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DETERMINATION OF FLOWER CHARACTERISTICS OF SOME KIWIFRUIT GENOTYPES (*ACTINIDIA* SPP.) OBTAINED WITH BREEDING PROGRAM

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ABSTRACT

All *Actinidia* species are dioecious, male and female flowers grow on separate kiwifruit plants. In breeding studies, it is generally desirable to obtain female individuals. However, male plants are also of great importance for pollination. Therefore, it is necessary to examine the flower characteristics of the genotypes obtained by breeding studies. This research was conducted in the kiwifruit breeding plot of Yalova Atatürk Horticultural Central Research Institute for two years. Genotypes obtained from cultivars belonging to *Actinidia deliciosa* and *Actinidia chinensis* were used in the research. At the time of flowering, phenological observations of male and female genotypes, which are prominent in the population, have been made and the developmental stages of the flowers have been determined. At least 10 flowers of each genotype were used to determine the morphological characteristics.

Number of leaves, number of petals, number of male organs, number of filaments, number of female organs, number of female organs and number of stylus were examined in order to determine flower characteristics. When the data obtained as a result of two years are evaluated; significant differences have been obtained particularly in terms of flowering time, flowering period, the number of stylus, the filament size, the number of female organs and the number of male organs. Female cultivars/genotypes tend to flowering later than male cultivars/genotypes, and female cultivars/genotypes have shorter filament length than male cultivars/genotypes. It has also been clearly observed that ovaries are not functional in male types.

Keywords: Kiwifruit, Flowering, Phenology, Flower structure, Selection

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INTRODUCTION

Turkey is the gene centre of many plant species and at the same time have important plant species and diversity. Turkey is one of the countries with different ecologic due to its geographical position and different climate structures. It is also successfully cultivated in many foreign species. 75 of the 138 species known in the world are grown in Turkey. Kiwifruit is one of these plants [1]. Despite the fact that the kiwifruit homeland is China, the first breeding work started in 1904 with the introduction of kiwifruit seeds to New Zealand and spread over the world from New Zealand. A very large part of the kiwifruit grown in Turkey is *Actinidia deliciosa* cv. Hayward. However, in recent years new cultivars have been developed in countries such as Italy, New Zealand and China. These are cultivars of *A.chinensis* and *A.deliciosa* which have different fruit flesh, aroma and harvest time.

Kiwifruit was first introduced to Turkey in 1988 and from this date to daily (about 30 years) production has increased every year. With the increasing production, all over the world, the demands of the consumers began to change. Consumers started to demand different cultivars, and started to work on breeding to develop new kiwifruit cultivars to provide an alternative to single cultivar [2].

In this breeding program, it is a priority aim to develop cultivars of kiwifruit with a yellow and/or red fleshed to the grower of our country.

In addition, the expansion of kiwi production areas in terms of the suitability of new cultivars to different ecological areas, solving the problem of early harvest, it is also aimed to offer cultivars with different flavour and aroma to consumers. In addition to these, besides fresh consumption of kiwifruit, expansion of different consumption areas such as cake, fruit juice and drying, reduction of kiwifruit and nursery imports, and reaching the potential of our country to export kiwifruit are among the aims of breeding program.

All *Actinidia* taxa are probably functionally dioecious, although this has been unequivocally established in a few taxa such as in *A.chinensis* and *A.polygama*. In all *Actinidia* taxa in which pistillate and staminate flowers are known have been described, female plants carry pistillate flowers which can be described as morphologically "perfect" since they have both well-developed pistils and what appears at first sight to be non-functional stamens whereas the staminate flowers of male plants are clearly unisexual, they have stamens but only small, rudimentary ovaries which don't contain viable ovules. Male plants therefore don't normally carry fruit [3].

Male and female flowers grow on separate kiwifruit plants [4, 5]. Kiwi is a dioecious species, with pale, straw-coloured flowers, arranged singly or in groups, according to the cultivar. The flowers have five sepals and six petals and a diameter of about 3 - 5 cm when open. The female flowers have several functional stigmata in the central region, surrounded by anthers that produce sterile pollen. The male flowers consist of a rudimentary and non-functional pistil and a large number of stamens with anthers that produce viable pollen grains [6].

Due to the different flower structure of kiwifruit compared to other species, flower phenology and morphology must be well evaluated during the breeding program. In this study, the flower morphology and phenology of the Hort16A, Jintao, Hayward, Topstar and 17684 seedlings were evaluated for two years.

MATERIALS AND METHODS

Plant Materials

The research was carried out in Atatürk Horticultural Central Research Institute in kiwifruit breeding plot. The *A.deliciosa* cv. Hayward which is 15 years old was used as a rootstock. Hybrid genotypes were grafted on this cultivar. All hybrid genotypes were obtained with open pollination. Flower characteristics were evaluated in the 4th and 6th years after grafting. Genotypes used in the research;

Seedlings of Hort 16 A; HO-A-13, HO-143, HO-I-14, HO-120, HO-8, HO-D-18, HO-H-18, HO-39, HO-153, HO-151.
Seedlings of 17684; B-19, B-25, B-34, B-26, B-64, B-24, B-39, B-16
Seedlings of Jintao; J-188, J-141, J-191, J-172
Cross of Hayward and Topstar; TH-44, TH-64, TH-50, TH-21
Also Matua, Tomuri and Hayward used as control cultivars.

Methods

Flowering dates were followed during April and May to identify phenology of kiwifruit genotypes during the two growing season. The flower samples used in the research were taken when 70% flowering in each genotype. It was brought together with the flower stalk and brought to the laboratory to be examined. Measurements were made with digital callipers.

Number of sepal, number of petal, number of stamen, filament length (mm) and width of ovary (mm) were determined in male genotypes. In addition to these flower characteristics, the number of stylus and stylus length (mm) in the female genotypes were also determined. At least 10 flowers from each genotype were analysed.

RESULTS AND DISCUSSION

As the genotypes of the different species were examined, naturally flowering varied in the dates. Also the climate data for the years of the study are given in Figure 1. The beginning of flowering was determined respectively as Hort16A (HO) seedlings, 17684 (B) seedlings, Jintao (J) seedlings, and finally Topstar-Hayward (TH) seedlings. The flowering start dates are given in Table 1 for 2015 and 2017.

The dates of the start of flowering of Hort16A seedlings were determined as the first week of May and the last week of April.

The flowering dates of the Jintao seedlings were determined as the second and third week of May. The flowering dates of 17684 seedlings were determined as the first and second week of May. Seedlings of Hayward, Tomuri, Matua and Topstar-Hayward (TH) were determined as the third and fourth week of May to beginning of the flowering.

Female and male flowers were determined during two vegetation periods. The flower characteristics of female and male genotypes are given in Table 2 and 3 as average of two years. The number of male organs (number of stamen) in Tomuri, Matua, TH-50 and TH-44 cultivars/genotypes were higher than the other genotypes. The number of male organs was 169.3 in Tomuri, 62.3 in Matua, 59.6 in TH-50 and 41.0 in TH-44. In other male genotypes, the average number of male organs was 49,24

The number of sepal was found to be close to each other in all cultivars/genotypes, and it was 6.17 on average. The petals are the most beautiful and glamorous part of the kiwi flower. The number of petals was close to 6.87 in all cultivars/genotypes. The genotypes in the filament size (mm) and the female organ size (mm) were found close to each other (Figure 2).

The number of male organs was found to be higher than other genotypes in Hayward (182.7), TH-64 (189.7) and TH-21 (151.0) but they are not functional. Hayward 9.5 mm and TH-21 9.5 mm were found to be longer than other types in terms of length of stylus length (mm). Female flowers have an average of 34.46 the number of stylus, while male flowers are not functional. The number of stylus was found to be 42.9 in B-19 and 45.0 in B-25 and it was found that they had more stylus compared to other genotypes. Because of the flower structure of kiwifruit, male and female plants must bloom at the same time with each other. This is very important for better fruit set also quality. The importance of correct identification of flower characteristics has also been emphasized in breeding studies [7]. This is especially important for cultivars/genotypes belonging to the *A.chinensis*, which have more flowers. Generally, artificial pollination applications to *A.chinensis* genotypes increase yield and quality [3, 8]. Male cultivars/genotypes have single, triple, and five flowers, whereas female flowers usually have single and double flowers. In addition, male flowers make it easier to distinguish between female and male flowers due to small and non-functional structures of the ovaries. It was observed that male flowers bloomed earlier than female flowers and remained flowering for a longer time.

Male flowers also secrete an aromatic odour that attract insects [9]. This increases the pollination rate. A similar situation was observed in the cultivars/genotypes used in the study, diferent researchers are made similar comments in their study [10, 11]. In the Hayward variety, the female organ was found to be 8.2 mm wide, the stylus size 9.4 mm and the stylus number 37.8. Similar to this study, also it was reported that 30-40 number of stylus were carried by the Hayward cultivar [12].

As a result, female cultivars/genotypes tend to flowering later than male cultivars/genotypes, and female cultivars/genotypes have shorter filament length than male cultivars/genotypes. It has also been clearly observed that ovaries are not functional in male types.

CONCLUSIONS

Kiwifruit breeding has gained momentum in recent years due to changing consumer demands. Due to the flower structure, the male and female genotypes of the kiwifruit must be well evaluated. Some important genotypes have been examined in this study conducted for this purpose. It is thought that this study will contribute to speed up the breeding studies and contribute to the quality of fruit. It should also be remembered that the quality of the fruit is absolutely important in the harmony of a good male and female plant.

Table 1. First flowering date of genotypes

		GENOTYPES									
	Year	HO-A13 (M)	HO-143 (M)	HO-I-14 (F)	HO-120 (F)	HO-H-18 (M)	HO-8 (F)	HO-D18 (F)	HO-39 (M)	HO-153 (M)	HO-151 (F)
First Flowering	2015	03.05	13.05	29.04	30.04	28.04	04.05	02.05	29.04	04.05	07.05
	2017	04.05	11.05	01.05	29.04	01.05	02.05	02.05	30.04	01.05	04.05

		GENOTYPES						
	Year	B-34 (M)	B-64 (M)	B-19 (F)	B-25 (F)	B-26 (M)	B-24 (F)	B-16 (M)
First Flowering	2015	13.05	14.05	15.05	12.05	11.05	14.05	15.05
	2017	08.05	07.05	08.05	09.05	08.05	09.05	07.05

		GENOTYPES						
	Year	HAYWARD (F)	TOMURİ (M)	MATUA (M)	TH-21 (F)	TH-44 (M)	TH-50 (M)	TH-64 (F)
First Flowering	2015	21.05	19.05	17.05	24.05	26.05	26.05	27.05
	2017	21.05	16.05	14.05	23.05	20.05	20.05	26.05

		GENOTYPES			
	Year	J-188 (M)	J-191 (F)	J-172 (M)	J-141 (F)
First Flowering	2015	17.05	17.05	20.05	20.05
	2017	10.05	13.05	14.05	17.05

M: Male. F: Female. HO: Hort16 A seedlings. B: 17684 Seedlings. J: Jintao seedlings. TH: Hayward/Topstar X Tomuri Seedlings

Table 2. Some flower characteristics of female genotypes

Characteristics of Flower	FEMALE GENOTYPES											
	J-191	J-141	HO-I-14	HO-120	HO-8	HO-D-18	HO-151	Hayward	B-19	B-24	B-25	TH-64	TH-21
Number of Sepal	6.1	6.7	6.6	7.0	7.4	6.1	6.7	5.1	5.9	6.0	5.8	5.8	5.3
Number of Petal	6.4	6.8	8.1	9.0	8.3	6.0	6.7	6.6	6.4	8.3	6.6	6.1	6.7
Number of Stamen	57.3	62.7	55.3	49.6	52.0	41.6	43.9	182.7	59.2	60.3	57.4	189.7	151.0
Number of Stylus	29.9	35.0	32.7	34.0	33.8	24.2	29.2	37.8	42.9	34.1	45.0	32.0	37.4
Filament length (mm)	8.8	9.1	8.0	6.5	9.2	8.1	7.5	10.0	9.6	11.8	11.2	8.6	11.6
Width of Ovary (mm)	5.5	6.0	6.7	7.0	7.1	6.2	6.2	8.2	6.2	7.1	7.1	6.5	8.4
Stilus Length (mm)	8.0	7.9	5.9	6.7	6.3	6.3	6.0	9.5	8.0	8.4	8.5	7.4	9.5

Table 3. Some flower characteristics of male genotypes

Characteristics of Flower	MALE GENOTYPES															
	J-188	J-172	HO-A-13	HO-143	HO-H-18	HO-39	HO-153	B-34	B-26	B-39	B-16	B-64	Tomuri	Matua	TH-50	TH-44
Number of Sepal	5.7	7.1	6.6	6.0	6.3	6.3	6.2	6.0	5.5	5.9	5.8	5.6	5.9	5.7	7.1	6.6
Number of Petal	6.2	7.9	7.8	6.8	7.2	6.7	6.9	5.7	5.5	6.4	6.4	5.7	6.2	6.2	7.9	7.8
Number of Stamen	62.3	59.6	41.0	92.7	49.2	40.4	42.3	53.7	53.9	52.0	49.2	62.8	169.3	62.3	59.6	41.0
Width of Ovary (mm)	13.2	10.4	6.2	11.9	7.8	8.8	7.3	12.8	11.1	11.8	10.8	10.0	12.6	13.2	10.4	6.2
Filament length (mm)	3.4	3.0	2.5	3.7	3.4	2.7	2.9	3.6	3.5	3.1	2.9	3.4	3.4	3.4	3.0	2.5

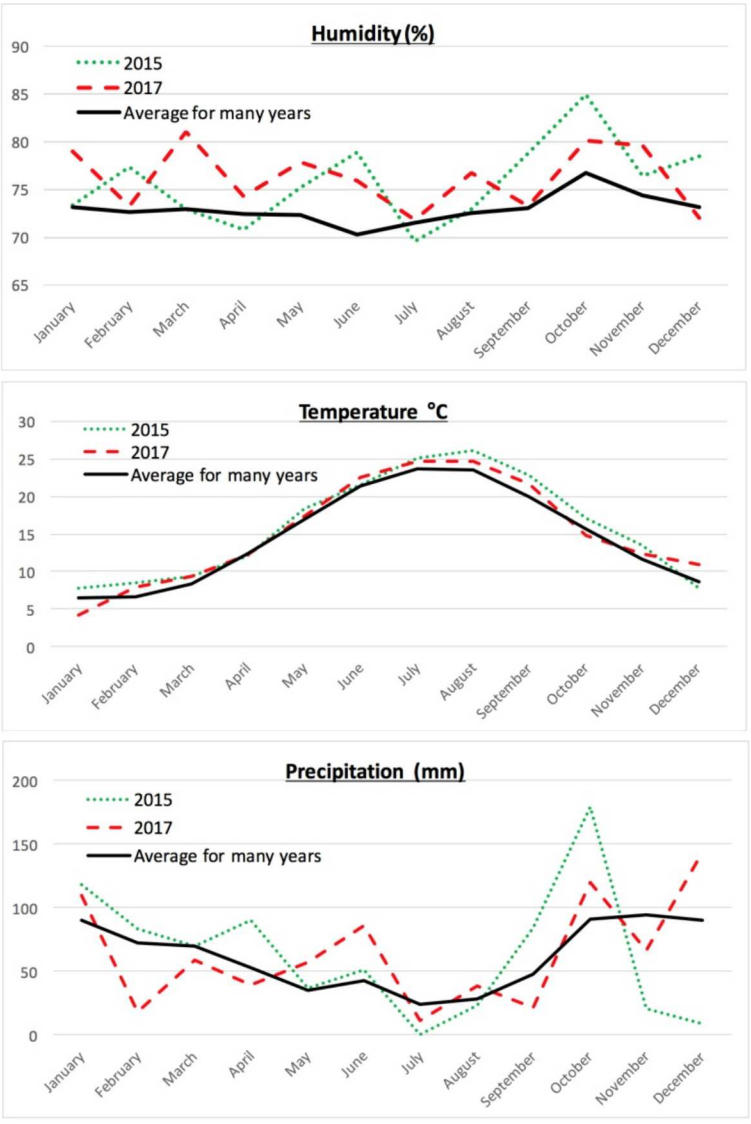

Figure 1. 2015 and 2017 climate data of experimental area

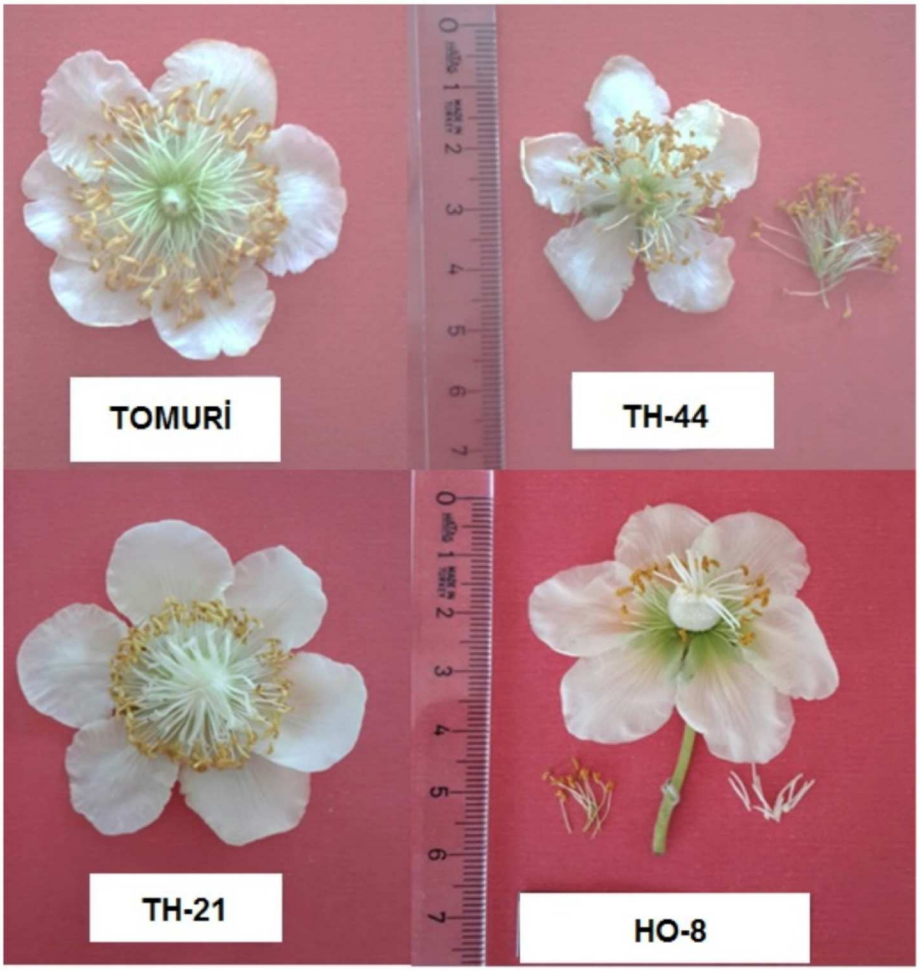

Figure 2. Full opened flowers of Tomuri, TH-44, TH-21, and HO-8

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