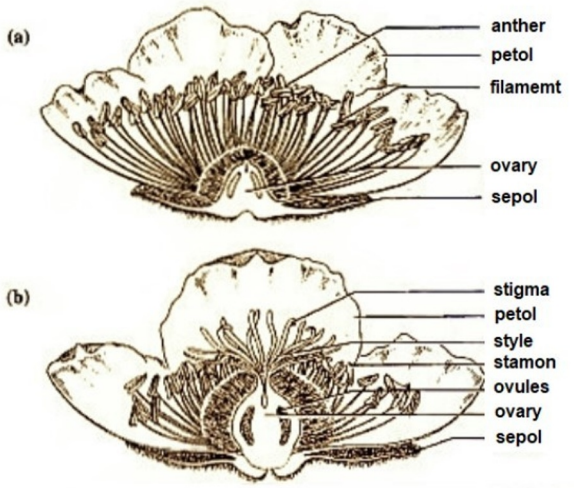

Fig. 4. The structure of the flowers Actinidia deliciosa: 1 - male flower; 2 - women's flower.

The anthers of female flowers contain sterile pollen, so they have no self -pollination (Figure 5, Table 2). As can be seen in the figure and in the table, the biometric parameters of the anthers of male plants are higher than female.

a b

Fig. 5. Kiwi anthers are male-shaped; b- female form.

Table 2. The comprehensive characteristics of the anthers.

Anthers	Length (µm)	Width (µm)	Color
Male flowers	97.43	39.27	Yellow color
Women's flowers	89.47	33.103	Beige colour

*1 µm = 252 photo pixels

Polts grains are rounded, white and very small. Pollen is abundant dry, fluid. Mature pollen grain of stamens of stamens is 2-cell, transverse-elliptical or round-triangular shape with three crasimarginate pores and smooth eccina. Spermioogenesis occurs in the pollen tube.

The activity of the germination of pollen in laboratory conditions is due to the varietal features of the pollinator and the time of its workpiece - immediately after the opening of

the flower is the highest, and by the middle after the opening of the flower this indicator drops sharply.

For the successful cultivation of kiwi in the conditions of wet subtropics of Russia, it is necessary that some high -quality varieties of kiwi develop using the relevant selection programs. But at the same time, data on the morphology, vitality and germination of pollen kiwi are not enough.

Recently, the study of the physiological properties of pollen, especially its germination and vitality, pays considerable attention in connection with their use in selection [11-13]. Pollen has a wonderful potential to achieve a genetic transformation [Nasib, A., Ali, K. and Khan, S. (2008)] [14].

Studies of the properties of pollen, especially the percentage of germination and growth of tubes in the pollen stored, should be carried out for its viability and durability in various studies.

Polts grains, being a sexual reproductive unit and a bearer of male genetic material in higher plants, play a vital role in the selection program and contribute to the successful tie of fruits. A high harvest, as a rule, depends on the viability of pollen grains. Polita's fertility and vitality are of paramount importance in the hybridization program. Pollen indicators, in terms of the ability to germination, can have a relative value for tie fruit.

In this study, we studied the basic morphological signs of pollen of actinidia delicacious, including the fertility and ability to germination, on varieties grown in the collectible section of the FIC of the SNC of the Russian Academy of Sciences. Tables 3 - 5 shows morphology, the fertility of fresh pollen grains and the degree of germination of pollen of male and female flowers.

Table 3. Morphology of pollen grains.

Condition	Pollen grain (male)		Pollen grain (female)	
	Length (μm)	Diameter (μm)	Length (μm)	Diameter (μm)
Dry condition (after collection)	185.2	74.7	118.4	57.1
Agarized environment	142.05	140.2	104.5	104.01

The study of the viability of the pollen of the male plant kiwi (Tomuri variety) showed the potentially high degree of its fertility. However, the actual germination of pollen did not exceed 74.5% (Tables 4 and 5). The percentage of abnormal pollen grains is small and cannot have a significant effect on the overall viability of the pollen of the male plant (Figure 4). It was established that the pollen of stamens of stained flowers quickly loses its germination energy and already 2-3 days after the opening of the flower loses its ability to fertilize.

Table 4. Farm of pollen.

Days of storage	Men's flower, %	Female flower, %
On the third day after the collection	44.45	0.23

Table 5. Polts germination 24 hours after sowing on nutrient medium.

Medium for germination	Men's flower, %		Female flower, %	
1% agar + sucrose (15%) + boric acid (0.06%)	Push germination, %	Length of the pollen tube, μm	Germination of pollen, %	Length of the pollen tube, μm
	74.5	630.10	4.1	189.51

The percentage of germination and pollen tube length of Actinidia deliciosa (kiwi) flower pollen decreased with increasing temperature and pollen storage period, and an

inverse relationship was observed between the percentage of germination and pollen tube length of pollen with storage period (Figure 6). The duration and temperature of pollen storage had a greater effect on pollen tube growth than on germination percentage. At room temperature, after 15 days, pollen lost germination energy.

Fig. 6. Pollen germination after 24 hours on agar medium (1% agar + Sucrose (15%) + Boric acid (0.06%)).

The kiwi flower is adapted to pollination by both insects and wind. The adaptability of the Actinidia deliciosa flower to pollination by honey bees is indicated by its large size, bright coloring of the corolla petals, presence of inflorescence, and aroma. Adaptation to wind pollination is indicated by the plant's dioeciousness, the absence of nectaries, and the lightness and flowability of pollen. Fruit set from open pollination is 50-70%. After the flower is pollinated, the pistil darkens and the petals fall off. If fertilization does not occur, the flowers remain open for 6-8 days or more. As a rule, most of the flowers form an ovary. Under normal conditions, almost every fertilized flower turns into a fruit, which indicates that in A. deliciosa plants there is practically no physiological shedding of the ovary.

As a rule, flowers bloom in the warmest time of the day and are arranged as if suspended upside down in such a way that the petals protect the generative organs from precipitation and direct sunlight.

To increase the fertility of female kiwi flowers, it is necessary to select male type flowers so that:

- The duration of the flowering period of the male plant was longer than that of the pollinated variety.
- The flowering periods of male and female plants coincided.
- Male plants were not too far from female ones.
- The ratio of male to female plants must be at least 1:10.
- Number of hives with a decrease in the number of male plants; you should have at least 7 pieces per 1 hectare of plantation.
- Do not heavily prune male plants before flowering.

4 Conclusion

- The flowering of Actinidia deliciosa in the subtropics of Russia begins in the third ten days of May and ends in the first ten days of June. Pollination is carried out by insects and wind.
- Female varieties bloom later than male varieties and have a shorter stamen filament length than male varieties. Male varieties have a non-functioning ovary
- Pollen from staminate flowers loses its ability to fertilize 2-3 days after the flower opens.

- Simultaneous flowering of female and male plants is a determining factor in obtaining consistently high yields. The correct selection of female and male varieties, in which the beginning and duration of flowering completely coincide, must be taken into account when planting plantations.

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