



### Phenological and Pomological Characteristics of Some Asian Pear Cultivars in Ereğli-Konya

Mahmut YAVUZ<sup>1</sup>, Lütfi PIRLAK<sup>2,\*</sup>

<sup>1</sup>Agriculture and Forestry District Directorate, Konya, Turkey

<sup>2</sup>Selçuk University, Faculty of Agriculture, Department of Horticulture, Konya, Turkey

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#### ABSTRACT

This study was carried out on the four Asian pear varieties grown in Ereğli district of Konya province between 2017- 2018. Within the scope of this work, some phenological and pomological characteristics of Hosiu, Kosiu, Hakko and Shinseiki cultivars were examined. 122.00 -206.00 g fruit weight, 58.97- 72,78 mm fruit width, 47.85-70,01 mm fruit size, 2.80- 5.48 kg cm<sup>-2</sup> fruit firmness, 11.83- 16.90 % total soluble solids and 1.02- 5.66 % titratable acidity ratio were found as research results. As a result of this work on Asian Pear cultivars, in 2017, swollen bud term was carried out as 02-04 April, beginning of flowering 18- 19 April, full bloom 23-25 April, harvest date 05-09 August and the period from blooming to harvest date is determined between 133- 137 days. For 2018, swollen bud term was observed on 05- 07 March, beginning of flowering was on 23- 27 March, the full bloom was on 26- 29 March, harvest date 14- 16 August and the period from blooming to harvest date is determined between 141- 143 days. As a result of this study, four Asian Pear cultivars' phenological and pomological characteristics were determined in Ereğli district. The obtained result is thought to be important for regional-based and country-based for fruit growing.

#### 1. Introduction

The pear is one of the fruit species that are grown and consumed in many countries in the hot climate zone. It is known that pear production has a long history. At the beginning of the earliest places where pear production is made, Anatolia, ancient Greece and Rome are coming. It is known that the pear production, as well as the western world, has a long history in China. Most of the cultivars that are subject to world trade on the five continents (Africa, America, Asia, Europe, and Oceania) have come from the *Pyrus communis* (European pears) and *Pyrus pyrifolia* (Asian pears). The vast majority of other species are used as rootstocks in the cultivation of cultivars of these two species. Despite the fact that there is a group of Asian Pears with a high share in world production, most of the pear varieties subject to world trade are in the European group (Akçay and Yücer, 2008).

According to the FAO data for 2016, China received the first rank with 19499487 tons in pear production, while Argentina received the second rank

with 905605 tons in production. The United States 738770 tons, 701928 tons Italy, Turkey 472250 tons and South Africa 433105 tons of pears realized production. Our country is in the 5th place in world production with 472250 tons of pears produced in 2016 (FAO, 2016). Pear production in Turkey's pome fruits is second ranks after apples. The reason for the fact that production is considerably low compared to apple is that there are few varieties resistant to fire blind disease (Şehirli and Özgen, 1987).

The production of Asian pears in our country is increasing in recent years. One of the important production places of Asian pears is Ereğli district of the Konya province, and new orchards are established every year in the district. The phenological development and pomological characteristics of the new varieties should be determined in order to determine suitable varieties in Ereğli district of Konya province which is one of the important pear-growing areas in our country.

#### 2. Materials and Methods

This research was carried out in the Asian Pear garden consisting of 4-year-old trees cultivated com-

\* Corresponding author email: [pirlak@selcuk.edu.tr](mailto:pirlak@selcuk.edu.tr)

mercially in the Ereğli district of Konya province in 2017-2018. The phenological and pomological characteristics of Hosiü, Kosiu, Hakko, and Shinseiki varieties were investigated. Phenological characteristics (swollen bud, the beginning of flowering, full bloom and harvest date) and pomological characteristics (fruit weight, fruit diameter, fruit height, pedicel length, fruit skin color, fruit flesh color, elasticity, fruit flesh firmness, soluble solids content, vitamin C, pH, and acidity). The measurements were made on 10 fruits. Fruit width, length, and pedicel lengths were determined with 0.05 mm precision calipers, fruit flesh firmness and elasticity with penetrometer, soluble solids content with hand refractometer and titratable acidity with titration.

Ereğli, which is located in the south-east of Konya Province, is hot, cold and snowy in winters and hot and dry in summers. The average annual temperature is 11.2°C, with an average annual rainfall of 332 mm. The highest temperature encountered is 40°C, while the lowest is -28.2°C. On average 10 days a year, the temperature is lower than -10°C. The number of days of frost is 90-100 days. Frost events can be seen between early Autumn (early September) and late Spring (May 15-20) (Anonymous, 2018).

In the research conducted in the garden in the first week of April 2018, about 90% of the flowers suffered frost damage. Due to this damage, the fruitiness of the pear varieties in the research in 2018 was very low.

### 3. Results and Discussion

#### 3.1. Phenological Characteristics

The beginning of flowering started at Hosiü, Shinseiki, and Hakko at the earliest on April 18, followed by Kosiu on April 19th. Full bloom was detected in Hosiü, Shinseiki, and Hakko on April 23, Kosiu on April 25. On the 5th of September, Shinseiki reached the earliest harvest in the cultivars examined, and it was followed by Hakko and Hosiü on September 6th. The latest harvest was discovered on 9 September at the Kosiu variety. The period between full bloom and harvesting in 2017 was 134 days in Hosiü and Hakko, 137 days in Kosiu and 133 days in Shinseiki (Table 1).

#### Table 1

Due to the warm winter in 2018, early wake-ups were observed in varieties compared to 2017. In the cultivars examined, the swollen bud was found in the Hosiü variety on March 5, the Kosiu and Hakko on March 6, and the Shinseiki variety on March 7. Beginning of flowering was determined on March 23 in the Hosiü and Hakko varieties, and March 27 in Kosiu and Shinseiki varieties. Full bloom was determined in Hosiü and Hakko on March 26, Kosiu and Shinseiki on March 29. Harvest occurred in Hakko on August 14, Hosiü and Shinseiki on August 15, Kosiu on August 16. The period between full bloom and harvest in 2018

was 141 days in Hakko, 142 days in Hosiü, 143 days in Kosiu and 142 days in Shinseiki (Table 1).

#### 3.2. Pomological Characteristics

The highest fruit weight was determined in Hosiü with 154.42 g in 2017 for the pear varieties examined. Shinseiki is 150.83 g and Kosiu followed this with 136.71 g. The lowest fruit weight was found in Hakko with 122.00 g. In 2018, the highest fruit weight was determined in Shinseiki with 206.00 g. This was followed by Hosiü with 201.00 g and Hakko with 193.00 g. The lowest fruit weight was found in Kosiu with 186.60 g. In 2017, the highest fruit size was determined in Kosiu with 62.00 mm, followed by Shinseiki with 60.95 mm and Hakko with 52.81 mm. The lowest fruit size was determined in the Shinseiki variety with 47.85 mm.

In 2018, the highest fruit length in varieties was determined in Shinseiki with 70.01 mm, followed by Hakko with 68.62 mm and Kosiu with 65.69 mm. The lowest fruit length was determined in Hosiü variety with 65.62 mm. For the year 2017, Hosiü with the largest fruit diameter of 72.00 mm, followed by Shinseiki (68.15 mm), Kosiu (60.14 mm) and Hakko (58.97 mm) respectively. In 2018, the largest fruit diameter was observed in the Hosiü variety with a 72.78 mm, followed by Shinseiki (72.31 mm), Kosiu (70.21 mm) and Hakko (69.66 mm) respectively (Table 2).

The pedicel length of the fruit was found at the longest Kosiu range of 3.30 cm in 2017. Followed by Shinseiki varieties with 3.20 cm and Hakko and 3.00 cm respectively. The shortest fruit pedicel was found in Hosiü variety with 2.80 cm. In 2018, the longest fruit pedicel was found in Kosiu with 2.89 cm, followed by 2.86 cm with Hakko and 2.47 cm with Shinseiki variety. The shortest fruit pedicel was found in the Hosiü range with 1.86 cm. Flesh firmness is observed in Kosiu (3.01 kg cm<sup>-2</sup>) in 2017, followed by Shinseiki (2.96 kg cm<sup>-2</sup>), Hakko (2.91 kg cm<sup>-2</sup>) and Hosiü (2.80 kg cm<sup>-2</sup>). In 2018, flesh firmness of Shinseiki is 5.48 kg cm<sup>-2</sup>, followed by Kosiu (3.71 kg cm<sup>-2</sup>), Hakko (3.53 kg cm<sup>-2</sup>) and Hosiü (3.50 kg cm<sup>-2</sup>). The elasticity was found to be 5.96 kg cm<sup>-2</sup> in Kosiu, 5.48 kg cm<sup>-2</sup> in Shinseiki, 5.41 kg cm<sup>-2</sup> in Hosiü and 4.81 kg cm<sup>-2</sup> in Hakko in 2017. In 2018, Shinseiki is 8.06 kg cm<sup>-2</sup>, 7.36 kg cm<sup>-2</sup> in Kosiu, 6.18 kg cm<sup>-2</sup> in Hakko and 4.73 kg cm<sup>-2</sup> in Hosiü.

The fruit flesh color was found to be 104.20 in Hosiü in 2017, 103.79 in Hakko, 101.48 in Kosiu and 101.81 in Shinseiki. In 2018, it was 105.54 in Hosiü, 101.35 in Kosiu, 99.34 in Shinseiki and 99.29 in Hakko.

The fruit skin color h\* value was determined in Hakko variety with highest 94.72 in 2017 followed by Hosiü 90.27, Shinseiki 87.67 and Kosiu 84.07 respectively. In 2018, the highest value of fruit skin color h\* value was found in Hakko 106.65, followed by Shinseiki 88.67, Kosiu, 85.11 and Hosiü 84.86.

The highest amount of soluble solids content was found in Hosi variety with 14.49%, followed by Hakko with 14.41%, Hosi with 12.43% and Shinseiki with 12.40%. In 2018, the highest soluble solids content was 16.90%, followed by Hosi with 15.53%, Shinseiki with 14.83% and Hakko with 11.83%.

The amount of titratable acidity of varieties was determined in Hakko with the highest rate of 5.66% in 2017, followed by Kosiu with 3.93%, Hosi with 2.00% and Shinseiki with 1.74%. The highest rate was determined in Kosiu by 3.74% in 2018, followed by Hakko with 2.64%, Shinseiki with 1.70% and Hosi with 1.02%.

The fruit juice pH value was determined in the Hosi range with the highest 5.04 in 2017. Kosiu (4.62), Shinseiki (4.58) and Hakko (4.06) were followed, respectively. In 2018, the highest pH value was determined in the Hosi range with 4.92. The pH values of other varieties were 4.87 in Shinseiki, 4.62 in Kosiu and 4.62 in Hakko.

Vitamin C value in fruit juice was observed in Hakko variety with the highest 0.45 mg/100gFW in 2017. This was followed by Kosiu (0.43 mg/100gFW), Hosi (0.33 mg/100gFW) and Shinseiki (0.30 mg/100gFW), respectively. In 2018, the highest value was found in Hosi with 0.77 mg followed by Hakko (0.76 mg/100gFW), Kosiu (0.57 mg/100gFW) and Shinseiki (0.55 mg/100gFW).

#### Table 2

In our country, there are many studies about this kind of subjects in different regions. Different results have been obtained due to the variety of species used and the different ecological conditions used in these studies. Yarılgaç and Yıldız (2001), as a result of their studies with local pear varieties in the Adilcevaz district, fruit weights of 89.73- 368.02 g, soluble solid content is 9.80-18.00%; Ünal et al., (1997), 21.30-337.00 g fruit weight and 5.50-17.00% soluble solid content in the study conducted in the Aegean region Karadeniz and Sen (1990) reported fruit weights of 50.00- 175.00 g in the study conducted with local pear varieties grown in and around Tirebolu. In a survey conducted in the Erciş district of Van province, the Mellaki Pear's swollen bud was determined between April 15- 27. The time between full bloom and harvest date is determined between 136- 145 days (Aşkın and Oğuz, 1995).

In a survey of 11 local and standard pear varieties in Yalova Atatürk Horticultural Research Institute, the fruit diameter was found between 3.5 cm and 6.2 cm (Özdemir et al., 2016). In a survey of 22 local pear cultivars grown in the Camili region of Artvin, soluble solid content varied between 9.0- 15.1% (Serdar et al., 2007). In a study conducted at pear garden in Uşak / Ulubey, titratable acidity values of the four aged Atago, Chojuro, Hosui, and Kosui Asian pear varieties were determined between 0.10 g/100 ml and 0.26

g/100 ml between 2013 and 2014 (Ekici and Yıldırım, 2017).

Late Spring frosts can be seen in the Ereğli District until the last week of April. The blooms in Hakko, Hosi, Kosiu and Shinseiki varieties which are studied at the beginning of flowering started the 3rd week of April in 2017. The winter which is relatively warm in 2018 and the bloom due to the breeze were seen in the 3rd and 4th weeks of March. On the 4th and 5th day of April, the style and ovaries are frozen in 90% of the flowers with the night temperature dropping -5 0C. In this respect, there is a risk of catching up late in the first spring after warm winter months.

The harvest in 2017 was carried out on the first and second weeks of September for all four varieties. In 2018, the harvest was realized on the 2nd week of August. Hence, the harvest was one month earlier than the previous year. The first Autumn frosts in Ereğli province are generally observed in the last week of September. In this respect, it can be said that the varieties studied are very unlikely to be damaged by early autumn frosts.

As a result of the study, the phenological and pomological characteristics of Hosi, Kosiu, Hakko and Shinseiki Asian Pears cultivated commercially in Ereğli district have been determined. Knowing the phenological and pomological characteristics of the cultivars to be used in fruit growing and having the region to be cultivated in accordance with the climatic conditions has a vital priority in fruit growing in our country. Similar studies should be done not only on pear but also on other species.

The characteristics of Hosi, Kosiu, Hakko, and Shinseiki have been found valuable because of some properties such as early harvest, excellent taste in harvest, aroma and crispy fruit flesh. In addition, that the four varieties have got more resistance to *Erwinia amylovora* and *Cacopsylla pyri* than other pear cultivars.

The varieties studied have their flowering beginnings and fruit harvest dates close to one another. All 4 types can be adversely affected by spring late frost. Ereğli's climate can meet the chilling requirement of all four cultivars. warming and warming of the fruits of the Ereğli District meet the desires. In terms of market, the stains found on Hosi and Kosiu fruits can be misinterpreted by consumers as rust stains. For this reason, problems can be seen in marketing these two types. Hakko and Shinseiki are preferred by the consumer because they have no stain on the fruit and the fruit has a nice yellow color on the harvest. Within this scope, Hakko and Shinseiki types seem to be more fortunate in terms of marketing.

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Table 1  
Phenological Observation Date in Asian Pear Varieties

| Varieties | 2017        |                        |            |              |                             |
|-----------|-------------|------------------------|------------|--------------|-----------------------------|
|           | Swollen Bud | Beginning of Flowering | Full Bloom | Harvest Date | Full Bloom to Harvest (Day) |
| Hakko     | 02.04.17    | 18.04.17               | 23.04.17   | 06.09.17     | 134                         |
| Hosiu     | 02.04.17    | 18.04.17               | 23.04.17   | 06.09.17     | 134                         |
| Kosiu     | 04.04.17    | 19.04.17               | 25.04.17   | 09.04.17     | 137                         |
| Shinseiki | 02.04.17    | 18.04.17               | 23.04.17   | 05.09.17     | 133                         |
| Varieties | 2018        |                        |            |              |                             |
|           | Swollen Bud | Beginning of Flowering | Full Bloom | Harvest Date | Full Bloom to Harvest (Day) |
| Hakko     | 06.03.18    | 23.03.18               | 26.03.18   | 14.08.18     | 141                         |
| Hosiu     | 05.03.18    | 23.03.18               | 26.03.18   | 15.08.18     | 142                         |
| Kosiu     | 06.03.18    | 27.03.18               | 29.03.18   | 16.08.18     | 143                         |
| Shinseiki | 07.03.18    | 27.03.18               | 29.03.18   | 15.08.18     | 142                         |

Table 2  
Pomological Characteristics of Asian Pear Varieties

|   | Hosiu  |        | Hakko  |        | Kosiu  |        | Shinseiki |        |
|---|--------|--------|--------|--------|--------|--------|-----------|--------|
|   | 2017   | 2018   | 2017   | 2018   | 2017   | 2018   | 2017      | 2018   |
| Fruit Weight (g)                                  | 154.42 | 201.00 | 122.00 | 193.00 | 136.71 | 186.60 | 150.83    | 206.00 |
| Fruit Diameter (mm)                               | 72.00  | 72.78  | 58.97  | 69.66  | 60.14  | 70.21  | 68.15     | 72.31  |
| Fruit Length(mm)                                  | 62.00  | 65.62  | 52.81  | 68.62  | 47.85  | 65.69  | 60.95     | 70.01  |
| Fruit Flesh Color                                 | 104.20 | 105.54 | 103.79 | 99.29  | 101.47 | 101.35 | 101.80    | 99.34  |
| Fruit Shell Color (h)                             | 90.27  | 84.86  | 94.72  | 106.65 | 84.07  | 85.11  | 87.67     | 88.67  |
| Fruit Stem Length (cm)                            | 2.80   | 1.86   | 3.20   | 2.86   | 3.30   | 2.89   | 3.00      | 2.47   |
| Hardness of the Fruit Flesh (kg cm <sup>2</sup> ) | 2.80   | 3.50   | 2.91   | 3.53   | 3.02   | 3.71   | 3.16      | 5.48   |
| Hardness of the Crustaceans (kg cm <sup>2</sup> ) | 5.41   | 4.73   | 4.81   | 6.18   | 5.96   | 7.36   | 5.48      | 8.06   |
| pH  | 5.04   | 4.92   | 4.06   | 4.62   | 4.62   | 4.62   | 4.58      | 4.87   |
| Soluble Solids content (%)                        | 14.93  | 15.53  | 14.41  | 11.83  | 12.43  | 16.90  | 12.40     | 14.83  |
| Acidity (%)                                       | 2.00   | 1.02   | 5.66   | 2.64   | 3.93   | 3.74   | 1.74      | 1.70   |
| Vitamin C (mg/ 100g FW)                           | 0.33   | 0.77   | 0.45   | 0.76   | 0.43   | 0.57   | 0.30      | 0.06   |