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The Effect of Different Pollinators on Fruit Set and Fruit Quality Parameters of Some Foreign Apricot Varieties in Kayseri Ecological Conditions (Central Anatolia, Turkey)

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ABSTRACT

Turkey is among the rare countries in terms of plant diversity, and thus, most plant species spread widely throughout the country. Apricot is one of these plant species. Due to the self-incompatibility seen in apricots, it is necessary to use a pollinator variety for a quality and efficient product. With this study carried out in 2021 year, the effects of different pollinators on fruit set and some fruit quality parameters of Casne Drenova, Ninfa and P. de Tyrinthe cultivars were investigated in Kayseri ecological conditions. In the study, early ripening apricot varieties were used as paternal parent. According to the results of the study, it was shown that fruit set values varied between 11.6% and 22.6%. In the pomological parameters examined in the study, in general (except for fruit firmness), differences were found in combinations using different pollinators compared to the open pollinated fruits of the maternal parent. It is foreseen that the results obtained will be guiding especially in the breeding studies to be carried out with these varieties and in the establishment of new orchards.

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Introduction

The climate in Turkey varies from subtropical to terrestrial climate, and the resulting ecological difference has led to the formation of a wide plant flora (Ercisli, 2004). In this way, Turkey is among the rare countries in the world in terms of plant genetic diversity (İpek and Gürbüz, 2010). *Prunus* species constitute a significant part of plant diversity and most of these species are considered economically (Uzun et al., 2018).

Apricot (*Prunus armeniaca*), which is one of the important Prunus species, is a very useful product for human health due to the various vitamins and phytochemicals it contains. (Alexa et al., 2018; Kafkaletou et al., 2019). Apricots are used in many areas such as dried and fresh consume, industry and consumed with pleasure by consumers (Davarynejad et al., 2010; Birisik et al., 2021). Apricot production in Turkey has increased from past to present. In the world production, which is over 4 million tons, Turkey ranks first with 846,606 tons (FAO, 2019) and Apricot is among the agricultural products that Turkey is the leader in world production.

Although Turkey is the leading country in apricot production, there are problems in apricot cultivation due to losses caused by late spring frosts, pollination and fertilization. In addition, there are different threats such as the changing consumer demands in the foreign market and the increases in the production and export of dried apricots in the Central Asian countries, (especially Uzbekistan) in recent years (Martínez-Lüscher et al., 2017; Herrera et al., 2021). Among these problems, product losses, pollination and fertilization problems are among the issues that should be emphasized, especially due to incompatibility in most fruit species, including apricot, which directly affects yield and quality (Ortega et al., 2004). In agricultural production, the main aim is to get efficient and quality products, and one of the ways to achieve this is to use appropriate pollinators. Even in different fruit species where there is no self-incompatibility, fruit quality and fruit set were investigated depending on the pollinator variety; There are different studies such as almond (Yaman and Uzun, 2021), persimmon (Yildiz and Kaplankiran, 2013), apple (Akkurt et al., 2020), grapes (Sahin and Sabır, 2016).

In this study, it was aimed to determine the effects of different pollinators on fruit set and fruit quality parameters in some foreign apricot varieties such as Casne Drenova, Ninfa and P. de Tyrinthe in the ecological conditions of Kayseri province.

Material and Method

Material

This study was carried out in the apricot collection orchard of Erciyes University, Faculty of Agriculture, Department of Horticulture. In the study, Casne Drenova, Ninfa and P. de Tyrinthe apricot cultivars were used as the maternal parent. As the paternal parent, some of the new apricot varieties grown in Mut district of Mersin province, which have an important place in the production of early ripening apricots as fresh consume, were used and the information about these varieties is given in Table 1.

The collection orchard was established in 2014. The soil structure is loamy-clay and the trees are 7 years old. The meteorological data of the study area's flowering, pollination, fertilization and fruit development periods are given in Table 2.

Method

Pollens of paternal parents (Variety 1 and Variety 2) were obtained from flower buds that have reached the balloon stage and have not yet opened. With the help of a watercolor brush, pollen was applied to the emasculated flowers and hybridization was performed. Fruit set rates: It was determined because of dividing the number of fruits that hold the fruit to the total number of hybridized flowers and multiplying the result by 100 (Yaman and Uzun 2020).

Apricot fruits were collected 20 fruits from each combination to determine the pomological characteristics and analyzes were made on parameters such as fruit weight (g), fruit width (mm), fruit length (mm), water soluble dry matter (%), flesh/stone ratio, acid (%), stone width (mm), stone length (mm), stone weight (g) (Son 2018; Yaman and Uzun 2021). SPSS (Statistical Package for the Social Sciences) 15.0 program was used in the analysis of the data. “Duncan” multiple comparison test was used to evaluate the difference between the results. Values for the combinations are presented as mean ± standard deviation (SD). All statistical analyzes were performed at $P<0.05$ and $P<0.01$ significance level.

Table 1. Some characteristics of paternal parents

Name	Type	Origin
Variety 1	Hybrid	Italy
Variety 2	Hybrid	Spain

Table 2. Meteorological data for experimental year

Month	Max. Temperature (°C)	Min. Max. Temperature (°C)	Average Temperature (°C)	Wind speed (m/s)	Precipitation (mm)
March	10.7	-0.2	5.0	2.2	1.2
April	16.8	4.4	10.7	2.2	0.7
May	23.5	7.2	15.8	2.1	0.6
June	23.0	9.7	16.2	2.0	1.2

Table 3. Fruit set ratios in apricot varieties and combinations

Combination	Number of Pollinated flowers	Number of fruit sets	Fruit set ratio (%)
Casne Drenova × Variety 1	500	79	15.8
Casne Drenova × Variety 2	500	113	22.6
Ninfa × Variety 1	500	93	18.6
Ninfa × Variety 2	500	58	11.6
P. de Tyrinthe × Variety 1	500	61	12.2
P. de Tyrinthe × Variety 2	500	73	14.6

Results and Discussion

In the study, controlled hybridization was carried out on 500 different flowers for each combination. In general, the least total fruit set was determined in hybridization combinations using P. de Tyrinthe cultivar. In combinations where Casne Drenova variety was used as the maternal parent, the fruit set numbers were 79 and 113, and the fruit set ratios were 15.8% and 22.6%. On the other hand, in combinations where Ninfa variety is used, the fruit set rates are 18.6% and 11.6% depending on the paternal parents. As a result of the study, fruit set rates in combinations varied between 11.6% and 22.6% (Table 3). In different studies, it has been determined that fruit set rates vary between 10.7%-13.6% (Tarantino et al., 2018), 2.3%-14% (Caliskan and Polat, 2014). It has been reported between 0.6% and 3.6% (Yaman and Uzun, 2020) in interspecies crossings. In addition, fruit set is affected by factors such as ecology, genetics, and cultural practices (Agusti and Promi-Millo, 2020).

Fruit shape and fruit size are among the important fruit quality parameters in fruits, Fruit size and shape influence fruit length and fruit width as well as fruit weight. In terms of fruit length values, the effect of some pollinators was in the direction of reducing fruit size in some combinations of Casne Drenova and P. de Tyrinthe compared to the open pollinated fruits of the maternal parents. Although pollinators have the effect of increasing fruit length in Ninfa variety, fruit length values are between 34.24 mm and 46.31 mm depending on the pollinator variety in the

study. Fruit length values vary between 33.23 and 37.77 mm (Karakum, 2016), 34.58 mm-48.50 mm (Pınar et al., 2017) in different apricot cultivars. n fruit width values, unlike fruit length, paternal parents used in Ninfa cultivar had the effect of reducing fruit width compared to open-pollinated fruits of the cultivar. In the study, the lowest fruit width values among the combinations were determined as 35.25 mm (P. de Tyrinthe × Variety 1) and the highest 43.52 mm (P. de Tyrinthe × Variety 2). In different studies, fruit width values were reported as 43.38 mm (Nazli, 2010) and 60.77 mm (Ersoy et al., 2011) in apricot. In terms of fruit weight, in combinations using Casne Drenova variety, father varieties had a positive effect on fruit weight, and in combinations using Ninfa variety, father varieties had an adverse effect.

Fruit weight values in the study ranged from 33.31 to 52.20 g. Different researchers have determined that ecology is also effective in fruit weight values and fruit weight values vary between 53.42-73.82 g (Dogru Cokran et al., 2015) and 17.71-76.70 g (Dogan, 2018).

Table 4. Some fruit properties in apricot varieties and combinations

Combination	Fruit Length (mm)	Fruit Width (mm)	Fruit Weight (g)	Fruit Firmness	WSDM (%)	Acidity (%)
Casne Drenova	35.11 ±1.55^{d}	37.76 ±2.84^{bcd}	33.06±5.84^{d}	Soft	12.19±1.45^{a}	0.97±0.24^{b}
Ninfa	41.97 ±2.33^{b}	40.10 ±2.03^{b}	39.15±4.03^{bc}	Strong	7.30±0.78^{bc}	1.32±0.34^{a}
P. de Tyrinthe	42.05 ±1.83^{b}	37.84 ±2.48^{bcd}	39.41±7.09^{b}	Strong	6.62±0.97^{bc}	1.22±0.22^{a}
Casne Drenova × Variety 1	35.68 ±1.10^{d}	39.64 ±2.83^{b}	36.55±5.99^{bcd}	Soft	11.87±1.48^{a}	0.90±0.20^{b}
Casne Drenova × Variety 2	34.24 ±2.37^{d}	35.37 ±3.04^{d}	37.85±4.32^{bcd}	Soft	12.25±1.49^{a}	0.87±0.24^{b}
Ninfa × Variety 1	42.14 ±1.89^{b}	36.81 ±1.78^{cd}	34.86±4.26^{bcd}	Strong	7.46±0.71^{b}	1.46±0.32^{a}
Ninfa × Variety 2	42.04 ±1.94^{b}	38.02 ±3.36^{bc}	33.52±5.21^{cd}	Strong	7.38±0.61^{b}	1.48±0.26^{a}
P. de Tyrinthe × Variety 1	38.86 ±1.60^{c}	35.25 ±1.34^{d}	33.31±5.62^{d}	Strong	6.35±0.37^{c}	1.34±0.27^{a}
P. de Tyrinthe × Variety 2	46.31 ±2.64^{a}	43.52 ±3.44^{a}	52.20±7.80^{a}	Strong	6.74±0.62^{bc}	1.39±0.23^{a}
Mean	39.75 ±4.26	38.20 ±3.47	37.60±7.68	-	8.70±2.65	1.21±0.34

*Different lowercase letters show statistical differences within the column (P<0.05).

Table 5. Stone parameters in apricot varieties and combinations

Combination	Stone Weight (g)	Stone Lenght (mm)	Stone Width (mm)	Fresh/Stone
Casne Drenova	2.29±0.25^{ab}	17.46±1.99^{abc}	12.73±1.75^{ab}	13.63±3.24^{b}
Ninfa	2.40±0.36^{a}	16.79±1.66^{bc}	13.94±1.70^{a}	15.63±3.43^{b}
P. de Tyrinthe	2.28±0.43^{ab}	18.68±1.67^{ab}	14.59±2.21^{a}	16.83±5.41^{b}
Casne Drenova × Variety 1	2.34±0.38^{ab}	17.53±2.75^{abc}	13.29±2.20^{ab}	14.81±2.67^{b}
Casne Drenova × Variety 2	2.54±0.38^{a}	19.06±1.73^{a}	11.75±1.19^{b}	14.25±3.10^{b}
Ninfa × Variety 1	2.31±0.17^{ab}	17.52±1.82^{abc}	14.67±2.18^{a}	14.13±2.28^{b}
Ninfa × Variety 2	2.12±0.35^{ab}	17.25±1.81^{abc}	13.55±1.98^{ab}	15.49±5.21^{b}
P. de Tyrinthe × Variety 1	2.19±0.67^{ab}	16.13±2.58^{c}	13.52±2.17^{ab}	15.40±5.40^{b}
P. de Tyrinthe × Variety 2	1.95±0.48^{b}	19.10±2.21^{a}	14.67±1.82^{a}	27.76±10.60^{a}
Mean	2.27±0.42	17.71±2.19	13.62±2.07	16.31±6.26

*Different lowercase letters show statistical differences within the column (P<0.05).

Fruit firmness in apricots is among the issues that should be emphasized especially in fresh apricot production. On the other hand, Acidity and WSDM values, which are effective in fruit flavor in early ripening apricots, are often ignored. In addition to genetic structure, various factors affect fruit flesh firmness (Cappai et al., 2018). In the study, there were no differences in the acidity parameter in the fruits of open pollinated and obtained different pollinators of the maternal parents, While the WSDM values varied between 6.35% (P. de Tyrinthe × Variety 1) and 12.25% (Casne Drenova × Variety 2) in combinations, the acidity values ranged from 0.87% (Casne Drenova × Variety 2) to 1.48% (Ninfa × Variety 2). In combinations, positive effects of paternal varieties were observed as well as reducing effects on WDSM and % acidity values (Table 4). WSDM and acidity values in apricot were determined by different researchers as 9.40-22.60% (Bilgin et al., 2016) and 1.49%-2.5% (Ayour et al., 2017). The reasons why the current study is different from the studies in the literature can be explained by the difference in ecology and the varieties used.

A positive effect was observed only in the combination of Casne Drenova × Variety 2 compared to the open-pollinated fruits of the main parents in the stone weight values, which is one of the parameters examined in the study related to the stone. In all other combinations, it had a reducing effect on paternal parental stone weight. The stone weight values in the study differed between 1.95 g and 2.54 g. In general, positive effect of father variety was observed in all combinations on stone length values, with the lowest stone weight 16.13 mm and the highest 19.10 mm. While pollinator cultivars had positive effects in Casne Drenova and Ninfa cultivars in stone length data, paternal parents had a negative effect in P. de Tyrinthe cultivar. In the flesh/stone ratio results, P. de Tyrinthe × Variety 2 was the most prominent combination with a ratio of 27.76. The stone weight values of different apricot cultivars were found to be between 1.8 g and 3.9, the stone length was between 22.3 mm and 32.7 mm (Mratanic et al., 2007), and in another study, the stone weight was between 2.14 and 4.34 g (Kumar and Ahmed, 2015). While the present study has similar features with the studies in the

literature, partial differences have been determined. Varieties used, ecology and the effect of pollinator can be shown as the reason for these differences.

As a result of this study, it was determined via hybridization breeding the effects of pollinator varieties on fruit set and fruit quality in some foreign apricot cultivars in Kayseri in 2021. In the results obtained in terms of fruit set in the study, it was observed that the number of fruit set changed depending on the pollinator varieties. In the examined part of the quality parameters, depending on the pollinator variety, positive effects were observed compared to the open pollinated fruits of the maternal parents, as well as reducing effects on some quality parameters. It is foreseen that the obtained data will be beneficial especially for the producers in the apricot breeding studies to be made with these varieties and the new orchard facility to be established.

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