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THE GRAFTING SUCCESS OF FOURTEEN GENOTYPES GRAFTED ON THREE DIFFERENT ROOTSTOCKS ON PRODUCTION OF SWEET CHERRY (*Prunus avium* L.) SAPLING

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ABSTRACT

This study was conducted in Çanakkale Province, Bayramiç County between 2011 and 2013. The aim of this study was to determine the best rootstock × genotype combination by grafting 14 standard and local sweet cherry genotypes cultivated in Amasya Province on Mazzard, Gisela 5 and Gisela 6 rootstocks with T-budding method. Graftings were conducted on August 15th in both years. Following the grafting, the average daily temperature and relative humidity values in addition to bud sprout ratios and graft shoot lengths and diameters were examined. The experiment location was suitable for fall T-budding based on obtained climate data. The results of research showed that cherry genotypes and rootstocks had significant effects on bud sprout ratio. The best bud sprout rates among the sweet cherry genotypes and rootstocks were obtained from 'Kargayüreği' genotype (100%) and Gisela 6 rootstock (91.4 and 94.5%, respectively) in both year. Graft shoot lengths and diameters showed differences depending on genotypes and rootstocks. Among the sweet cherry genotypes and rootstocks, the best graft shoot length were obtained from 'Kargayüreği' genotype and Gisela 5 rootstock in both year. The highest graft shoot diameter values among the sweet cherry genotypes and rootstocks were obtained from 'Bing' genotype and Gisela 5 rootstock in both years. As a result, it was shown that the 14 sweet cherry genotypes cultivated in Amasya can be successfully grafted on Mazzard, Gisela 5 and Gisela 6 cherry rootstocks and that 1st and 2nd class sweet cherry saplings can be produced.

Key words: *Prunus avium*, sweet cherry, rootstock, budding, grafting success

INTRODUCTION

Cherry (*Prunus avium* L.), in botanical taxonomy, is included in order *Rosales*, *Rosaceae* family, *Prunoidae* subfamily and *Prunus* genus. There are 119 varieties in the cherry-sour cherry group. The cultured cherry types are originated from *Prunus avium* L. and cultured sour cherry types are originated from *Prunus cerasus* L. Cherry is the oldest cultivar among these [Öz 1988, Özbek 1989].

Cherry spreads to 35° north and 55° south latitudes and other suitable areas in terms of temperature and ecological factors around the world. Today, cherry cultivation has spread to many countries within

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mild climate zones. Cherry is cultivated intensively in North Africa, all of Europe, western parts of the Middle East, Anatolia and Caspian Sea and neighboring countries, and North and South America [Westwood 1995]. Birds, wars between ancient civilizations and economic and cultural interactions have played important roles in cherry's spread to other parts of the world [Özçağiran et al. 2003]. Today, there are many types of cherry and sour cherry. This wide variety is associated with adaption to different environmental conditions, different evaluations of the fruit and the need to extend the ripening season [Iezzoni et al. 1990].

North East Anatolia is one of the homelands of cherry [Özçağiran et al. 2003]. Many cherry genotypes are present in Amasya, which is one of the provinces in this region [Küden 1998], where 28880 tons of cherry is produced annually [TUIK 2014]. Birds have an important role in the development of cherry forms [Özçağiran et al. 2003]. Turkey, with the advantage of being the homeland for cherry, should determine and register cherry genotypes with superior qualities which have been formed naturally. As a result of studies conducted in accordance with these objectives, the level of consanguinity of cherry genotypes in 14 standard and local cherry genotypes cultivated in Amasya province were examined and the different genotypes were previously determined [Demirsoy et al. 2008].

In modern fruit cultivation, rootstocks with known properties are generally used; these properties do not change except in the case of mutations [Trefois 1985]. Rootstocks have effects on tree frequency and arrangement (single or multi-row planting), pruning requirements, improvement methods and the support system preference [Barritt 1992]. There are serious problems in Turkish fruit production regarding providing rootstocks that adapt well to local conditions and can adapt with the standard types and their use in fruit cultivation [Çelik 1983]; clonal rootstocks cannot yet be used to full extent [Eroğul 2012].

Seedling and clonal rootstocks are used in fruit production. In cultivation made using seedling rootstocks, clonal rootstocks are used due to the growth and heritability differences between cultivars [Gonda et al. 2007] and late yield properties. Uniform individuals are obtained through the use of clonal rootstocks and certified virus free saplings with known growth strength and other properties [Çelik and Sakin 1991]. In cherry sapling production, seedling rootstocks including mazzard (*Prunus avium* L.), sour cherry (*Prunus cerasus* L.) and mahaleb (*Prunus mahaleb* L.) [Westwood 1995] and clonal rootstocks including Colt, Maxma (Mazzard × Mahaleb hybrids), SL-64, and Gisela series are widely used. Seedling rootstocks are regenerated with seeds while clonal rootstocks are regenerated with rooting, layering or tissue culture. Clonal rootstocks form homogeneous trees and the cultivars that are grafted on them give early fruits and provide high quality and efficient production. Also, they offer alternatives to the standard cultivators in terms of resistance to different biotic and abiotic stresses [Aktürk 2009].

Among the seedling rootstocks, *Prunus mahaleb* L. and *Prunus avium* L. (Mazzard) are the primary rootstocks used for cherry and sour cherry cultivation in the world [Moghadam and Khalighi 2007]. Mazzard (*Prunus avium* L.) has been used as a cherry rootstock for 2400 years. Greek and Roman gardeners used Mazzard rootstock for cherry production, spread it to other countries and maintained its survival to the present day with very few changes. The compatibility of Mazzard rootstocks with cherry and sour cherry types is very good [Webster and Schmidt 1996]. The trees on Mazzard are tolerant to heavy soil and the trees on mahaleb make larger trees [Demirsoy and Demirsoy 2000]. Gisela series cherry rootstocks were developed in Germany in recent years [Webster and Schmidt 1996]. Gisela rootstocks are sewn in deep soils with good irrigation facilities where pH is below 8 and with a calcar level below 10%. Gisela rootstock, compared to Mazzard, provides 2–3 years early fruiting [Eroğul 2012]. Gisela 5 is a dwarf rootstock [Charlot et al. 2005]. Gisela 5 is an inter-specific hybrid which gives early fruit for cherry cultivars with a high yield. Its performance has not been fully determined in Mediterranean conditions [Ruisa and Rubauskis 2004].

Cherry rootstocks affect the performance of the culture cultivars on which they are grafted. Rootstocks affect the cherry fruit quality, tree development [Facteau et al. 1996, Jiménez et al. 2004 a], yield [Facteau et al. 1996, Moreno et al. 2001], flowering, and leaf nourishment [Neilsen and Kappel 1996, Betrán et al. 1997, Jiménez et al. 2004 b]. Vegetative reproduction method, as in many fruit types, is mostly used in cherry sapling production. The most suitable vegetative reproduction method in cherry is grafting. The most suitable graft method in the fall period is T-budding [Westwood 1995, Eriş and Barut 2000, Hartmann et al. 2011].

In this study, the success of grafting 14 standard and local sweet cherry cultivated in Amasya Province on Gisela 5, Gisela 5 and Mazzard rootstocks using fall T-budding were investigated.

MATERIALS AND METHODS

Experiment location

This study was conducted at Alara nursery located in Çanakkale (Turkey) Province, Bayramiç County (North: 39°48', East: 26°36', Altitude: 108 m). The study was conducted in nursery parcels located in open field. Graftings were also performed in open field. The nursery soil was sandy-loam structure and drip irrigation was implemented.

Plant materials

In the study, two old Mazzard (*Prunus avium L.*), Gisela 5 and Gisella 6 cherry rootstocks produced with vegetative methods were used. Rootstocks were cultivated in open field. Fourteen standard and local sweet cherry cultivars determined in Amasya Province [Demirsoy et al. 2008] were used as scions. Scions required for grafting were obtained in Amasya, wrapped in damp cotton cloth and transported to Çanakkale Province, Bayramiç County where the grafting was conducted in protective boxes.

The time of grafting and the graft type

Graftings were conducted on August 15, 2011 and 2012. T-budding, which has been widely recommendded for cherry saplings [Westwood 1995, Eriş and Barut 2000] was used as the grafting method. White, soft, silicone rubber produced specifically for the graftings were used as grafting tape. Rootstocks were grafting at a point 20 cm above the soil surface. Cultivation factors such as irrigation, weeding and removal of suckers below graft union were done following regular intervals. The rootstocks used in research were fertilized with farmyard manure on February 20 and irrigated during summer using drip irrigation systems. There were no chemical spraying in the orchard.

Observations and measurements

The following observations and measurements were conducted during the trial.

1. A mechanical data logger (HOBO U10 Temp/RH data logger) was used for the daily mean temperature and relative humidity measurements (1 hour intervals).
2. Bud sprout ratio (%): Calculated as the ratio of the number of saplings that formed shoots from the graft buds at the end of the vegetation period (December 1^{st}) to the number of saplings that were initially grafted.
3. Graft shoot length (cm): The length of shoot from the graft bud at the end of vegetation (December 1) for each application was measured by meter at a point 5 cm above the graft union.
4. Graft shoot diameter (cm): The diameter of shoot from the graft bud at the end of vegetation (December 1) for each application was measured by 0.01mm sensitive electronic digital caliper compass at a point 5 cm above the graft union.

Statistical analysis

Experimental design used was a randomized complete block design with three replications. Each replication contained 10 plants. Sprouting data were recorded after bud burst. Observations on shoot length and diameter were recorded on December 1^{st}. Data expressed as percentage (sprouting rate) were transformed using the arc-sin$\sqrt{x}$ transformation. Lettering in the table of values was made after data retransformation, given in parentheses in the table. Data analyses were performed using univariate routine SPSS [2011] statistical package via the license of Ondokuz Mayis University. Design of the experiment was evaluated as 3 × 14 factorial. Before the ANOVA tests, homogeneity of variances were examined with Levene variance homogeneity test. Variances of all traits were found homogeneous ($P > 0.05$). Duncan test was used for multiple comparisons.

RESULTS AND DISCUSSION

Experiment location climate data

Average daily temperature (°C) and relative humidity (%) are given in Figures 1 and 2. In the first year of the study (fig. 1), the average daily temperature from August 15th, which was the date for the first grafting, to December 1st, which was the date that the data was collected (end of vegetation), varied between 0.2°C and 30.1°C, and the average daily relative humidity varied between 42.7 and 99%. In the second year of the study (fig. 2), during which the measurements were taken during the same dates as in the first year, the average daily temperature varied between -4 and 30.7°C while the average daily relative humidity varied between 41.7 and 99%. In both years, temperature gradually decreased from August 15th reaching the lowest values between January and February. Temperature began to increase day by day from March 15th, reaching to the highest value on July 17th. From this date, temperature gradually decreased (figs 1 and 2). During both years, daily relative humidity was low in periods which the temperature was high, and high in periods which the temperature was low.

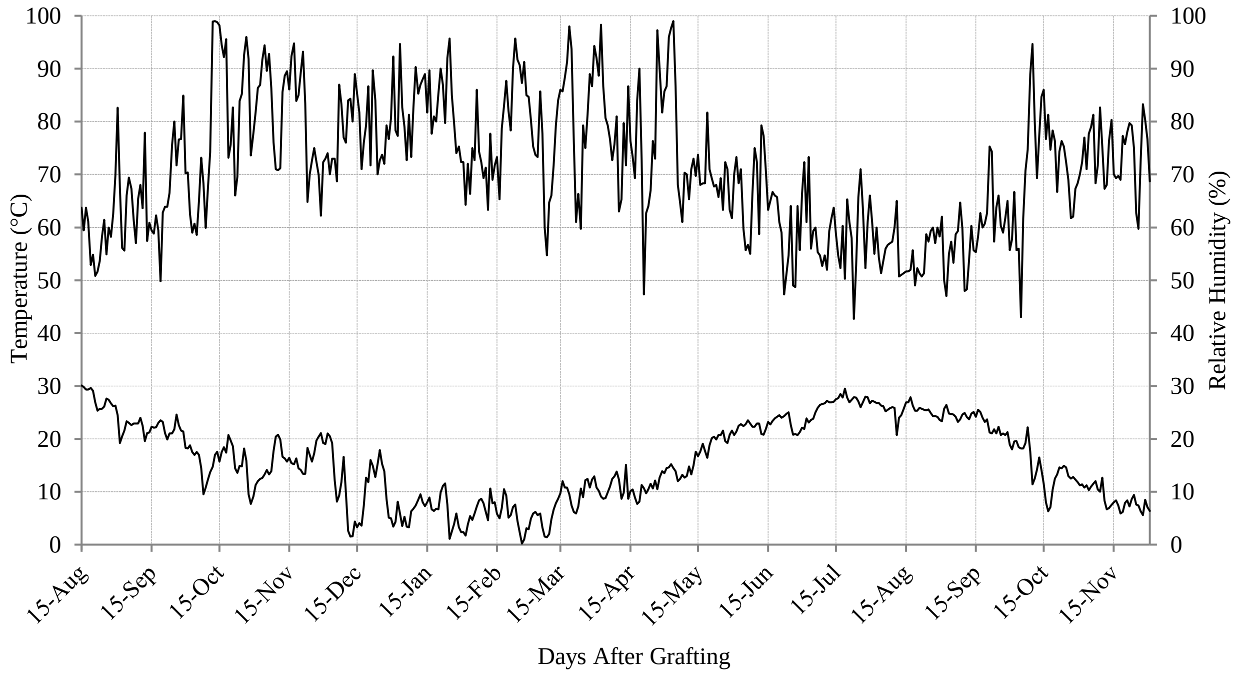

Fig. 1. Average temperature and relative humidity during the days after grafting in 2011

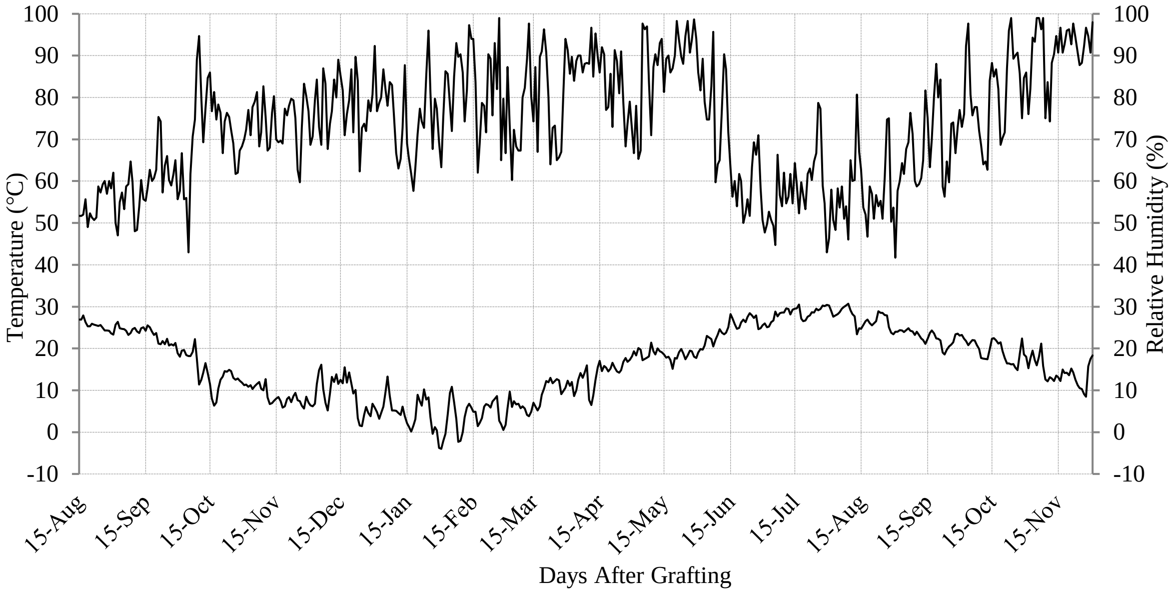

Fig. 2. Average temperature and relative humidity during the days after grafting in 2012

Temperature and relative humidity data of the experiment site was compatible with the long term data [TSMS 2014]. Therefore, it can be said that the experimental years 2011, 2012 and 2013 were not extreme in terms of climatic conditions and thus the results obtained in the study can be generalized. Hartmann et al. [2011], stated that temperature and relative humidity is very important especially during the 30 days following grafting. This was associated with the wound closure and graft cohesion and active formation of callus cells; the compatibility of the grafts was determined within these days. The researchers reported that the temperature should be between 4–32°C for the formation of callus cells. Another researcher [Yilmaz 1992] stated that the temperature should be close to 26 and 28°C for the formation of callus cells. Temperature data at the experiment site for the first month varied between 19.2 and 30.1°C in 2011 and between 27.9 and 23.2°C in 2012, temperatures which are compatible for graft cohesion and fall budding.

Bud sprout ratio

The data obtained by grafting 14 standard and local cherry genotypes cultivated in Amasya Province on Mazzard, Gisela 5 and Gisela 6 rootstocks by T-budding are given in Table 1. Bud sprout ratios of cherry rootstocks varied between 40 and 100% in 2011 and between 33.3 and 100% in 2012. Significant differences were detected in cherry genotypes × cherry rootstocks interactions in both years ($p < 0.05$). The best results (100%) in 2011 were obtained by grafting 'Türkoğlu' and 'Kargayüreği' on 'Mazzard' rootstock, 'Kargayüreği', 'Hüsenba' and 'İzmit' on 'Gisela 5' rootstock and 'Kargayüreği', 'Hüsenba', 'Arap' and 'Camgöz' on 'Gisela 6' rootstock. The best results in 2012 were obtained by grafting 'Türkoğlu' and 'Kargayüreği' on 'Mazzard' rootstock, 'Kargayüreği', 'Hüsenba' on 'Gisela 5' rootstock, and Kargayüreği', 'Hüsenba', 'Arap', 'Camgöz', 'Honey Heart' and 'Early Burlat' on 'Gisela 6' rootstock. The lowest results in both years were obtained by grafting 'Early Burlat' on 'Gisela 5' rootstock.

Table 1. The effect of grafting different cherry genotypes on different rootstocks on the bud sprout ratio (%)

Year	Genotypes	Mazzard	Gisela 5	Gisela 6	Mean genotypes
2011	Arap	93.3[1] (77.7)[2] abc	70.0 (57.8) b–g	100.0 (90.0) a	87.8 (75.2) a–d
	Bella di Pistoia	90.0 (75.0) a–d	80.0 (63.9) b–f	90.0 (78.9) ab	86.7 (72.6) bcd
	Bing	66.7 (55.1) d–g	80.0 (63.9) b–f	70.0 (57.0) c–g	72.2 (58.7) d
	Camgöz	93.3 (77.7) abc	80.0 (68.1) b–e	100.0 (90.0) a	91.1 (78.6) abc
	Early Burlat	80.0 (63.9) b–f	40.0 (39.2) g	100.0 (90.0) a	73.3 (64.4) cd
	Haci Ali	90.0 (78.9) ab	70.0 (57.0) c–g	80.0 (63.9) b–f	80.0 (66.6) cd
	Honey Heart	80.0 (68.1) b–e	50.0 (45.0) fg	100.0 (90.0) a	76.7 (67.7) cd
	Hüsenba	90.0 (75.0) a–d	100.0 (90.0) a	100.0 (90.0) a	96.7 (85.0) ab
	İzmit	63.3 (53.2) efg	100.0 (90.0) a	80.0 (63.9) b–f	81.1 (69.0) bcd
	Karakirtik-1	90.0 (75.0) a–d	90.0 (75.0) a–d	80.0 (63.9) b–f	86.7 (71.3) bcd
	Karakirtik-2	60.0 (50.9) efg	80.0 (63.9) b–f	100.0 (90.0) a	80.0 (68.3) cd
	Kargayüreği	100.0 (90.0) a	100.0 (90.0) a	100.0 (90.0) a	100.0 (90.0) a
	Türkoğlu	100.0 (90.0) a	90.0 (75.0) a–d	90.0 (75.0) a–d	93.3 (80.0) abc
	0900 Ziraat	80.0 (68.1) b–e	70.0 (57.0) c–g	90.0 (78.9) ab	80.0 (68.0) cd
	Mean rootstock	84.1 (71.3) b	78.6 (66.8) b	91.4 (79.4) a	84.7
	LSD 5% (genotypes × rootstock): 8.61, LSD 5% (rootstock): 3.48, LSD 5% (genotypes): 7.21				
2012	Arap	100.0 (90.0) a	80.0 (63.4) cde	100.0 (90.0) a	93.3 (81.1) abc
	Bella di Pistoia	90.0 (75.0) abc	93.3 (81.1) abc	96.7 (83.9) ab	93.3 (80.0) a–d
	Bing	80.0 (63.4) cde	86.7 (72.3) a–d	80.0 (63.4) cde	82.2 (66.4) cd
	Camgöz	90.0 (71.6) bcd	86.7 (72.3) a–d	100.0 (90.0) a	92.2 (77.9) a–d
	Early Burlat	86.7 (68.9) bcd	33.3 (35.2) g	100.0 (90.0) a	73.3 (64.7) d
	Haci Ali	93.3 (81.1) abc	80.0 (63.4) cde	83.3 (66.1) bcd	85.6 (70.2) cd
	Honey Heart	86.7 (72.3) a–d	50.0 (45.0) fg	100.0 (90.0) a	78.9 (69.1) cd
	Hüsenba	93.3 (77.7) abc	100.0 (90.0) a	100.0 (90.0) a	97.8 (85.9) b
	İzmit	56.7 (48.9) efg	100.0 (90.0) a	86.7 (72.3) a–d	81.1 (70.4) cd
	Karakirtik-1	93.3 (77.7) abc	93.3 (81.1) abc	86.7 (68.9) bcd	91.1 (75.9) a–d
	Karakirtik-2	70.0 (57.3) def	86.7 (72.3) a–d	96.7 (83.9) ab	84.4 (71.1) bcd
	Kargayüreği	100.0 (90.0) a	100.0 (90.0) a	100.0 (90.0) a	100.0 (90.0) a
	Türkoğlu	100.0 (90.0) a	96.7 (83.9) ab	96.7 (83.9) ab	97.8 (85.9) b
	0900 Ziraat	90.0 (75.0) abc	80.0 (63.4) cde	96.7 (83.9) ab	88.9 (74.1) bcd
	Mean rootstock	87.9 (74.2) b	83.3 (71.7) b	94.5 (81.9) a	85.6
	LSD 5% (genotypes × rootstock): 7.26, LSD 5% (rootstock): 3.23, LSD 5% (genotypes): 6.61				

[1] original data, [2] transformed data

Table 2. The effect of grafting different cherry genotypes on different rootstocks on the graft shoot length (cm)

Year	Genotypes	Mazzard	Gisela 5	Gisela 6	Mean genotypes
2011	Arap	119.30 h–k	150.23 b–i	171.23 a–e	146.92 abc
	Bella di Pistoia	120.90 g–k	164.33 a–f	150.90 b–i	145.38 abc
	Bing	145.50 c–j	161.93 b–g	138.83 d–k	148.76 abc
	Camgöz	117.50 h–k	149.33 b–j	142.90 d–j	136.58 bc
	Early Burlat	162.07 b–g	176.00 a–d	108.57 ijk	148.88 abc
	Haci Ali	129.47 e–k	203.17 a	106.90 jk	146.51 abc
	Honey Heart	137.67 d–k	204.33 a	145.00 c–j	162.33 a
	Hüsenba	124.00 f–k	158.33 b–h	170.43 a–e	150.92 abc
	İzmit	138.50 d–k	166.00 a–f	144.67 c–j	149.72 abc
	Karakirtik-1	134.00 d–k	147.30 b–j	114.77 ijk	132.02 c
	Karakirtik-2	146.67 b–j	185.27 abc	114.90 ijk	148.94 abc
	Kargayüreği	136.37 d–k	186.53 abc	169.33 a–e	164.08 a
	Türkoğlu	137.77 d–k	161.67 b–g	97.57 k	132.33 c
	0900 Ziraat	117.33 h–k	171.50 a–e	188.17 ab	159.00 ab
	Mean rootstock	133.36 b	170.42 a	140.30 b	148.0
	LSD 5% (genotypes × rootstock): 17.23, LSD 5% (rootstock): 5.86, LSD 5% (genotypes): 14.78				
2012	Arap	110.63 rs	140.77 kmn	179.07 bc	143.49 abc
	Bella di Pistoia	116.47 prs	156.53 efg	154.87 e–k	142.62 abc
	Bing	141.67 i–n	156.00 e–i	137.20 mno	144.96 abc
	Camgöz	114.57 rs	141.23 j–n	142.53 h–n	132.78 bc
	Early Burlat	161.03 ef	157.40 efg	117.80 prs	145.41 abc
	Haci Ali	140.83 kmn	201.27 a	111.67 rs	151.26 abc
	Honey Heart	143.80 g–n	183.43 bc	151.80 e–k	159.68 ab
	Hüsenba	117.87 prs	155.50 e–j	183.93 bc	152.43 abc
	İzmit	133.17 no	152.47 e–k	150.17 e–m	145.27 abc
	Karakirtik-1	133.07 no	136.70 mno	124.10 opr	131.29 c
	Karakirtik-2	148.27 f–m	180.13 bc	124.73 opr	151.04 abc
	Kargayüreği	136.60 mno	174.73 cd	175.97 bcd	162.43 a
	Türkoğlu	130.20 nop	163.13 de	109.67 s	134.33 bc
	0900 Ziraat	109.37 s	159.53 ef	189.20 ab	152.70 abc
	Mean rootstock	131.25 c	161.35 a	146.62 b	146.4
	LSD 5% (genotypes × rootstock): 6.19, LSD 5% (rootstock): 4.66, LSD 5% (genotypes): 11.35				

Table 3. The effect of grafting different cherry genotypes on different rootstocks on the graft shoot diameter (mm)

Year	Genotypes	Mazzard	Gisela 5	Gisela 6	Mean genotypes
2011	Arap	14.74 i–o	17.14 b–j	18.51 b–f	16.80 bc
	Bella di Pistoia	15.72 e–m	16.48 c–j	14.83 h–o	15.68 bc
	Bing	21.67 a	18.90 b–e	17.79 b–g	19.45 a
	Camgöz	13.41 k–p	16.53 c–j	15.05 f–n	15.00 bcd
	Early Burlat	17.88 b–g	19.41 abc	12.84 nop	16.71 bc
	Haci Ali	16.01 d–k	18.10 b–f	12.42 nop	15.51 bcd
	Honey Heart	16.27 d–k	19.03 bcd	14.55 i–o	16.62 bc
	Hüsenba	13.09 m–p	17.07 b–j	16.96 b–j	15.71 bc
	İzmit	16.15 d–k	16.69 b–j	16.39 d–j	16.41 bc
	Karakirtik-1	17.87 b–g	16.74 b–j	14.80 h–o	16.47 bc
	Karakirtik-2	14.80 h–o	16.17 d–k	12.13 op	14.36 cd
	Kargayüreği	14.75 i–o	17.74 b–h	16.80 b–j	16.43 bc
	Türkoğlu	11.98 op	16.90 b–j	10.87 p	13.25 d
	0900 Ziraat	14.28 j–o	17.49 b–i	19.59 ab	17.12 b
	Mean rootstock	15.62 b	17.46 a	15.25 b	16.11
	LSD 5% (genotypes × rootstock): 1.21, LSD 5% (genotypes): 1.08, LSD 5% (rootstock): 0.53				
2012	Arap	13.61 opr	16.17 e–m	19.36 ab	16.38 ab
	Bella di Pistoia	15.13 j–n	15.65 h–n	15.26 i–n	15.35 bc
	Bing	20.30 a	16.50 d–k	15.78 g–n	17.53 a
	Camgöz	13.06 pr	15.63 h–n	15.01 k–o	14.57 bc
	Early Burlat	17.76 cde	17.32 c–g	14.27 nop	16.45 ab
	Haci Ali	16.90 c–h	17.91 cd	12.95 pr	15.92 ab
	Honey Heart	16.98 c–h	17.06 c–h	16.10 f–m	16.71 ab
	Hüsenba	12.44 r	16.76 c–i	18.30 bc	15.83 abc
	İzmit	15.53 h–n	16.01 f–m	16.97 c–h	16.17 ab
	Karakirtik-1	17.30 c–g	15.53 h–n	14.27 nop	15.70 abc
	Karakirtik-2	16.31 e–m	15.73 g–n	13.17 pr	15.07 bc
	Kargayüreği	14.75 mno	16.62 d–j	17.42 c–f	16.26 ab
	Türkoğlu	12.16 r	17.05 c–h	12.17 r	13.79 c
	0900 Ziraat	13.23 pr	16.27 e–m	19.68 ab	16.39 ab
	Mean rootstock	15.39 b	16.44 a	15.76 ab	15.87
	LSD 5% (genotypes × rootstock): 0.66, LSD 5% (rootstock): 0.44, LSD 5% (genotypes): 0.92				

Examining the effect of cherry genotypes on bud sprout ratio, significant differences were determined in both years ($p < 0.05$), with the highest results (100%) obtained from 'Kargayüreği' genotype. Examining the effect of cherry rootstocks on bud sprout ratio, significant differences were determined in both years ($p < 0.05$) with the highest results obtained from 'Gisela 6' rootstock. The lowest results were obtained from 'Gisela 5' rootstock.

Generally, adequate levels of bud sprout ratios were obtained from the graftings. Differences were observed among cherry genotypes in terms of bud sprout ratios. 'Kargayüreği' gave the highest results in both years. The differences in bud sprout ratios among the different cherry genotypes are likely due to the associated genetic differences Zenginbal [2007], Hartmann et al. [2011], Stachowiak and Świerczyński [2009], in accordance with our study results, stated that genetic diversity has an effect on bud sprout ratios. Also, Demirsoy et al. [2008], studying the level of consanguinity in cherry genotypes in Amasya, determined that some of the 14 cherry genotypes were very different from each other. In this study, there were similarities between cherry rootstocks in terms of bud sprout ratios, with the best results obtained from Gisela 6 rootstock in both years. We believe that the different results obtained in terms of bud sprout ratios were due to rootstock/scion incompatibilities. Indeed, Özcağiran et al. [2003], Stachowiak and Świerczyński [2009] reported that the rootstock/scion incompatibilities are common in cherry cultivation.

Graft shoot length and diameter

The average shoot length values obtained by grafting 14 different rootstocks on 'Mazzard', 'Gisela 5' and 'Gisela 6' rootstocks with T-budding method are given in Table 2. Significant differences were detected in cherry genotype × cherry rootstock interactions ($p < 0.05$). The best graft shoot lengths (203.17 cm and 204.33 cm) were obtained by grafting 'Haci Ali' and 'Honey Heart' genotypes on 'Gisela 5' rootstock in 2011 and 'Haci Ali' genotype on 'Gisela 5' rootstock in 2012. Cherry genotypes had a significant effect on graft shoot lengths in both years ($p < 0.05$). The best result in 2011 was obtained from 'Kargayüreği' genotype with 164.08 cm and the lowest result was obtained from 'Türkoğlu' genotype with 132.33 cm. Examining the 2012 data, the best result was obtained from 'Kargayüreği' genotype with 162.43 cm, and the lowest result was obtained from 'Karakritik' genotype with 131.29 cm. Cherry rootstocks had a significant effect on graft shoot lengths in both years ($p < 0.05$). The best graft shoot length values in both years (170.42 cm and 161.35 cm, respectively) were obtained from Gisela 5 cherry rootstock.

The graft shoot diameter values obtained by grafting 14 different cherry genotypes on cherry rootstocks are given in Table 3. Cherry genotype × cherry rootstock interactions had a significant effect on graft shoot diameter in both years ($p < 0.05$). Graft shoot diameter values varied between 10.87 and 21.67 mm in 2011 and between 12.16 and 20.3 mm in 2012. The best results in 2011 were obtained by grafting 'Bing' cherry genotype on 'Mazzard' rootstock with 21.67 mm, while the lowest result was obtained by grafting 'Türkoğlu' cherry genotype on 'Gisela 6' rootstock. The best results in 2012 were obtained by grafting 'Bing' cherry rootstock on 'Mazzard' rootstock with 20.30 mm, while the lowest result was obtained by grafting 'Türkoğlu' and 'Hüzenba' cherry genotypes on 'Mazzard' and by grafting 'Türkoğlu' cherry genotype on 'Gisela 6' rootstock. Cherry genotypes had a significant effect on graft shoot diameters in both years ($p < 0.05$). The highest results (19.45 and 17.53 mm, respectively) in 2011 and 2012 were obtained from 'Bing' cherry genotype. Examining the effect of cherry rootstocks on graft shoot lengths, significant differences were determined in both years ($p < 0.05$) with the highest results obtained from 'Gisela 5' rootstock. Similar results were obtained from 'Mazzard' and 'Gisela 6' rootstocks, results which were lower than those obtained from 'Gisela' rootstocks.

The differences in graft shoot lengths and diameters among the different cherry genotypes and rootstock are likely due to the associated genetic differences Zenginbal [2007], Hartmann et al. [2011], Świerczyński and Stachowiak (2004), Stachowiak and Świerczyński [2009], in accordance with our study results, stated that genetic diversity has an effect on graft shoot lengths and diameters. The highest graft shoot length and diameter values were obtained from 'Gisela 5' rootstock, which was the shortest cherry rootstock in the study. The lowest results were obtained from 'Mazzard' rootstock, which is the strongest cherry rootstock in the study. This was due to the dwarf rootstocks having fast growth in the first years and then slow growth in the following years. According to cherry sapling standard by Turkish Standards Institution [TSE 1996] quality classification foundation in Turkey (1 year old cherry sapling standard: 1. One year old, 20 mm diameter, 135 cm height; Height 2. 15 mm diameter, 125 cm height), the saplings obtained as a result of the study were Height 1 in terms of graft shoot length and Height 2 in terms of graft shoot diameter. Consequently, saplings were between Height 1 and Height 2 and had good quality.

CONCLUSION

The results conclusively showed that 14 standard and local sweet cherry genotypes cultivated in Amasya can be successfully grafted on Mazzard, Gisela 5 and Gisela 6 cherry rootstocks. The success in bud sprout ratios is an indication for this conclusion. The best bud sprout rates among the sweet cherry genotypes and rootstocks were obtained from 'Kargayüreği' genotype and Gisela 6 rootstock. Graft shoot lengths and diameters showed differences depending on genotypes and rootstocks. Among the sweet cherry genotypes and rootstocks, the best graft shoot length were obtained from 'Kargayüreği' genotype and Gisela 5 rootstock. The highest graft shoot diameter values among the sweet cherry genotypes and rootstocks were obtained from 'Bing' genotype and Gisela 5 rootstock. Dissatisfactory bud sprout ratios in some genotypes should be examined in detail. Accordingly, different graft types should be produced and their anatomical examinations should be conducted. Also, graft shoot length and diameter development of 14 different cherry genotypes on 3 different rootstocks are at very good levels. Sweet cherry saplings obtained are between 1st and 2nd Class. We hope and believe that this study will make a contribution to sapling production, which is the first step of introduction to modern fruit cultivation.

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