

Effect of Some Quince Rootstocks on Inflorescence Properties, Flowering and Fruit Set in Loquat (*Eriobotrya japonica* Lindl.)

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ABSTRACT

The present investigation was conducted to determine the effect of different quince clone rootstocks on phenological characteristics, flowering and fruit set ratios of Hafif Çukurgöbek (HCG) loquat variety. 'HCG' variety budded on Quince-A, Quince-C and BA-29 rootstocks were planted at 1.0 m × 0.5 m inter and intra-row spacing, respectively, was used for the study. The experiment was arranged as a completely randomized design with 5 replications and 6 plants were used in each replicate. The effects of the quince rootstocks on phenological observations such as the flowering periods and the inflorescence characteristics were recorded. The HCG cultivar which are grafted on all three rootstocks completed the flowering between 11 December and 31 January. The first flowering and fruit set were recorded at the earliest in BA-29, and the latest in Quince-C. Fruit ripening was occurred at the earliest in BA-29 rootstock (May 11), followed by Quince-C (May 18) and Quince-A (May 19). The effect of rootstocks on the number of flower buds and flowers in the cluster, and the number of final fruit set were found significant. In terms of all three features, higher values were obtained in Quince-C rootstock. Quince-A rootstock yielded the lowest value in the ratio of fruit harvested in both years, Quince-C and BA-29 gave close values to each other. As a result, BA-29 and Quince C rootstocks performed better than Quince-A rootstock.

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Bazı Ayva Anaçlarının Yenidünyada(*Eriobotrya Japonica* Lindl.) Salkım Özellikleri, Çiçeklenme ve Meyve Tutumu Üzerine Etkileri

ÖZET

Bu araştırma, farklı ayva klon anaçlarının Hafif Çukurgöbek (HCG) yenidoğya çeşidinin fenolojik özellikleri, çiçeklenme ve meyve tutum oranları üzerindeki etkisini incelemek amacıyla yapılmıştır. Denemede; Quince-A, Quince-C ve BA-29 ayva anaçları üzerine aşılı, 1.0 m x 0.5 m sıra arası ve sıra üzeri aralıklarla dikilmiş HCG yenidoğya çeşidi kullanılmıştır. Deneme tesadüf parselleri deneme desenine göre 5 tekerrürlü kurulmuş ve her tekerrürde altı bitki yer almıştır. Ayva anaçlarının, çiçeklenme dönemleri ve çiçek salkım özellikleri gibi fenolojik gözlemlere etkileri kaydedilmiştir. Her üç anaç üzerine aşılı HCG çiçeklenmesini 11 Aralık-31 Ocak arasında tamamlamıştır. İlk çiçeklenme ve meyve tutumu en erken BA-29'da, en geç Quince-C'de gerçekleşmiştir. Meyve olgunlaşması, en erken BA-29 anacında(11 Mayıs) olurken, bunu Quince-C(18 Mayıs) ve Quince-A (19 Mayıs) izlemiştir. Anaçların, salkımdaki çiçek tomurcuk sayısı, salkımda açan çiçek sayısı ve derimi yapılan meyve sayısı üzerine etkisi önemli bulunmuştur. Her üç özellik bakımından Quince-C anacında daha yüksek değerler elde edilmiştir. Her iki yılda da derimi yapılan meyve oranında en düşük değeri, Quince-A anacı vermiş olup, Quince-C ve BA-29 birbirlerine yakın değerler vermişlerdir. Sonuç olarak, BA-29 ve Quince-C anaçları, Quince-A anacından daha iyi performans göstermiştir.

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INTRODUCTION

Loquat has specific climatic requirements for bud initiation and flowering compared with other subtropical fruit species. Loquat usually flowers in autumn and early winter and the fruits ripen in spring when most other subtropical fruits are just in flowering or setting fruits. Loquat trees that flowers in winter are harvested 152-189 days after full bloom (Lupescu et al., 1980).

Loquat (*Eriobotrya japonica* Lindl.) is propagated mainly by budding method, and when it is budded mostly loquat seedling is used as rootstock. Loquat trees on the seedling rootstocks are very tall (5-10 meter) and large crowned. There are several difficulties of established an orchard with such large trees. First of all, the number of trees that can be planted per unit area is limited and also, operations such as pruning, spraying and fruit picking are difficult and its cost is high (Polat, 1995; Crane and Caldeira, 2019). It is necessary to control the vegetative growth to reduce the cost of management. High density planting with small crowned trees makes easy to prune, spraying, thinning and especially for fruit picking. In addition, these trees produce quality fruits with high and marketable value.

Dwarfing rootstocks are used in different fruits, especially for apples and pears for many years (Faust, 1976; Hartmann and Kester, 1983). Use of dwarfing rootstock is considered of great importance in intensive loquat cultivation. Loquat trees on dwarf rootstock provide the opportunity to plant more trees per unit area that also produced higher yield in a unit area (Polat et al., 2003).

Some researchers suggest that loquat seedling, quince and pyracantha can be used as rootstocks for loquat (Ochse et al., 1961; Hızal et al., 1982); when quince is used as rootstock. They observed that the trees were fruiting early and ripening earlier, the fruits were larger and of higher quality (Demir, 1987; Polat and Kaşka, 1992a; Polat, 1995). Studies conducted by Polat and Kaşka (1992a, 1992b) and Polat (1996), showed that quince rootstock reduce loquat tree size by 20-25% compared to loquat seedling rootstock. Polat et al. (2004) reported 3 to 4 times higher yield from high density planting compared with using standard planting distances. They also stated that it would be appropriate to evaluate the effect of quince rootstocks, especially BA-29 rootstock, in high density planting trials.

In the literature, there are no study on effects of quince rootstocks on the flower phenology and fruit set in the loquat were examined detailed. The present

investigation was taken up to study, the effect of Quince-A, Quince-C and BA 29 quince clone rootstocks on phenological properties, flowering and fruit set for the first time. This forms the original aspect of the research and shows its importance.

MATERIAL and METHOD

Material

This study was carried out in the loquat orchard in Hatay (36°12'E and 36°52'N, 80 elevation), located on the coast of the Mediterranean region of Turkey during 2018 and 2019. Two-year-old plants of 'HCG' variety budded on BA-29, Quince-A and Quince-C quince rootstocks were used for the study. These plants were planted at high density with planting spaces of 1.0 m x 0.5 m in January 2017. For each plant 60 g pure N (300 g ammonium sulphate) from February to July was given 4 times (75 g with each irrigation) with irrigation, and regular technical and cultural maintenance processes and shaped with the pruned to an open-center system.

Method

Thirty plants were selected from each rootstock to study the flowering periods and the fruit set rate of the cultivar on different rootstocks. Then, a branch was selected randomly from the four sides of the canopy of these plants and they were tagged accordingly. All observation regarding flowering and fruit set were made from these branches.

Observations on flowering periods

Observations about flowering were made at 3 days' intervals since the first bud swelling began to appear. In this context, the beginning of flowering, first flowering, full bloom, end of flowering and fruit set dates were recorded. These observations were made according to Durgac et al. (2006) and Polat (2018).

Observations on inflorescences

Observations were made at an intervals of 3 days on average after the clusters of the branches were seen. Inflorescence characteristics such as peduncle numbers in cluster, number of flower buds in cluster, number of flowers in cluster, the number of fruits set in cluster, and the number of harvested fruits. These observations were made according to Polat (2007).

Observations on flowering and fruit set ratios

Percent blossom ratios, initial fruit set (%), and final fruit set (%) were recorded under each of the rootstocks during the experimental period. These

observations were made the methods suggested by Westwood (1995) and Polat (2007 and 2015).

Evaluation of the data

The experiment was laid out following a completely randomized designed (CRD). In the study, 30 plants were used each in rootstock and each 6 plants were considered as one replicate. The percent values were transformed ($\sqrt{\arcsin}$) to increase normality. Variance analysis was performed with MSTAT-C statistical software and means were compared by Tukey test at the 0.01 or 0.05 level (Steel and Torrie, 1980).

RESULTS

Flowering Periods

The findings of 2018-2019 regarding the effects of quince rootstocks on the flowering properties of the

HCG variety are presented in Table 1.

The HÇG variety which are grafted on all three rootstocks completed the flowering between 11 December and 31 January. The first flowering and fruit set were recorded on the plants with BA-29 rootstock (11 December and 13 February, respectively), and the latest in plants with Quince-C rootstock (15 December and 17 February, respectively). Fruit ripening was occurred the earliest on plants with BA-29 rootstock (May 11), followed by Quince-C (May 18) and Quince-A (May 19) (Table 1).

Inflorescences Properties

According to the two-year average, the highest values in terms of the number of peduncle, flower buds, flowers and final fruits were obtained from the plants raised on Quince-C rootstock (Table 2).

Table 1. The effects of quince rootstocks on the flowering properties of the HCG variety (2018-2019 average).

Çizelge 1. Ayva anaçlarının HÇG çeşidinin çiçeklenme özellikleri üzerine etkileri (2018-2019 ortalaması).

Rootstock Anaç	Beginning of blossoming Çiçeklenme başlangıcı	Date of first flowering İlk çiçeklenme	Full Bloom Tam çiçeklenme	End of blossoming Çiçeklenme sonu	Fruit Set Meyve tutumu	Date of fruit ripening Meyve olgunlaşma tarihi
Quince-A	23 Nov.	14 Dec	18 Jan	31 Jan	17 Feb	19 May
Quince-C	21 Nov.	15 Dec	10 Jan	23 Jan	17 Feb	18 May
BA-29	22 Nov.	11 Dec	11 Jan	25 Jan	13 Feb	11 May

Table 2. The effects of quince rootstocks on the flowering and inflorescences properties of the HCG variety (2018-2019 average).

Çizelge 2. Ayva anaçlarının HÇG çeşidinin çiçeklenme ve salkım özellikleri üzerine etkileri (2018-2019 ortalaması).

Rootstock Anaç	No. of peduncle per cluster Salkımdaki somak sayısı (adet)	No. of flower buds per cluster Salkımdaki çiçek tomurcuğu sayısı (adet)	No. of flowers per cluster Salkımda açan çiçek sayısı (adet)	No. of Initial fruits Salkımdaki ilk meyve tutumu (adet)	No. of small fruits Küçük meyve tutumu (adet)	No. of Final fruits Derimi yapılan meyve (adet)
Quince-A	17.67±0.93	128.02±0.11c ^(s)	102.51±0.94c	17.60±1.24	9.89±0.53	2.71±0.28b
Quince-C	19.44±0.61	156.52±4.45a	143.82±2.34a	16.55±1.37	9.26±0.44	7.51±0.24a
BA-29	16.68±0.25	143.17±0.40b	132.63±0.85b	15.80±1.10	8.62±0.50	6.54±0.32a
HSD	NS ^(y)	*	**	NS.	NS.	*

(s) Different letters within columns are indicate significant difference by Tukey's test at P < 0.05 or P < 0.01.

*: Stunlardaki farklı harfler Tukey testine göre % 1 veya % 5 düzeyinde önemli farklılığı göstermektedir.

** : Significant at P < 0.01; * : Significant at P < 0.05; ^yNS: Not significance

** : % 1' de önemli P < 0.01; * : %5'te önemli P < 0.05; ^yNS: Önemli değil

While the Quince-A rootstock showed the higher values in terms of the initial fruit set and small fruit set, it gave the lowest value in terms of the number of final fruits set. However, these differences between rootstocks were found to be statistically significant only in terms of the number of flower buds in the cluster (P < 0.05), the number of flowers in the cluster (P < 0.01), and the number of final fruit set (P < 0.05). The differences between the rootstocks in terms of other characteristics were not significant.

Flowering and Fruit set rates

The results of statistical analysis on the effects of quince rootstocks on the flowering and fruit set rates of the HCG variety are given in Figure 1 and 2.

The highest blossoming rate (92.65%) was recorded in plants grafted on BA-29 rootstock and the lowest rate (80.07%) was in the plants grafted to the Quince-A rootstock (Figure 1). In terms of the initial fruit set ratio in the cluster, the Quince-A rootstock showed

higher value than the other two rootstocks (Figure 2). These differences between rootstocks were found to be statistically significant at $P < 0.05$ level. In term of

the small fruit set and fruit harvested, although there were differences between rootstocks, these differences were not statistically significant.

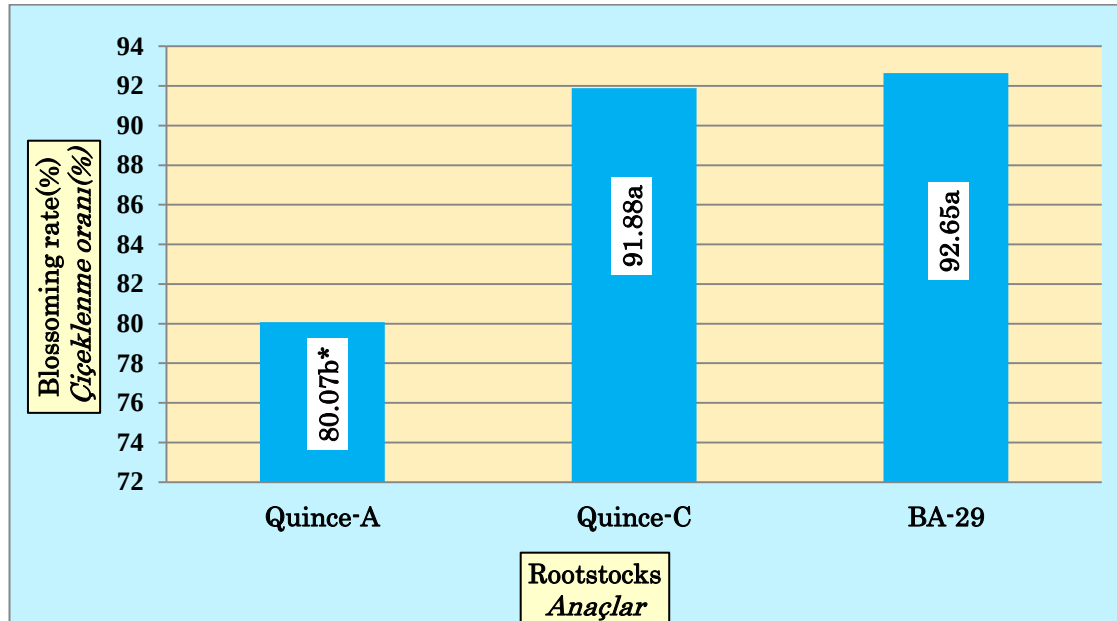


Figure 1. The effects of quince rootstocks on the flowering rates of the HCG variety.

*: Different letters on the bars indicate significant differences by Tukey's test at $P < 0.05$.

Şekil 1. Ayva anaçlarının HCG çeşidinin çiçeklenme oranları üzerine etkileri

*: Klonlardaki farklı harfler Tukey testine göre % 5 düzeyinde önemli farklılığı göstermektedir.

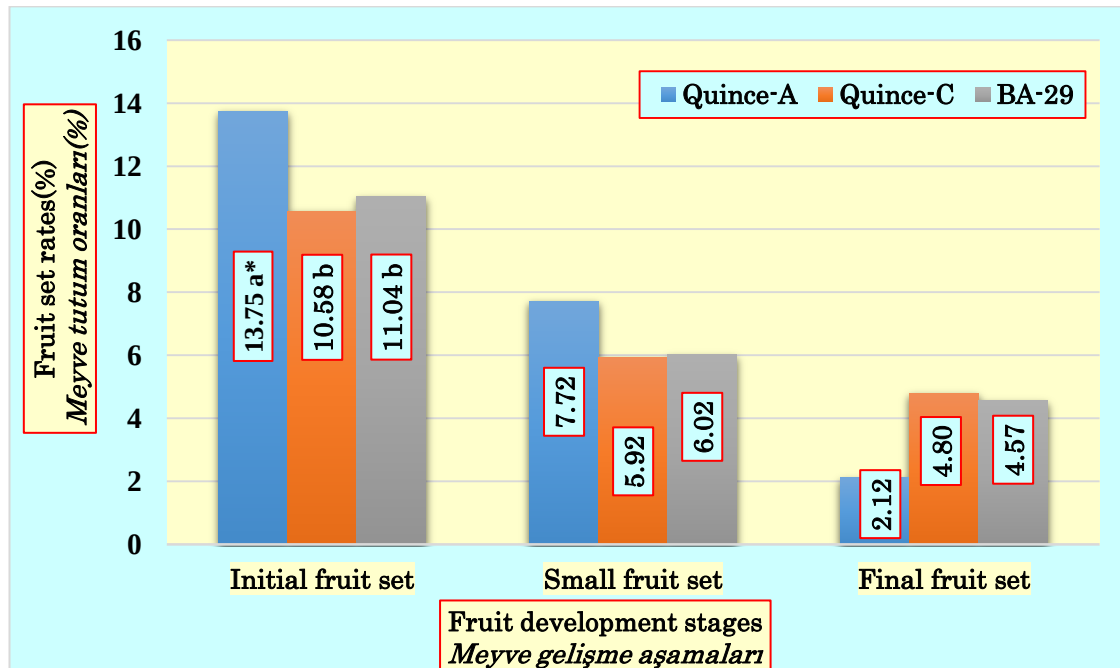


Figure 2. The effects of quince rootstocks on the fruit set rates of the HCG variety.

*: Different letters on the bars indicate significant differences by Tukey's test at $P < 0.05$.

Şekil 2. Ayva anaçlarının HCG çeşidinin meyve tutumu üzerine etkileri

*: Klonlardaki farklı harfler Tukey testine göre % 5 düzeyinde önemli farklılığı göstermektedir.

CONCLUSION

Reducing of vegetative growth is very important in loquat cultivation because of its very high tree size. The most effective method for this is the use of

dwarfing rootstocks such as quince (*Cydonia oblonga*). In this study, the effect of Quince-A, Quince-C and BA 29 quince clone rootstocks on phenological properties, flowering and fruit set rates of the HCG variety was studied in detail for the first time. Results obtained

from this research revealed that dwarf quince rootstocks such as Quince-A, Quince-C and BA-29 can be used in intensive loquat cultivation. However, it is of great benefit to continue the further work to make a definitive judgment about the possibilities of using BA-29, Quince-A and Quince-C rootstocks as new dwarfing rootstocks. Therefore, researches need to be continued, especially to determine all the characteristics regarding yield and fruit quality.

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Contribution of the Authors as Summary

Authors declares the contribution of the authors is equal.

Statement of Conflict of Interest

Authors have declared no conflict of interest.

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