

## EVALUATION OF YIELD AND FRUIT QUALITY OF SOME APPLE CULTIVARS GRAFTED ON DIFFERENT ROOTSTOCKS

Aydin Uzun <sup>1\*</sup>, Ahmet Kantemiz <sup>1</sup>, Hasan Pinar <sup>1</sup>

<sup>1</sup> Erciyes University Department of Horticulture, Kayseri, Turkey



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### Abstract

Apple (*Malus domestica* Borkh.) is one of the most economically important pome fruits worldwide and Turkey. Domesticated apples have been cultivated since ancient times and are now produced in a range of area from Siberia with freezing temperatures to some equatorial locations with high temperatures. Using rootstock is one of the most important factors in apple cultivation and adaptation to stress conditions. Rootstock also affects yield and fruit quality. In this study, the effects of dwarf and semi-dwarf rootstocks on different apple cultivars were investigated in Kayseri-Turkey conditions. Three rootstocks (M9, M26, MM106) and four apple cultivars (Braeburn, Granny Smith, Spur Golden, Starking Delicious) were used in the study. The plants used in the study are 4 years old. Rootstocks effects of yield, fruit weight, fruit length, fruit width and total soluble solids of apple cultivars were investigated. There were significant differences for investigated characters except fruit width among studied rootstock/scion combinations. Braeburn/M9 combination was the best one for yield (23.4 kg/tree) whereas Starking/M9 had the lowest value (10 kg/tree). Fruit weight of combinations ranged between 169.6 (Granny Smith/M26) and 196.7 g (Spur Golden/M26). This study conducted that rootstocks effected (positively or negatively) yield and fruit quality of apple cultivars.

Keywords: fruit characteristics, *Malus* spp, rootstock, yield

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### 1. INTRODUCTION

The apple belongs to the genus *Malus* from the sub-family Pomoideae of the Rosales family, Rosaceae family. *Malus* genus in Asia, Europe, the United States and other countries are growing more than 30 species (Özbek, 1978). It has been reported that apple cultivation has been carried out in Asia and Europe since prehistoric times (Özçağiran et al., 2004), and that apples were cultivated more than 4000 years ago (Özbek, 1978). Four major gene centers have been identified in the world for apples, namely East Asia, Central Asia, North America and West Asia - Europe (Özbek, 1978). Anatolia is located in West Asia - Europe gene center.

Apple, the most produced temperate zone fruit. More than 83 million tons of apples are produced in the world. Turkey is one of the major producing countries and production is more than 3 million tons. It is seen that Turkey production has increased regularly over the last twenty year period (FAO, 2017).

One of the main conditions of efficient and quality apple production is the use of a rootstock. In addition to forming the subsoil part of the plant, rootstocks ensure that the soil is attached to the soil, water and nutrients are taken from the soil and transmitted to the crown and photosynthesis products and hormones are transported to the roots. Rootstocks effects cultivars on the growing character, early crop yield, yield and fruit quality, adaptability to different soil types and biotic-abiotic stress resistance has many factors such as resistance (Jackson, 2003). Rootstock is used for

the positive effects on tree development, adaptation to soil conditions, resistance to diseases and pests, fruit yield and quality (Castle et al., 2010).

Although generative rootstocks can be used in fruit growing, modern orchards are generally established with clonal rootstocks. Especially in the presence of different strength clonal rootstocks in apple cultivation, provides a wide range of rootstock selection (Ercişli et al., 2000). Vegetatively produced dwarf and semi-dwarf clone rootstocks have significant advantages over seed propagated rootstocks. Some of these advantages are; planting frequency and profitability is higher, labor and other production costs are lower (Özongun et al., 2016). On the other hand, rootstock can affect the productivity and lifetime of the orchards. Modern orchards are established on dwarf and semi-dwarf rootstocks (Gjamovski and Kiprijanovski, 2011).

In this study carried out in Kayseri province located in Central Anatolia, the effects of different rootstocks on yield and fruit quality of some apple cultivars were investigated. The results of the study can be used for recommendations for this region.

## **2. MATERIALS AND METHODS**

The study was carried out on Granny Smith, Starking Delicious, Spur Golden and Braeburn apple cultivars grafted on M9, M26 and MM106 rootstocks.

The trees used were 6 years old, each combination had 4 replicates and each repetition had one tree. The fruits were harvested in mid-October, the harvest period of the cultivar and the following characteristics were examined in 20 fruits taken from each tree. Yield (kg/tree), fruit weight (g), fruit length (mm), fruit width (mm), the amount of total soluble solids (TSS) (%), total acidity (TA) (%). The data obtained from the study were averaged and standard deviations were calculated in Excel program.

## **3. RESULTS AND DISCUSSION**

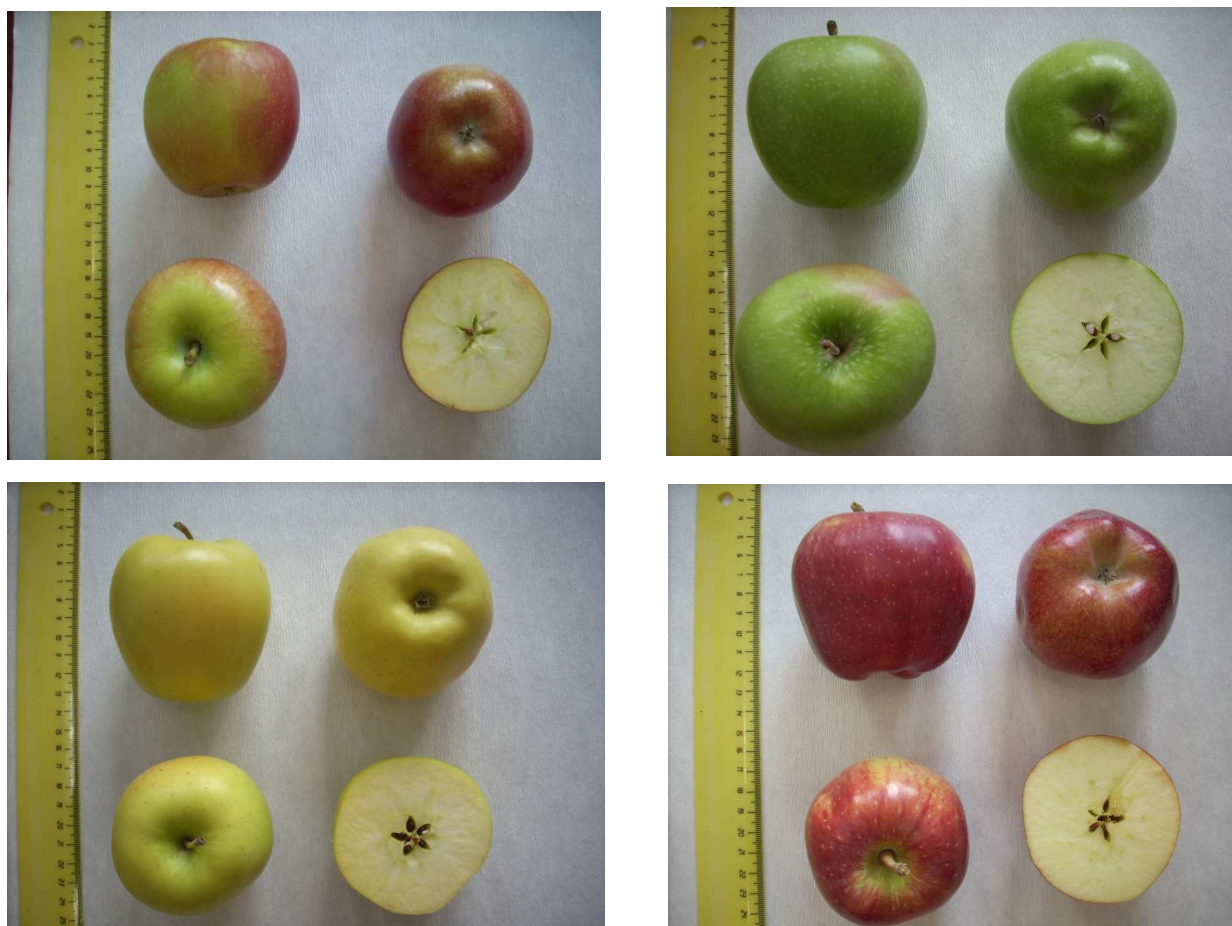
According to the findings obtained in the study, differences were found in terms of fruit characteristics in rootstock/scion combinations. The highest fruit weight was found for Spur Golden cultivar grafted on M26 rootstock. For cultivars grafted on M9 rootstock, average fruit weights was determined between 180 g (Braeburn) and 184.4 g (Starking D.), fruit length between 69.1 mm (Braeburn) and 65.5 mm (Starking D.), fruit width 73.3 mm (Braeburn) and 77 mm (Starking D.) (Table 2). Fruit weight of Braeburn cultivar grafted on MM106 rootstock 177.7 g, fruit length 65.2 mm and fruit width was determined as 73.6 mm (Table 1). The lowest fruit weight was obtained from Granny Smith (169.6 g) grafted on M26 rootstock. For M26 rootstock, fruit length ranged between 68 mm (Granny Smith) and 71.1 mm (Spur Golden), fruit width 73.8 mm (Granny Smith) and 76 mm (Spur Golden) (Table 2). TSS ratio of rootstock/scion combinations varied between 9.5 (M26/Granny Smith) and 12.8 (MM106/Braeburn). In general, Braeburn had the highest TSS ratio even on different rootstocks. Figure 1 presented some images from different rootstock/scion combinations.

Fruit characteristics of apple cultivars also showed differences in another studies. Fruit weight of Granny Smith grafted on MM 106 was found 165.45 g, fruit length was 6.32 cm, and fruit width was 6.94 cm (Akça and Sağlam, 1999). In Yalova conditions, 20 apple cultivars grafted on MM106 rootstock, Braeburn had the lowest fruit width (6.98 cm), and Enterprise had the highest value (8.60 cm) (Burak et al., 2003). Among 7 apple cultivars grafted on MM106, the highest fruit weight was determined in Granny Smith (169.5 g) and Jonagold (153.5 g) cultivars while the lowest fruit weight was found in Starkrimson (122.8 g) cultivars (Soylu et al., 2003). The average TSS ratio in apple cultivars grafted on MM106 rootstock in Bursa ecological conditions was determined

between 12.9% -15.8% (Soylu et al., 2003). Fruit weight of Auksis cultivar grafted on M9 found as 171 g and TSS ratio of this cultivars found 12.9% in Lithuania (Kviklys et al., 2012). On the other hand average fruit weight of Granny Smith apple cultivars grafted on M26 rootstock was examined as 220 g (Özongun et al., 2016). This result was higher than the value of the same combination in our study.

**Table 1. Rootstock effect on some fruit characters of some apple cultivars**

Rootstock/ Cultivar	Yield (kg/tree)	Fruit Weight (g)	Fruit Lenght (mm)	Fruit Width (mm)	TSS (%)	Acidity (%)
M9/Starking D.	10±2.4	184.4±8	69.1±3.9	77±4.4	11±1	0.39±0.01
M9/Braeburn	23.4±5.1	180±7	65.5±4.1	73.3±3.5	12±0.2	0.84±0.09
MM106/Braeburn	15.6±2.9	177.7±12	65.2±3.8	73.6±4.3	12.8±1.2	0.70±0.08
M26/Granny Smith	10.8±2.6	169.6±10	68±4.6	73.8±5.4	9.5±0.4	0.94±0.07
M26/Spur Golden	17.7±4.5	196.7±14	71.1±6.7	76±6.8	11.8±0.5	0.63±0.10



**Figure 1. Some images of fruits obtained in different combinations in the study (Above: left: MM106/Braeburn; right: M26/Granny Smith; Below: left: M26/Spur Golden; right: M9/Starking Delicious)**

There were differences among the combinations for yield per tree in present study. M9/Braeburn combinations had the highest yield (23.4 kg/tree) whereas, M9/Starking Delicious had lowest value (10 kg/tree). On the other hand, M26/Spur Golden, MM106/Braeburn and M26/Granny Smith combinations provided moderate yield value as 17.7, 15.6, 10.8 kg/tree respectively (Table 1). In the study conducted by Ekinci (2010) under Isparta conditions, the highest yield of Red Chief cultivar was determined at MM106 rootstock (20.62 kg/tree). The lowest yield was determined in M26 rootstock (9.08 kg/tree). Three years average yield of Granny Smith grafted on M9 T984 was reported as 17.6 kg/tree (Gjamovski and Kiprijanovski, 2011). In the study carried out with apple cultivar grafted on M9 rootstock, the highest effective yield value was found in the Gala cultivar (0.40 kg/cm<sup>2</sup>) and the lowest in Jonagold cultivar (0.16 kg/cm<sup>2</sup>). This value was 0.22 kg/cm<sup>2</sup> in Braeburn cultivar (Baytekin and Akça, 2011).

#### 4. CONCLUSIONS

Rootstock use has a significant effect on yield and fruit quality. Different results obtained from the studies may be originated from rootstock/cultivar, ecology, cultural practices, fertilization, diseases and pests. The results obtained from present study may guide the selection of appropriate cultivars and rootstocks for Kayseri conditions.

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