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MARA

EFFECTS OF DIFFERENT CUTTING TIMES AND IBA DOSES ON THE ROOTING RATE OF HARDWOOD CUTTINGS OF CORNELIAN CHERRY (Cornus mas L.)

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ABSTRACT: *This research was carried out to investigate the effects of IBA doses and cutting timings on rooting of hardwood cuttings of some cornelian cherry (**Cornus mas** L.) types. Hardwood cuttings were collected on 28.01.1996 and 28.02.1996 and treated with IBA at 2000,4000 and 6000 ppm. The rooting rate, viability rate, callused cutting rate, root number, root length, root diameter and root quality were determined.*

The highest rate of rooting was obtained from cuttings collected in january. In this study, 6000 ppm IBA application gave the best result for rooting hardwood cuttings of cornelian cherry.

Keywords: *Cornelian cherry, **Cornus mas** L., propagation, rooting, cutting, IBA.*

ÇELİK ALMA ZAMANLARI VE IBA DOZLARININ BAZI KIZILCIK (Cornus mas L.) TİPLERİNDE ODUN ÇELİKLERİNİN KÖKLENMELERİ ÜZERİNE ETKİLERİ

ÖZ: *Bu çalışma bazı kızılcık tiplerinde odun çeliklerinin köklenmesi üzerine çelik alma zamanı ve IBA uygulamalarının etkilerini belirlemek amacıyla yapılmıştır. 28.01.1996 ve 28.02.1996 tarihlerinde odun çelikleri alınarak bunlara IBA'in 2000, 4000 ve 6000 ppm dozları uygulanmıştır. Çeliklerde köklenme oranı, canlı kalma oranı, kalluslu çelik oranı, kök sayısı, kök uzunluğu, kök çapı ve kök kalitesi incelenmiştir.*

Bütün tiplerde en iyi köklenme ocak döneminde alınan çeliklerde bulunmuştur. Kızılcıkta odun çeliklerinin köklenmesi üzerine en etkili IBA dozunun 6000 ppm olduğu belirlenmiştir.

Anahtar sözcükler: *Kızılcık, **Cornus mas** L., üretim, köklendirme, IBA.*

INTRODUCTION

Cornelian cherry (*Cornus mas* L.) is an economically important fruit species. It bears fruit regularly, and fruits are rich in nutrients. The fruits contain high ascorbic acid content and are consumed in a variety of ways; as fresh, jelly, compost, juice, jam, syrup or alcoholic beverages (Darrow, 1975; Ivanicka and Cvopa, 1977; Browicz, 1986; Smatana *et al.,* 1988).

According to 1993 statistics, there are 1.585.000 cornelian cherry trees with annual production of approximately 14.000 tons in Turkey (Anonymous, 1995). Although Turkey has a very old tradition of fruit culture, there is no registered variety for cornelian cherry as in the other fruit species. The reason for this is that most of the cornelian cherry trees are grown by seeds. Since it is a cross-pollinated fruit species (Browicz, 1986), a considerable number of cornelian cherry types exist naturally in different regions of Turkey. Yields are generally very low; therefore, propagating of the promising types from selection studies is required to increase production. This can be achieved by growing many saplings in a short period. Plants grown by seeds may differ from their parents in respect to size, shape and fruit quality (Hansen and Hartman, 1958). However, it is possible to produce a number of rooted saplings similar to their parents in a short period of time.

Similar to other fruit species, the protection of genetic characteristics of cornelian cherry may be possible by vegetative production. However, cornelian cherry can not be propagated easily by methods commonly employed in the propagation of other fruit species. Propagation of cornelian cherry by grafting is restricted because it is an expensive and time-consuming method. Poor results were obtained by layering (Ivanicka and Cvopa, 1977), as well. Because of the reasons discussed above, propagation by cuttings should be preferred. Rooted saplings can be produced by cutting in a relatively short period, however, studies on propagation by cutting are inadequate.

In USA, Tichnor (1976) investigated the effects of IBA application on rooting of different species of Cornus and found that there was no positive effect of 0.8 % IBA on rooting of hardwood cuttings.

Ivanicka and Cvopa (1977) obtained that the rooting ratio of hardwood cuttings of three selected cornelian cherry types grown naturally in Slovakia by 2000 ppm IBA application was very low.

In a few studies carried out on the propagation of fruits by cutting in Ukraine it is reported that the application of IBA on cornelian cherry cuttings increased the rate of rooting (Stepanova *et al.,* 1986; Smykov *et al.,* 1987). In another study, Ivanicka (1989) reported that 0.1-0.3 % IBA application enhanced rooting in cornelian cherry cuttings collected in early July.

This study was conducted to determine the effects of different dates of taking cuttings and IBA levels on performance of hardwood cuttings of some cornelian cherry types.

MATERIALS AND METHODS

This study was conducted under greenhouse conditions during 1995-96 winter period at the Atatürk University, Faculty of Agriculture. Perlite was used as rooting media (Fordham, 1972; Kantarcı and Ayfer, 1989). In this study, 3 types of cornelian cherry previously selected from Uzundere-Erzurum (Pırlak, 1993) were utilized. Some characteristics of these types are given below;

25-Uz-33 (1^{st} type): Having medium size fruits (average: 3.408 g) with conical shape and dark red colour that is suitable for table consumption.

25-Uz-39 (2^{nd} type): Medium strength 20-25 years-old tree. Having large and oval fruits. Maturation in late August.

25-Uz-43 (3^{rd} type): Having medium size fruits, fruitful, for industrial use, but could be evaluated also for table.

10-15 cm long hardwood cuttings were collected from 1 year old shoots on 28.01.1996 (1^{st} date) and 28.02.1996 (2^{nd} date), shortly before planting.

In this experiment, IBA levels at 2000, 4000 and 6000 ppm were used to enhance rooting (Ivanicka and Cvopa, 1977; Ivanicka, 1989). Cuttings were planted into the rooting media after immersing 2-3 cm of the basal end the cuttings in IBA solution for 5-10 sec. (Mendilcioğlu and Karakır, 1986; Ünal *et al.,* 1992). Bottom heating in the mist unit was performed automatically with an electrical system and the average temperature was kept at 21ºC. The experimental design was a completely randomized design with 3 replications, each having 10 cuttings. Variance analysis was performed for data evaluation, Duncan and LSD tests were utilised for multiple comparisons (Düzgüneş *et al.,* 1993).

After 4 months from planting; rooting and viability ratios, the ratio of callused cutting, the root number, root diameter, root length and root quality were determined. Roots were classified for their quality using a 0-3 scale; 0:None, 1:Weak, 2:Medium and 3:Strong (Kantarcı ve Ayfer, 1989).

Although, the ArcSin transformation was used on data for statistical evaluation, the real numbers are given in tables as percentages (Düzgüneş ve ark. 1987).

RESULTS AND DISCUSSION

Rooting Rates of Cuttings

The effects of IBA applications and the time of cutting on rooting of hardwood cuttings taken from three types of cornelian cherry are given in Table 1.

Table 1. Effects of different cutting date and IBA doses on rooting rate of some cornelian cherry types (%).

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	16.66 b	6.66 b	10.00 b	3.33	13.33	6.66
2000	26.66 ab	16.66 ab	16.66 ab	6.66	20.00	3.33
4000	30.00 ab	16.66 ab	20.00 ab	10.00	26.66	6.66
6000	46.66 a	20.00 a	23.33 a	13.33	26.66	10.00
D	17.330 (*)	11.810 (*)	8.301 (**)	NS	NS	NS

* $P<0.05$ ** $P<0.01$
NS: Non significant

In all three types, rooting rate increased with the increasing level of IBA in both cutting times. These increases were significant in both periods of the 1st type, the 1st period in the 2nd type and not significant in the others. The rooting rates of the cuttings taken on Jan. 28, 1996 from the first type for control, 2000, 4000 and 6000 ppm IBA applications were 16.66, 26.66, 30.00 and 46.66%, respectively. The same groups of the 2nd type, had 10.00% in the control group whereas 23.33% in 6000 ppm IBA application.

The effect of time on rooting was significant. In all types, rooting was higher in the 1st date than the 2nd and the differences were statistically significant. For instance, in the control group, the rooting rate of the cuttings taken on the first date was 10.00% while it was 3.33% in the 2nd date. On the other hand, 6000 ppm IBA application increased the rooting rate to 23.33% and 13.33% for the 1st and 2nd dates, respectively.

On the average, the rooting rate of the 1st type was 29.99% for the 1st date and 14.99% for the 2nd date (Table 2).

There were statistically significant differences among the rooting rates of different types. Average rooting rates for the types were 22.49, 12.91 and 14.16% for the 1st, 2nd and 3rd types respectively (Table 3).

Table 2. Effects of different cutting dates on root characteristics.

Timing	Characteristics						
	Rooting rate	Sprouting ratio	Callus formation	Number of roots	Root length	Root diameter	Root quality
1st type							
1st	29.99 b	40.83	34.99 b	16.58 b	6.892 b	0.943 b	1.630
2nd	14.99 a	37.49	16.66 a	8.20 a	3.393 a	0.490 a	1.402
	(**)	NS	(**)	(**)	(*)	(**)	NS
2nd type							
1st	17.49 b	26.66	23.33 b	15.12 b	6.872	0.945 b	1.596
2nd	8.39 a	34.16	12.49 a	5.12 a	4.423	0.555 a	1.433
	(**)	NS	(**)	(**)	NS	(**)	NS
3rd type							
1st	21.66 b	25.83 a	23.33 b	16.22 b	6.391 b	0.949 b	1.833 b
2nd	6.66 a	26.66 b	10.83 a	2.79 a	2.579 a	0.440 a	0.875 a
	(**)	(*)	(**)	(**)	(*)	(**)	(**)

* P<0.05 ** P<0.01

Table 3. Rooting characteristics of the studied cornelian cherry types.

Types	Characteristics						
	Rooting rate	Sprouting ratio	Callus formation	Number of root	Root length	Root diameter	Root quality
1st	22.49 a	39.16 a	25.82 a	12.39	5.142	0.717	1.516
2nd	12.91 ab	30.41 b	17.91 ab	10.12	5.648	0.750	1.515
3rd	14.16 b	31.24 b	17.08 b	9.51	4.485	0.695	1.354
LSD	7.768(*)	4.30(**)	4.99(**)	NS	NS	NS	NS

* P<0.05 ** P<0.01
NS: Non significant

Sprouting Rate of the Cuttings

Hormone application increased the sprouting of the cuttings as compared to the control groups, but these increases were significant only for the 1st date of the 2nd type (Table 4) in which the rates were 16.66% for control group, 23.33% for 2000 ppm and 33.33% for 4000 and 6000 ppm IBA applications.

Table 4. Effects of two cutting times and IBA doses on the sprouting rate of some cornelian cherry types (%).

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	36.66	36.66	16.66 b	36.66	20.00	43.33
2000	33.33	36.66	23.33 ab	33.33	23.33	26.66
4000	40.00	36.66	33.33 a	23.33	26.67	30.00
6000	53.33	40.00	33.33 a	43.33	33.33	46.66
D	NS	NS	9.523 (*)	NS	NS	NS

* $P<0.05$
NS: Non significant

Effect of time on the sprouting rates of cuttings was statistically significant only for the 3rd type in which the rate increased from 25.83% to 26.66% for the 1st and 2nd dates respectively (Table 2).

There were statistically significant differences among types in respect to the sprouting rates. The rate of the 1st type was higher than those of the 2nd and 3rd types at the end of the experiment (Table 3).

Callus Formation

Effects of IBA application and the time of cutting on the formation of callus in cornelian cherry types are given in Table 5. The formation of callus generally increased with increasing levels of IBA application. These increases were statistically significant in the 1st date of the 1st and 2nd types. In the 1st type, the minimum callus rate was 10.00% with 2000 ppm application of IBA in the 2nd timing, but the maximum callus formation rate was 46.66% with 6000 ppm IBA application in the 1st timing. In the 1st date of the 2nd type, the ratio of cuttings having callus increased from 13.33% to 30.00% in the control and 6000 ppm IBA application, respectively.

Table 5. Effects of two cutting times and IBA doses on callus formation of some cornelian cherry types (%).

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.

0	26.66 b	16.66	13.33 b	10.00	20.00	6.66
2000	30.00 b	10.00	20.00 ab	13.33	20.00	10.00
4000	36.66 ab	16.66	30.00 a	10.00	23.33	10.00
6000	46.66 a	23.33	30.00 a	16.66	30.00	16.66
D	8.319 (*)	NS	13.36 (**)	NS	NS	NS

* P<0.05 ** P<0.01
NS: Non significant

The effect of time on callus formation was statistically significant. In all three types, the ratio in the 1st group was higher than in the later group (Table 2).

In all types, the performance of types in terms of callus formation were similar to those of rooting and sprouting. The formation of callus in the 1st type was higher than in the 2nd and 3rd types (Table 3).

Number of Roots

The number of roots increased with IBA application, and these increases were statistically significant except for the second date of the 2nd and 3rd types. In the 1st type, the number of root was the lowest in the 2nd date of the control groups (2.33) and the highest in the 1st date of 6000 ppm IBA applied group (29.02). Similarly, in the 2nd and 3rd types, the root number was minimum in the control group and maximum in 6000 ppm IBA application (Table 6).

In all types, the number of roots of the 1st timing group was higher than the 2nd and the difference between the two dates was statistically significant (P< 0.01). For example, on the average in the 3rd type, the number of roots per cutting was 16.22 and 2.79 in the 1st and 2nd timing groups (Table 2).

Table 6. Effects of two cutting times and IBA doses on the number of root of cornelian cherry types.

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	6.33 c	2.33 b	3.33 c	1.00	6.66 c	2.66

2000	12.50 bc	7.83 ab	12.66 b	4.00	14.33 b	1.66
4000	18.47 b	10.66 a	17.66 b	5.33	17.25 b	3.00
6000	29.02 a	12.00 a	26.83 a	10.16	26.66 a	3.83
D	8.440 (**)	7.806 (*)	6.615(**)	NS	7.044(**)	NS

* P<0.05 ** P<0.01
NS: Non significant

Root Length

IBA application increased the root length in both cutting dates as compared to the control. Effect of IBA application on root length was statistically significant except for the 2nd date of the 3rd type (Table 7). The root length in the control group increased from 1.012 cm to 15.755 cm for 6000 ppm IBA application in the 1st type and from 0.388 cm to 8.056 cm in the 2nd date of the 1st type. In the 2nd type, the minimum root length was obtained in the 2nd date of the control group (0.160 cm) and the maximum root length was in the 1st date of the 6000 ppm IBA applied group (15.758 cm). On the other hand, the effect of IBA application on root length was significant in the 1st date of the 3rd type with 0.771, 2.013, 9.169 and 13.612 cm for the control, 2000, 4000 and 6000 ppm IBA application.

Table 7. Effects of two cutting times and IBA doses on the root length of some cornelian cherry types (cm).

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	1.012 c	0.388 c	1.110 c	0.160 c	0.771 c	0.377
2000	3.105 c	1.322 bc	2.486 c	0.688 c	2.013 c	0.670
4000	7.696 b	3.807 b	8.137 b	4.804 b	9.169 b	3.251
6000	15.755 a	8.056 a	15.758 a	12.041 a	13.612 a	6.020
D	4.271 (**)	29.33 (**)	3.322 (**)	3.940 (**)	14.75(**)	NS

** P<0.01
NS: Non significant

The root length of the cuttings taken on Jan.28 was higher than those taken february, and the differences were significant in the 1st and 3rd types. The average root length was 6.892 cm in the 1st group, while it was 3.393 cm in the 2nd group taken in february (Table 2).

There were no significant differences for root length among types (Table 3).

Root Diameter

Root diameter increased by hormone application and these increases were statistically significant except the 2nd time of the 2nd and 3rd types (Table 8). In the 1st type, the minimum root diameter was obtained in the 2nd date of the control group (0.203 mm) and the maximum root diameter was obtained in the 1st date of the 6000 ppm IBA applied group (1.296 mm). In the 2nd type, the minimum root diameter was 0.180 mm in the control group of the 2nd date and the maximum root diameter was 1.210 mm in 6000 ppm IBA application of the 1st date.

Table 8. Effects of two cutting times and IBA doses on the root diameter of some cornelian cherry types (mm).

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	0.753 b	0.203 b	0.830 b	0.180	0.780 b	0.236
2000	0.816 b	0.250 b	0.823 b	0.456	0.866 b	0.233
4000	0.906 ab	0.686 ab	0.916 b	0.723	0.936 b	0.516
6000	1.296 a	0.823 a	1.210 a	0.863	1.213 a	0.776
D	0.411 (**)	0.480 (**)	0.207 (**)	NS	0.214 (**)	NS

** $P<0.01$
NS: Non significant

The effect of time of cutting collection on root diameter was statistically significant in all three types. The root diameter decreased from 0.943 mm to 0.490 mm for the 1st and and 2nd date in the 1st type and from 0.945 mm to 0.555 mm in the 2nd type and from 0.949 mm to 0.440 mm in the 3rd type (Table 2).

There were no significant differences among the root diameters of the types (Table 3).

Root Quality

IBA application had positive effects on root quality, and these effects were statistically significant at $\alpha=0.01$ level except for the 2nd date of the 3rd type (Table 9). The root quality was low in the control group however, it was increased to medium and strong quality classes by hormone applications. The highest root quality was obtained from 6000 ppm IBA application in all types and dates.

Table 9. Effects of two cutting times and IBA doses on root quality of some cornelian cherry types.

Treatments (IBA doses)	Types					
	1st type		2nd type		3rd type	
	28 Jan.	28 Feb.	28 Jan.	28 Feb.	28 Jan.	28 Feb.
0	1.000 c	0.666 b	1.000 c	0.333 b	1.000 c	0.666
2000	1.416 b	1.360 ab	1.166 bc	1.083 ab	1.666 b	0.666
4000	1.636 b	1.416 ab	1.666 b	1.650 ab	1.916 b	1.083
6000	2.470 a	2.166 a	2.553 a	2.666 a	2.750 a	1.083
D	0.386 (**)	0.922 (**)	0.573 (**)	1.652 (**)	0.559 (**)	NS

** $P<0.01$
NS: Non significant

The effect of date of taking cuttings on root quality was not significant in the 1st and the 2nd types but there was a significant difference between the root quality of the 1st and 2nd dates in the 3rd type (Table 2).

There were no significant differences among types in respect to root diameter (Table 3).

In this study, the effects of IBA levels and the time of taking cuttings on characteristics related to rooting varied in three cornelian cherry types. It was emphasized by several researchers (Hansen and Hartman, 1958; Mendilcioğlu, 1969; Yılmaz, 1970; Özbek, 1971) that the endogenous factors such as genetic structure, stored matters, endogenous hormones and other extrinsic factors such as fertilization, irrigation, time of cutting, rooting media, temperature, humidity and growth regulators exerted significant effects on rooting rates of cuttings.

The best time of taking cuttings was found as January in this study, since there were significant differences between the rooting rates and root quality of cuttings collected in january and february.

There were significant effects of IBA application on rooting rates and other studied parameters. The ratio of rooted cuttings increased and other characteristics were enhanced by the increasing IBA doses between 2000 and 6000 ppm.

In this study, the most effective dose of IBA on rooting ratio was 6000 ppm. Similar results confirming the results of the other researchers (Stepanova *et al.,* 1986; Smykov *et al.,* 1987; Ivanicka, 1989). In addition, Kaşka and Yılmaz (1987) reported that hormone application generally increased the ratio rooted cuttings.

It was clear that there were differences among cornelian cherry types in respect to parameters studied possibly due to the differences in their genetic structures. Similarly, Ivanicka and Cvopa (1977) reported that the rooting characteristics of four cornelian cherry types studied were different.

CONCLUSIONS

Recently, cornelian cherry has gained importance in Turkey and in the world. Unfortunately, the studies on rooting of cuttings are very limited. In this study, the rooting status of cuttings in pre-selected types were found important for high quality.

Cornelian cherry is generally produced by seeds and there is no varietal standardization in Turkey. Because of these reasons, it is very hard to produce high quality fruits. Therefore, the types chosen by selection must be produced by vegetative methods. There is a need for further studies on propagation by cuttings which is the most suitable method for vegetative propagation.

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