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THE EFFECT OF DIFFERENT IBA DOSES ON ROOTING IN SOFT-WOOD CUTTINGS OF ROOTSTOCK CANDIDATE SWEET CHERRY, SOUR CHERRY AND MAHALEB GENOTYPES

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ABSTRACT

This study was carried out to investigate the effect of different IBA (Indole Butyric Acid) concentrations on rooting in soft-wood cuttings of rootstock candidate sweet cherry, sour cherry, and mahaleb genotypes in a plastic greenhouse with underfloor heating and mist propagation of Black Sea Agricultural Research Institute. 500, 1000, and 2000 ppm IBA doses were applied to the soft-wood cuttings taken in june. Perlite was used as propagation medium and rooting medium was disinfected with methyl bromide before planting. The study was planned according to a randomized plot design with three replications and 20 cuttings in each replication. The rooting rate (%), number of roots (piece), number of branching roots (piece), and root length (mm) were investigated. The highest rooting ratio of 59% (08 K 056) was obtained from the 1000 ppm IBA application, while the lowest rooting ratio of 22.50% (55 K 104) was obtained from the 1000 ppm IBA application.

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1. Introduction

Rootstock is used in fruit growing for reasons such as reducing the negative effects of soil and climatic conditions, increasing fruit quality, and controlling the growth strength of the tree. Rootstocks are propagated in two different ways by seed or clonal. The plants produced from seeds cannot show uniform development, and a homogeneous production is not possible (Ağaoğlu et al., 2001). Clonal rootstocks are propagated by vegetative methods (cutting, layering, tissue culture, etc.). Vegetatively propagated rootstocks have the same characteristics as the parent material and the new individuals obtained show homogeneous development. In this way, thanks to the orchards where rootstocks with standard characteristics are used, it also contributes to the standardization in production (Akça, 2000).

With the discovery of plant growth regulators, accelerated the propagation by cuttings and it became possible to propagate plants with the use of plant growth regulators. Rootstocks propagation studies have continued for a very long time and successful results have been obtained in cuttings propagation in species other than those that are difficult to root. In propagation by cuttings, the parts prepared by cutting the leaves, branches, or root parts from the mother plant are provided with plant growth regulator application and root formation under appropriate humidity and temperature conditions. The new plant obtained in this way shows all the characteristics of the mother plant (Edizer and Demirel, 2012). The method of propagation with cuttings can be applied in many plant species in 3 different periods: soft, soft-wood and wood cutting. Plant growth regulators such as IAA, IBA, and NAA are used in vegetative propagation of many plant species (Hartmann et al., 1966). Plant growth regulators are not capable of propagating with all types of cuttings. However, they play an active role in increasing the rooting rate and shortening the rooting period (Ürgenç, 1982).

The vegetative production of clonal rootstocks are great of importance. If a clonal rootstock is difficult to propagate vegetatively, it may not be possible to spread the rootstock even though its other characteristics are very good. For this reason, it is necessary to investigate the possibilities of propagation of rootstocks especially vegetatively (Edizer and Demirel, 2012). In this context, there are studies on rooting with cuttings in fruit species of Prunus species such as peach (GF-677, Garnem), plum (Marianna GF 8-1, St. Julien), and sweet cherry (SL-64) (Reighard et al., 1990; Özkan and Madakbaş, 1995; Kankaya and Özyiğit, 1998; Ahmed et al., 2003; Edizer and Demirel, 2012; Ilgın and Bulat, 2014).

This study aims to determine the effect of 500, 1000, and 2000 ppm doses of IBA on the rooting of softwood cuttings of rootstock candidate genotypes for cherry.

2. Materials and methods

2.1. Plant materials

The study was carried out at the Black Sea Agricultural Research Institute in 2018-2019. The data were evaluated by taking the average of the years. According to the results of the project numbered TOVAG 106 O 031 in the genetic resources area of the Black Sea Agricultural Research Institute, 3 *Prunus avium* (55 K 104, 08 K 056, 52 K 063), 2 *Prunus cerasus* (28 V 001, 55 V 004), and 2 *Prunus mahaleb* (55 M 005, 52 M 003) genotypes, which may be rootstock candidates, are the materials of the study (Bilginer et al., 2009).

2.2. Methods

The soft-wood cuttings taken in june and were prepared to be 20-25 cm long and contain 3-5 nodes. The cuttings were prepared with 2 leaves and the other leaves were cut to prevent moisture losses. Prepared cuttings were immersed in IBA solution for 5 seconds. Cuttings treated with IBA were planted in perlite after the evaporation of alcohol. Soft cuttings of rootstock candidate genotypes were removed from the rooting medium after 60 days. The following properties were examined in the removed from soft cuttings.

Rooting rate (%): The cuttings forming roots were counted and expressed as %.

Root number: Root number was determined by taking the average values of the results obtained by counting the roots in all rooted cuttings.

Number of branching roots: The number of branching roots was calculated by taking the average values of the results obtained by counting the branching roots in all rooted cuttings.

Root length (mm): Root length was measured with a 0.01 mm precision digital caliper.

2.3. Statistical analysis

The experiment was set up with 3 replications and 20 cuttings in each replication. In this study, the differences between treatments in terms of rooting rate (%), number of roots, number of branching roots, and average root length (mm) were analyzed with JUMP 7.0 statistical package program.

3. Results and discussion

3.1. Rooting rate

It was determined that the effects genotypes and genotype x dose interaction on rooting rate were statistically significant ($p<0.01$). The minimum rooting rate was obtained from the 1000 ppm IBA dose of the 55 K 104 genotype (22.50%), the highest rooting rate was obtained from the 1000 ppm IBA dose of the 08 K 056 genotype (59.00%). In terms of average rooting rate, the lowest rooting rate was obtained from the 55 K 104 genotype at 23.03%, while the highest rooting value was obtained from the 08 K 056 genotype at 46.33%. While the rooting value was the lowest in the application of 500 ppm IBA dose, the rooting rate was the highest in the application of 1000 ppm IBA dose (Table 1). The rooting rate of sweet cherry, sour cherry, and mahaleb genotypes selected from Samsun province was determined as 85.0% in sour cherry genotypes, 58.3% in mahaleb genotypes, and 23.3% in sweet cherry genotypes at different IBA doses (Koç, 2009). Dick and Leakey's (2006) statement that young cuttings root better supports the idea in our study that soft cuttings root better. The rooting of mahaleb (*Prunus mahaleb*) and sweet cherry (*Prunus avium*) cuttings, the cuttings taken 8 weeks after the leafing period indicated better results (Rather et al., 2005). Özyurt et al. (2012) in their study, 2500 ppm Indol-3-Butyric Acid (IBA) was applied to soft cuttings taken from SL 64 rootstock and mahaleb (*Prunus mahaleb* L.) genotypes grown in Tokat province. While the average rooting rate of the genotypes was between 3.30% (60TM10) and 61.60% (60TM30), the rooting rate of SL 64 rootstock was 33.30%. the effect of 0, 1000, 2000, and 4000 ppm doses of IBA on rooting wood cuttings of peach (GF-677, Garnem), plum (Marianna GF 8-1, St. Julien, and cherry (SL 64) fruit clonal rootstocks. The highest rooting rate of 38% was obtained from 2000 ppm IBA application (Boyaci et al., 2017). According to the research results; All doses of IBA gave better results in terms of the properties examined than the control application. The results obtained in this study, which were carried out for the rooting of soft cuttings of rootstock candidate genotypes, agree with the results obtained from the rooting experiments of other researchers.

3.2. Root number

As can be seen from Table 2, the difference between the treatments in terms of root number was found to be statistically significant ($p<0.01$). While the minimum number of roots was obtained from the 500 ppm IBA dose of the 55 K 104 genotype (1.66), the highest number of roots was obtained from the 2000 ppm IBA dose of the 55 M 005 genotype (18.49). 52 K 063 genotype has the lowest number of roots in terms of average root number, 55 M 005 genotype has the highest number of roots with 12.78. While the number of roots is the lowest at 500 ppm IBA dose, the number of roots is highest at 2000 ppm IBA dose (Table 2). Boyaci et al. (2017) determined in their study that the average number of roots varied between 2.90 and 4.55. Özyurt et al. (2012) determined that the average number of roots in mahaleb genotypes was 2.10-9.70. Edizer and Demirel (2012) in their study on the reproduction of clonal rootstocks with softwood cuttings; the average root number of clonal rootstocks was 11.00-18.50, they stated that there was a positive relationship between IBA dose and root number. Kalyoncu et al. (2008) in their study on the propagation of cherry with soft cuttings, determined the number of roots as 1.62-6.25, although it changes according to moisture levels. Our results about root number are consistent with the results of the studies carried out.

Table 1. The effect of IBA applications on rooting rate (%) in genotypes.

Genotype Code	IBA doses			Average
	500 ppm	1000 ppm	2000 ppm	rooting rate (%)
08 K 056	37.50 bc	59.00 a	42.50 b	46.33 A
28 V 001	41.67 b	29.33 d-g	39.17 b	36.72 B
52 K 063	28.33 eg	36.67 bcd	28.33 efg	31.11 C
55 V 004	25.00 fg	42.50 b	23.33 g	30.28 C
55 M 005	26.00 efg	28.33 efg	33.33 cde	29.22 C
52 M 003	28.33 efg	31.67 c-f	25.00 fg	28.33 C
55 K 104	23.33 g	22.50 g	23.33 g	23.03 D
Average (%)	30.02 B	35.71 A	30.71 B	
cv			14	
Genotype			**	
Dose			*	
Genotype x Dose			**	

Different letters in the same line or column are statistically significant. **Significant at $p≤0.01$. *Significant at $p≤0.05$. cv: Coefficient of variation.

Table 2. Effect of IBA applications on root number in genotypes.

Genotype Code	IBA doses			Avarage
	500 ppm	1000 ppm	2000 ppm	
08 K 056	5.38 d-ı	6.32 def	7.25 cd	6.32 B
28 V 001	4.87 d-j	5.85 d-h	5.01 d-j	5.24 BC
52 K 063	2.92 ıl	2.17 kl	2.63 jl	2.57 C
55 V 004	3.92 f-l	3.25 h-l	7.38 cd	4.85 BC
55 M 005	6.35 def	13.50 b	18.49 a	12.78 A
52 M 003	4.50 ek	3.60 g-l	6.13 dg	4.74B C
55 K 104	1.66 l	7.09 cde	9.50 c	6.09 B
Avarage	4.23 C	5.97 B	8.06 A	
cv			16	
Genotype			*	
Dose			**	
Genotype x Dose			**	

Different letters in the same line or column are statistically significant. **Significant at $p≤0.01$. *Significant at $p≤0.05$. cv: Coefficient of variation.

Table 3. The effect of IBA applications on the number of branching roots in genotypes.

Genotype code	IBA doses			Average
	500 ppm	1000 ppm	2000 ppm	
08 K 056	2.90 bc	2.30 bc	2.60 bc	2.60 BC
28 V 001	2.60 bc	3.00 bc	3.40 b	3.02 ABC
52 K 063	2.10 bc	2.90 bc	2.50 bc	2.49 BC
55 V 004	1.70 c	2.20 bc	2.70 bc	2.18 C
55 M 005	2.40 bc	3.20 b	6.10 a	3.90 A
52 M 003	2.00 bc	2.50 bc	5.80 a	3.46 AB
55 K 104	2.50 bc	2.00 bc	2.20 bc	2.23 C
Average	2.31 B	2.60 B	3.60 A	
cv			19	
Genotype			*	
Dose			*	
Genotype x Dose			*	

Different letters in the same line or column are statistically significant. **Significant at $p≤0.01$. *Significant at $p≤0.05$. cv: Coefficient of variation.

Table 4. Effect of IBA applications on root length (mm) in genotypes.

Genotype code	IBA doses			Average (mm)
	500 ppm	1000 ppm	2000 ppm	
08 K 056	69.69 b	67.24 bcd	67.72 bc	68.21 AB
28 V 001	65.79 bcd	67.47 bc	67.59 bc	66.95 B
52 K 063	42.50 fg	43.97 efg	39.09 g	41.85 D
55 V 004	66.68 bcd	84.81 a	76.63 ab	76.04 A
55 M 005	43.27 fg	72.90 ab	69.97 b	62.05 BC
52 M 003	47.57 efg	71.71 b	55.93 cde	58.40 C
55 K 104	68.85 h	49.39 efg	54.92 def	37.05 D
Average (mm)	48.90 B	65.35 A	61.69 A	
cv		13		
Genotype		**		
Dose		**		
Genotype x Dose		**		

Different letters in the same line or column are statistically significant. **Significant at $p \leq 0.01$. *Significant at $p \leq 0.05$. cv: Coefficient of variation.

3.3. Number of branching roots

The minimum number of branching roots (1.70) of the 55 V 004 genotype at 500 ppm IBA dose and the highest number of branching roots (6.10) at 2000 ppm IBA dose of 55 M 005 genotype were obtained. While the number of branching roots is the lowest in the 55 V 004 genotype (2.18), the number of branching roots is the highest in the 55 M 005 genotype (3.90). There is a positive correlation between IBA doses and the number of branching roots (Table 3). Edizer and Demirel (2012) stated that IBA doses significantly increased branching in roots compared to the control. Kalyoncu et al. (2008) in their study the number of branching roots in cherry varied between 0.0-2.21. The differences between these literatures, which are compatible with our study, and the results we obtained; can be explained by the genetic structures and dose differences of genotypes.

3.4. Root length

As stated in Table 4, there were statistically significant differences in genotype x dose interaction in terms of root length ($p<0.05$). The minimum root length was obtained from the 2000 ppm IBA dose of the 52 K 063 genotype (39.09 mm), the highest root length was obtained from the 1000 ppm IBA dose of the 55 V 004 genotype (84.81 mm). In terms of root length, 55 K 104 genotype has the shortest root length at 37.05 mm, while 55 V 004 genotype has the longest root length at 76.04 mm. In terms of applied IBA doses, the shortest root length was obtained from a 500 ppm IBA dose, while the longest root length was obtained from a 1000 ppm IBA dose application (Table 4). Özyurt et al. (2012) determined that the root length in mahaleb genotypes was 10.00-51.80 mm. Edizer and Demirel (2012) found that root lengths ranged from 30.00 to 44.58 mm in their study on the propagation of some clone rootstocks with green cuttings. They stated that IBA doses significantly increased branching in roots compared to the control. Boyaci et al. (2017) determined that the root length varies between 24.0-54.0 mm in their study. Kalyoncu et al. (2008) stated that the root length is between 2.00-20.10 mm in their study on the reproduction of cherries with soft cuttings. Our results regarding root length agree with the results of the studies.

4. Conclusion

500, 1000, and 2000 ppm doses of IBA were applied to soft-wood cuttings of rootstock candidate genotypes for cherry. IBA had a significant positive effect on properties such as rooting rate (%), number of roots (number), number of branching roots (number), and average root length (mm). According to the data we obtained from the study; the highest rooting rate was obtained from 59.00% to 1000 ppm IBA dose. It was determined that 1000 ppm IBA for rooting rate and root length in softwood cuttings of rootstock candidate genotypes we used in our study, and the most appropriate IBA dose for root number and branching root number was 2000 ppm.

Compliance with Ethical Standards

Conflict of Interest

As the author of article declare that there are no conflicts of interest with respect to the research, authorship, and/or publication of this article.

Authors' Contributions

Erol AYDIN: Validation, Writing - original draft, Formal analysis, Data curation. **Ercan ER**: Methodology, Investigation, Review and editing.

Ethical approval

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Consent for publication

We humbly give consent for this article to be published.

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