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NURSERY PERFORMANCE of APPLE NURSERY PLANTS in DIFFIRENT ECOLOGICAL CONDITIONS*

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Abstract:

The aim of this study is to determine the nursery development performance of Red Chief and Golden Smoothee plants grafted on MM106 and M9 apple rootstock in Isparta and Aydın/Söke. An open field and under-cover in Isparta and an open field in Aydın/Söke were chosen to conduct the study. The open field nursery in Isparta was determined as control group. The open field nursery in Isparta and the nursery in Söke/Aydın (openfield) were compared in respects of morphologic parameters such as treeheight, number of lateral shoots, length of lateral branches, angle of branches, height of the fistshoots, treediameter and number of roots. At the end of the study, it was concluded that the field in Aydın/Söke reached the highest values in respect of all parameters. On the other hand, the nursery in Isparta (under-cover) with high land climate reached similar values in respect of morphologic parameters with the nursery in Söke (openfield). ***This paper is produced from M.Sc. Thesis.**

KeyWords: Malus x domestica, climate, rootstock, variety

INTRODUCTION

Apple (MalusdomesticaBorkh) is one of the most important fruit species among temperate climate fruits. It is estimated that apple's motherland is South Caucasus, including Anatolia.In modern fruit growing, dwarf rootstocks are used with the aim of making more use of unit area, reducing costs, shortening the period of youth infertility, increasing efficiency and raising high quality fruit. Many studies have been carried out in recent years in order to reduce the cost of growing saplings, especially with dwarf rootstocks(Howard vd. 1974; KüdenandKaşka 1995; Küden, 1995).Using clone rootstocks like M9, M27, M26, M7 and MM106, quality and abundant fruits can be obtained from the first years of planting. Also; cultivation processes such as pruning, spraying, dilution and harvesting are realized more easily(Seferoğluet al/k., 2006).

Thanks to new rootstocks and varieties it is very important to produce nursery plants in 1 year(Özongunet al. 2002).It is very important to abbreviate the seedlings in the sapling production and standardize the seedlings(Bağcı, 2002).Sowing of branched seedlings provides

yield and high yield at early ages. It is considered a necessity to use well-branched seedlings in intensive plantings made with dwarf rootstocks(Quinlan andTobutt, 1990; Hrotkoet al., 1996).

In this study, the effects of different ecologies (Aydın open field, Isparta under-cover and Isparta open field) on branching in an one years old apple seedlings were investigated in two different rootstock / varieties combination (Golden Smothee seedlings over M9, and Red Chief seedlings over MM106).Seedlings in Isparta open field parcels were determined as control. In this study, morphological parameters such as seedling length, branch numbers, branch lengths, first branch heights, stem diameter and number of roots were determined in the Isparta under-cover and Söke adaptation parcels.

MATERIAL AND METHODS

The research was carried out in 2011 in Isparta (under-cover and open field) and Söke/Aydın (open field). In the study, Golden Smoothee grafted on M9 rootstocks and Red Chief grafted on MM106 rootstocks seedlings was used. A high tunnel was used to provide under-cover conditions in this research. The seedlings were removed from the cold air store at the beginning of March and planted at 50x30 distance between rows. The seedlings were planted in March of the following year, with the test plots as 100 cm between rows and 50 cm above the rows. The seedlings were cut at 60 cm from the ground.

The nursery plants grown in our research were found the seedlings height (cm), the first branch height (cm), the number of lateral branches (number / seedlings), lateral branch length (cm), seedlings diameter (mm). In addition, temperature and humidity were determined at all locations.

RESULTS AND DISCUSSION

The temperature values determined at all locations during the study were compared. It has been observed that air temperatures in Isparta (under-cover) and Söke (open field) have close values. The average temperature was determined to be 23.5 ° C during the cultivation of Isparta (under-cover) and 20.5 ° C in Söke (open field). The average temperature in Isparta (open field) is 14.91 °C (Table 1).

In fruit seedlings, height is an important quality feature and height seedlings are preferred.The seedlings identified in our study are also presented in the Table 2. Seedlings heights were determined that the Isparta (under-cover) and Söke (open field) were higher than control (Isparta open field) seedlings. The obtained data are consistent with the values reported in the literature(Karamürsel (2008), Bağcı (2002)).The highest seedlings height was found in the Golden Smoothee varieties with 169.52 cm in under-cover growth treatment (Table 2). The Golden Smoothee variety has been found to have a higher developmental performance than the Redchief variety. This is explained by the fact that the development performances of the varieties are different from each other.

Table 1.Temperature values of Isparta, Söke and Isparta under-cover (°C)

Months	Isparta	Isparta (under-cover)	Söke (open field)
1	3	9,1	9,6
2	3,8	9,4	10,8
3	6,4	13,5	12
4	10,1	18,6	15
5	14,1	26,2	20,1
6	19,5	27,8	25,2
7	24,6	30,5	28,5
8	24	32,6	28,4
9	20	30,1	25,6
10	11,3	19,9	17,5
11	4,2	12,7	12,3
12	2,4	10	10,5

Table 2.The effect of treatments on the height of seedlings

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chef	86,648$^{\pm}$0,983B* b**	136,82$^{\pm}$2,00Ab	136,20$^{\pm}$1,91Ab	110,15$^{\pm}$ 1,32
G. Smoothee	132,37$^{\pm}$0,657Ca	169,52$^{\pm}$1,49Aa	155,37$^{\pm}$1,87Ba	145,97$^{\pm}$ 0,919
Mean109,95$^{\pm}$1,08		153,17$^{\pm}$1,62	145,79$^{\pm}$ 1,45	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

When the effects of the different locations used in the study on the branch length were examined, the highest branch length in the Red Chief variety was obtained in the Isparta (under-cover) while the highest branch length in the Golden Smoothee variety was determined in the Söke (open field). At both locations the lowest value belongs to the control group (Table 3). The results we obtained are consistent with the literature (Miao and Dong (1988), Bağcı (2002), Karamürsel (2008), Kamiloğlu (2010)).

Table 3. The effect of treatments on the length of branches

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chef	86,648$^{\pm}$0,983B* b**	136,82$^{\pm}$2,00A b	136,20$^{\pm}$1,91A b	110,15$^{\pm}$ 1,32
G. Smoothee	132,37$^{\pm}$0,657Ca	169,52$^{\pm}$1,49Aa	155,37$^{\pm}$1,87Ba	145,97$^{\pm}$ 0,919
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Segura et al., (2007) were identified the wood branches as branches generally longer than 20 cm (Atay, 2012). In our study, branch lengths were determined as longer than 20 cm and shorter than 20 cm. Golden Smoothee varieties in Isparta (under-cover) and Red Chief varieties in Söke (open field) have the highest values. In this study, branches of 20 cm were evaluated as "bun" and "short fruit branches". In literature, branches shorter than 5 cm are defined as "bun" and branches longer than 5 cm are defined as limbs (Lauri et al., (1997), Costes et al., (2003)). In the under-cover conditions, the Golden Smoothee variety gave the best results in terms of number of branches (average 2 pieces) under 20 cm(Table 4, Table 5).

Table 4. The effects of treatments on the branches which is longer than 25 cm

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	0,8636±0,0608	0,8000±0,0827	0,2800±0,0435	0,6934±0,0393b**
G. Smoothee	1,1969±0,0777	1,128±0,108	0,5510±0,0581	1,0220±0,0511a
Mean	1,0396±0,0505A*	0,9640±0,0686A	0,4141±0,0370B	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

Table 5.The effects of treatments on the branches which is shorter than 25 cm

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	1,7832± 0,0696 B* b**	4,032±0,134 A b	3,993 ±0,154 A a	2,8752±0,0777
G. Smoothee	3,2844 ±0,0714 B a	5,752±0,162 A a	2,340± 0,126 C b	3,5709±0,0777
Mean	2,5759 ±0,0585	4,892 ±0,118	3,175± 0,110	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

The branch angle has a local effect on vegetative growth and fruit production (Autio and Greene, 2010). Golden Smoothee varieties have the highest values at all locations in terms of branch angle average in our research. It has been observed that the Golden Smoothee variety tends to form a high branches number and a wide angle branches (Table 6).

Table 6.The effect of treatments on the branches which is wide angle

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	0,7042 ±0,0620 B* b**	3,008± 0,146 A b	2,663± 0,140 A a	1,7370± 0,0740
G. Smoothee	3,2406± 0,0904 B a	4,400 ±0,160 A a	2,600 ±0,120 C a	3,3227 ±0,0709
Mean	2,0480± 0,0761	3,704±0,117	2,6167 ±0,0922	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

In our research, Red Chief varieties have high values in Söke (open field) in terms of number of branches with wide angle. The Golden Smoothee variety has the highest values in the under-cover (Isparta) conditions. The ecological conditions in under-cover (Isparta) and Söke (open field) have encouraged the formation of wide angle side branches.

Table 7.The effect of treatments on the branch which is narrow angle

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	1,9613± 0,0688A* a**	1,8160±0,0953ABb	1,6867±0,0923Ba	1,8551±0,0480
G. Smoothee	1,2437 ±0,0598Bb	2,496± 0,133Aa	0,2333 ±0,0395Cb	1,2521± 0,0538
Mean	1,5811± 0,0475	2,1560± 0,0845	0,9600± 0,0654	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

In apples, the highest shoot growth occurs in upright shoots (Myers and Ferree, 1986). The Golden Smoothee variety comes out on the foreground in terms of the number of narrow angle branches in Söke (open field). It has been observed that the seedlings grown in Söke (open field) tend to produce fewer narrow-angle seedlings (Table 7).

The first branch height should be about 60-80 cm in branchy plants (Anonymous, 2011). Bolat (1993) determined the first branch heights of one year old seedlings between 33.5 and 33.84 cm. In the study we did, the first branch heights in Isparta open field (control) conditions were lower than in other locations. The data we obtain is consistent with the literature (Table 8).

Table 8. The effects of treatments on first branch height

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	34,349± 0,729B* b**	43,576± 0,979Ab	37,36 ±1,08Bb	37,194 ±0,540
G. Smoothee	37,816 ±0,675Ca	51,774± 0,948Aa	46,75± 1,23Ba	42,973± 0,569
Main	36,171± 0,500	47,659 ±0,728	42,071± 0,864	

*The differences between the averages in the same line are statistically significant ($p \leq 0.05$)

**The differences between the averages in the same column are statistically significant ($p \leq 0.05$)

Wertheim et al. (1995) reported that both the thickness and the number of lateral branches in the seedlings had a significant effect on the early yield (Anonymous, 2011). Many researchers have been reported that the yields are increase when the thickness increasing in the first 4-5 years (Barrit, 1992, Ferree and Rhodus, 1987; 1978; Wertheim et al., 1995). However, it is preferred that the optimal diameter of nursery plants is 15-20 mm (Anonymous, 2011).In terms of this feature, Golden Smoothee has the best result (16,681mm) in Isparta (under-cover). The Red Chief variety has the highest thickness value (20,576 mm) in Söke (open field) (Table 9). Karamürsel (2008) reports that the shoot diameter is 10,71 mm in the under-cover and 6,84 mm in the open field. Shoots lengths are reported by the same researcher as 120.43 cm and 84.87 cm (respectively under-cover and open field). Our data are consistent with the literature.

Table 9. The effects of treatments on the branch thickness

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	12,006± 0,159C* b**	17,200± 0,179Bb	20,576±0,254Aa	15,325± 0,190
G. Smoothee	15,259± 0,0972Ba	16,681± 0,177Aa	16,537± 0,205Ab	15,878± 0,0867
Main	13,666± 0,113	16,942± 0,127	18,557± 0,200	

*The differences between the averages in the same line are statistically significant ($p \leq 0.05$)

**The differences between the averages in the same column are statistically significant ($p \leq 0.05$)

The number of lateral branches, lateral branch angle and seedling height are very important for early and high yield (Barritt, 1992; Hrotko et al., 1996). In our study, under-cover conditions were found to promote the formation of lateral branches. However, varieties with different branch numbers in the under-cover conditions can be explained by the fact that each variety has its own potential for creating lateral branches (Table 10). This results are in line with the literature (Yıldırım and Kankaya (2004)).

Table 10. The effect of treatmentson the branches number

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	2,6761± 0,0888C* b**	4,828±0,162Ab	4,408± 0,150Ba	3,6169 ±0,0815
G. Smoothee	4,4938± 0,0944Ba	6,919± 0,174Aa	2,878± 0,116Cb	4,5980± 0,0891
Main	3,3691± 0,0749	5,867 ±0,136	3,641± 0,105	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

There is a balance between the under-ground part of the trees and the over-ground part of the trees. The reduction in the amount of any one slows down the development of the other (Taylor and Ferree, 1981). The Red Chief variety in terms of number of roots has the highest number of roots in all locations. Both varieties have a maximum number of roots in the under-cover conditions (Table 11). These results are consistent with the literature (Uchio et al. (1989).

Table 11. The effects of treatments on the root number

	Control	Isparta (under-cover)	Söke (open field)	Mean
Red Chief	6,990± 0,269C* a**	18,448± 0,480Aa	11,458± 0,311Ba	12,584± 0,317
G. Smoothee	5,530± 0,123Bb	11,280± 0,397Ab	3,497± 0,148Cb	6,659± 0,230
Main	6,264± 0,157	14,864± 0,385	7,503± 0,289	

*The differences between the averages in the same line are statistically significant (p≤0.05)

**The differences between the averages in the same column are statistically significant (p≤0.05)

CONCLUSIONS

As a result, it can be said that hot climatic conditions can be provided in the under-cover in the highland climate conditions. In our study, it is seen that the nursery plants can be produced by under-cover in highland climates as quality as in warm climates.

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