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Effect of time, method of budding and type of scion on bud take of sour cherry scions onto mahaleb rootstocks

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Key words: Number of leaves; Bud length; Lateral shoot; Budding time; T- budding; chip budding.

Abstract

Amongst methods for asexual propagation of sour cherry, budding is the most common procedure. Budding is performed onto compatible rootstocks. In order to determine the most appropriate time and method of budding to achieve the maximum bud take (compatibility) success, this study was conducted in a private nursery located in Marbin, close to the Isfahan city. The two Guissi and Hungry cultivars were employed as scion and the Mahaleb seeding was used as rootstock. Treatments included two different scions (Guissi and Hungry sour cherries), two different times (August and early march) and three budding methods (T- budding, chip budding and T- without budding). This research was conducted in August 2013 as an experimental project of split- split plot in the framework of complete random blocks with three replications. Results of the study revealed that in both Guissi and Hungry scions, the chip budding in August had the maximum effect on such characteristics as growth bud length, number of leaves, number of lateral shoots and percentage of bud take. In the chip budding, since compared with other types of budding callus tissue was formed sooner and a strong connection was established between the scion and the rootstock, the buds developed sooner. As a result, compared with other budding types water and nutrients were absorbed more rapidly. Results of this research revealed that in both Guissi and Hungry sour cherry scions, the most appropriate time for budding is in August and the best method is chip budding on Mahaleb rootstocks.

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Introduction

Sour cherry with the scientific name of *Prunus cerasus* belongs to the Rosaceae family (*Marini*, 2009). Grafting is usually employed for such cultivars for which plant propagation via sexual reproduction or other vegetative methods is difficult and additionally good characteristics of some of the rootstocks can be used (*kako et al .,*2012). Grafting is a type of vegetative reproduction (*Lewis and Alexander*, 2008). Grafting is a practice employed for joining two plants so that they act, through regeneration at the connection site, as a single plant and continue their growth independently (*Lewis and Alexander*, 2008; *Pektas et al.*, 2009). Successful graft unions result when cell at the surface of both scion and rootstock tissues complete the sequence of wound response (callus proliferation and differentiation), to create a continuous cambium and vascular system between scion and rootstock (*Olmstead et al.* , 2006). The section which is placed on top of the graft site is scion and the lower section constituting the root is called rootstock (*Lewis and Alexander*, 2008; Marini, 2009; *Long and Kaiser*, 2010). In budding, the section of cortex bearing a single bud as scion is placed onto the rootstock. Through the growth of this bud, the crown will develop (*Lewis and Alexander*, 2008). A major problem in the production of sweet cherry trees is tree vigor and the physiological incompatibility of some of the rootstocks with particular cultivars (*Baryla et al.*, 2013). Good results of bud grafting largely depend on the quality of rootstocks (*Baryla and Kaplan*, 2012; *Baryla et al.*, 2013). Production of specifications of sour cherry cam be improved through employment of suitable rootstock and influence growth and yield. Tree height and yield as well as the productivity index depend on the sour cherry cultivar and the rootstock type (*Kopytowski and Markuszewski*, 2010; *Baryla et al.*, 2013). The commonest rootstocks used for sour and sweet cherry propagation are Mazard (*Prunus avium* L.), Mahaleb (*Prunus mahaleb* L.), and Stackton Morlo (*Prunus cerasus* L.), Colt and F12/1 (*Lanauskas et al.,* 2012). Mahaleb is considered as an important rootstock for sour and sweet cherries (*Baryla and Kaplan*, 2012; *Long and Kaiser*, 2010). Growth and yield of sour cherry trees to a great point depends on the cultivars used (*Kopytowski and Markuszewski*, 2010). *Medikovic and Djakovic* (1985) found that cultivar was highly effective on growth vigor and transplants viability (*kako et al.*,2012). Grafting season and grafting techniques are amongst the factors influencing graft success (*Pektas et al.*, 2009). Budding time significantly influences the budding compatibility and depends on climatic and environmental conditions of the region (*Baryla and Kaplan*, 2012). For sour and sweet cherries the best time for budding is late August to early September, while for plum, apricots and peaches it is mid- August (*Ahmad et al.*, 2012). Budding and grafting methods significantly affect bud take and survival outcome (*Zenginbal et al.*, 2007; *Rayya et al.*, 2009; *Ali et al.,*2012). This research project was conducted with the objective of determining the appropriate time and best budding method of sour cherry on Mahaleb rootstock.

Materials and methods

This research was conducted in August 2013 in a private nursery. With surface area of 1000 m^2 in the Marbin region located in the west of Isfahan city. The nursery soil was clay loam in which plants were cultivated as ridges and furrows; width of ridges was 50 cm and interval between two consequent ridges was 110 cm and plants interval in ridges and furrows rows was 10×35 cm. This project was conducted as a split- split plot in the framework of complete random blocs with 3 replications. Budding in the main plots was performed at two times of August and early march and scion type for secondary plots included Guissi and Hungry sour cherries employing three budding methods: T- budding, T- without budding and chip budding were considered as auxiliary plot. Each plot contained 10 seedlings. As a whole 360 seedlings were planted onto 180 of which scions were budded in August and into the other 180 seedlings budding was performed in early march. Budding operations were performed in two time of August and early march for a period of one week on the seedlings. In this research project, the two Guissi and Hungry sour cherry cultivars were budded at the height of 10 to 20 cm from the ground level employing three budding methods including T-budding, T- without budding and chip budding on Mahaleb rootstocks. For budding in August, scions were taken from the one- year growing shoots and for budding in early March, scions were taken from the one- year shoot with latent buds. Assessed traits (characteristics) included length of the bud growth, number of leave, number of lateral shoot and bud take success.

bud take success

About 15 days post- budding seedlings were visited to monitor the bud take. the number of all seedlings whose buds had been taken was counted.

length of the bud growth

The seedlings budding starts the last April. the growth of the budding was measured using a ruler or measuring tape.

number of leave and lateral shoots

Number of leaves and lateral shoot was counted on the budding growth in each treatment. Also the average number of both leaves and lateral shoots for each plant was calculated.

Statistical analysis of results was performed employing the SAS software and comparing of means through the Duncan multivariate test.

Results

Variance analysis of data obtained of the study of effects of time, scion type and budding method on the surveyed traits including bud take length, number of leaves, number of lateral shoots and bud take percentage is presented in the following table. This variance analysis indicates the effect of time, scion type and budding method on the studied traits.

Table 1. Variance analysis of effect of various treat meats on the studied traits.

Modification sources	Degree of freedom	Mean of squares			
		Bud length	No. of leaves	No. of lateral shoots	Bud take percentage
Replication	2	14.399	4.18	0.17	119.444
Budding time	1	473.606	484.22	180.77**	4900**
Error (a)	2	6.586	19.720	0.434	258.333
Scion type	1	40689/6**	1021.7**	10.857*	177.778
Error (b)	4	3.088	2.8	0.722	77.778
scion type	2	594.40*	25.13*	0.588	211.111
Budding time× Scion type× bud type	2	11.091	0.023	0.022	677.7**
Error (c)	16	9.583	4.752	0.507	75.0
Coefficient of modifications (%)	2	3.74	4.09	0.434	10.46

* and ** indicate significant at statistical levels of 0.05 and 0.01 respectively.

As is observed in results of variance analysis, budding time had a significant effect at one percent level on the number of lateral shoots and also had a significant impact at five percent level on bud take percentage. Type of scion had a significant effect at one percent level on the bud length, number of leaves as well as a significant effect at five percent level on the number of lateral shoots. Reciprocal impact of budding time, scion type and budding type had a significant effect at one percent level on bud take.

Mean comparisons

Effect of time budding on the studied traits

As it can be seen in table 2, the highest bud length, number of leaves, number of lateral shoots and bud take percentage was obtained in August.

Effect of scion type on the studied traits

Comparison of mean effect of scion type in table 3 indicates that the highest bud length was obtained in scion of Hungry sour cherry scion and the highest number of lateral shoots was obtained in the Guissi sour cherry scion.

Effect of bud type on the studied traits

Comparison of means in Table 4 indicates that the highest bud length was obtained in chip budding and the highest Bud take was achieved in T- without budding graft. The highest leaf number was obtained in chip budding. However, the difference was not significant.

Table 2. Comparison of mean effect of time on the studied traits.

Source of Modifications	Bud length (cm)	No. of leaves	No. of lateral shoots	Bud take percentage
Budding time				
August	86.957 a	56.981 a	13.287 a	94.444 a
Early March	78.748 b	49.646 b	9.332 b	71.111 b

Means with one common letter lack statistical difference based on Duncan test at 5 percent probability level.

Effect of time budding, scion type and bud type

Comparison of means in Table 5 shows that the highest bud length was obtained using Hungry sour cherry scion in August. However, no significant difference was seen between the budding methods. The highest number of leaves and number of lateral shoots in Guissi sour cherry scions was obtained in August. However, no significant difference was seen between the budding methods. The highest bud take in both scion types was obtained in August. Through chip budding and T- without budding procedures.

Discussion

Bud take percentage

Scions of Hungry and Guissi sour cherry in August through the chip budding and then T- without budding resulted in the highest bud take percentage. Results reveal that the level of bud take is severely influenced by the method and time of budding. The reason for success of chip budding is production of a great volume of callus around the graft union and that callus formation happens quicker in chip budding. In the T- without budding method, Due to the layer of wood, it can exhibit a performance like that of the chip budding and also for better protection of bud, T- without budding method was used. In fact T- without budding leads to increased strength of rootstock and scion together and a lesser surface of wound is exposed to climatic conditions and as a result, healing at the graft union happens much better and quicker in T- without budding compared with the T- budding. Howard *et al,* repotted that callus formation was higher and faster for chip budding than those of T and conventional local T budding (*zanginbal et al.,* 2007). The result of which research corresponded with those of Howard *et al. Rayya et al.* (2009), stated that the highest loud take and its survival was observed in the chip budding procedure performed in August to September onto the almond rootstocks. Also, chip budding was performed on pistachio seedling during the early spring (April) with dormant bud stick while T-budding was performed during June or July. Chip budding was found to be the best budding methods for pistachio propagation. Results of this research corresponded with those of *Rayya et al.*(2009); *zenginbal et al.* (2007) reported that chip budding was superior to T budding in terms of bud take in kiwifruit. These result correspond with those obtained by *zenginbal et al. (2007).* As reported by *Ahmad et al.* (2012), in peach, budding time had no considerable effect on bud take success which was contrary to our findings since in our research budding time was effective on bud take success.

Length of bud growth

The highest bud length was seen in Hungry sour cherry scion and the least bud length was seen in Guissi sour cherry scion in August. The highest bud length in both scion types was achieved employing the chip budding. This is due to rapid formation of strong graft union and longer growth period in chip budding. From the view point of budding time, budding performed in August showed the highest longitudinal growth, since the effect of budding time on longitudinal growth of shoots resulting from bud growth is more than the budding procedure. Such that the sooner the time of budding, the higher will be the shoots longitudinal growth resulting from the bud development. The reason is that the shoot resulted from budding during the growth season had a longer time available for its growth. *Baryla and Kaplan* (2012), reported that a significant difference was not seen in the height of sour cherry trees in the nursery depending on the time of budding, however, it was observed that the height of sour cherry trees budding on August 1 and 15 was higher compared to those budded on September 1, results which corresponded with ours. *Ahmad et al.* (2012), reported that budding time had a significant effect on the growth of buds resulting from budding. Also, *zenginbal et al.* (2007), reported that they had achieved the highest shoot growth resulting from budding in kiwifruit using chip budding, results which correspond with ours.

Number of leaves

Result of this study revealed that the highest number of leaves was obtained in the Guissi sour cherry scion treatment performed in August employing the chip budding and that highest number of leaves in Hungry sour cherry scion was also obtained in August through employment of chip budding. Due to better and sooner bud take in chip budding, growth, germination and absorption of water and nutrient happened faster. *Ahmad et al.* (2012), reported that the maximum number of leaves was obtained in seedling budded on June 15, followed by July 5 and July 25 respectively. Obtained results confirm the effect of budding time on the number of leaves in each seedling, results corresponding with those of *Ahmad et al.*(2012). Rayya *et al.* (2009), reported that chip budding performed in July resulted to the highest mean number of leaves. The number of leaves however, obtained through T budding, performed in July decreased severely. Result of this result from the viewpoint of bud type corresponds with those obtained by *Rayya et al.*(2009).

Table 3. Comparison of mean effect scion type on the studied traits.

Source of Modifications	Bud length (cm)	No. of leaves	No. of lateral shoots	Bud take percentage
Scion type				
Guissi	49.233 b	61.641 a	11.858 a	80.556 a
Hungry	116.472 a	47.986 b	10.76 b	85.0 a

Means with one common letter lack statistical difference based on Duncan test at 5 percent probability level.

Table 4. Comparison of mean effect bud type on the studied traits.

Source of Modifications	Bud length (cm)	No. of leaves	No. of lateral shoots	Bud take percentage
Bud type				
T- budding	82.009 b	51.687 b	11.247 a	78.333 b
Chip budding	84.962 a	54.458 a	11.555 a	83.333 ab
T- without budding	81.587 b	53.794 a	11.126 a	86.667 a

Means with one common letter lack statistical difference based on Duncan test at 5 percent probability level.

Number of lateral shoots

Results of this research indicated that the highest number of lateral shoots belonged to the Guissi sour cherry scion performed in August employing chip budding. In Hungry sour cherry scion compared with other methods the same results were obtained through performance of chip budding. As a whole, results show that number of lateral shoots obtained from budding performed in August is higher than those performed in early March. It can be conducted then that budding time is effective on the number of lateral shoots. In chip budding since there developed a strong union between the rootstock and the scion, development of buds happened sooner, as a result, compared with other budding procedures, water and nutrients were better absorbed and since the budding had a longer time available for growing in the growth season. This resulted to increased number of lateral shoots. *Ahmad et al.* (2012), reported that the maximum number of lateral shoots in budded seedlings was registered for those budded on June 15 and the minimum number of shoots was registered for those budded on June 5. These results indicate that the budding time has a significant effect on the number of lateral shoots, result which correspond with ours. Result obtained by *Baryla and Kaplan* (2012), showed that budded on 1 and 15 August of Łutówka cultivar of sour cherry on Mahaleb seedling using chip budding had a more beneficial effect on growth and shoot generation of trees compared with budded on 1 September. Late budding time resulted in poorer branching of maiden tree in the nursery. Our results correspond with of *Baryla and Kaplan* (2012). *Rayya et al.* (2009), reported that budding procedure and its time influenced the number of lateral shoots obtained by Neplus ultra budding. The highest number of lateral shoots for each plant during the three time of May, July and September belonged to the chip budding. They also found out that budding in July on the average resulted to the highest number of lateral shoots. Our result corresponded with those of *Rayya et al.*(2009) From the viewpoint of bud type however, it contrasted from the point of view of budding time which was due to the difference between the budding time and type of trees used.

Table 5. Comparison of mean effect of reciprocal effects on the studied traits.

Source of Modifications	Bud length (cm)	No. of leaves	No. of lateral shoots	Bud take percentage
Budding time× scion type× Bud type				
August, Guissi, T- budding	51.44 d	62.167 a	14.277 a	93.333 ab
August, Guissi, chip budding	51.46 d	66.113 a	14.663 a	93.333 ab
August, Guissi, T- without budding	48.967 d	64.11 a	13.723 ab	96.667 a
August, Hungry, T- budding	123.4 a	47.553 cd	12.443 bc	93.333 ab
August, Hungry, chip budding	123.95 a	51.72 b	12.837 bc	100.0 a
August, Hungry, T- without budding	122.527 a	50.22 bc	11.777 c	90.0 ab
Early March, Guissi, T- budding	46.343 d	52.22 b	9.377 d	43.333 d
Early March, Guissi, chip budding	49.353 d	53.61 b	9.443 d	63.333 c
Early March, Guissi, T- without budding	47.837 d	53.623 b	9.667 d	93.333 ab
Early March, Hungry, T- budding	106.853 c	44.807 d	8.89 d	83.333 ab
Early March, Hungry, chip budding	115.087 b	46.39 cd	9.277 d	76.667 bc
Early March, Hungry, T- without budding	107.017 c	48.223 cd	9.337 d	66.667 c

Means with one common letter lack statistical difference based on Duncan test at 5 percent probability level.

Conclusion

The objective of this research project was to determine the appropriate time and best method for budding sour cherry on Mahaleb seedlings. Regarding the obtained results, for both type of Guissi and Hungry scions, the most appropriate time for budding was in August and the most suitable budding method was chip budding. Therefore, Regarding the results, obtained of this research, to all seedling producers willing to propagate and produce sour cherry trees on Mahaleb rootstock, using two Guissi and Hungry scions we recommend that the best time for budding is in August and best budding method that can be used is chip budding.

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