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Research Article
Effect of Scion Source, Budding Method and Graft Union Height on Sweet Cherry Budding Compatibility on Mahaleb Rootstock

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Abstract
This research was done with aim of determine the most suitable scion source, the best grafting height and the most suitable budding methods on Mahaleb rootstock. This study was performed during the summer season of 2013 at Nursery in Marbin region of Isfahan. The two cultivars of sweet cherries (white and black) was used as scion and Mahaleb seedling was used as rootstock. The treatments consisted of two cultivar of sweet cherries (white and black), three budding methods (T with and without wood budding and chip budding) at three different height (10-12, 20-25 and 30-35 cm) above ground. The experiment was laid out in a split plot randomized complete block design with three replications. All treatments were found to be suitable for sweet cherry propagation. However, the shortest time of bud take and earlier sprouting time were obtained with T-budding with wood performed at 10-12 cm above ground. The highest mean shoot length is obtained with black sweet cherry scion with T-budding with wood at 10-12 cm above ground. The most number of leave were obtained with black sweet cherry scion with T-budding with wood performed at 30-35 cm above ground. The most number of lateral shoot were obtained with white sweet cherry scion with T-budding with wood performed at 20-25 cm above ground. T-budding with wood was significantly more successful than two other methods. Also budding at 10-12 and 20-25 cm above ground had been best results and scion of black sweet cherry was be most suitable as scion for Mahaleb rootstock.

Key words: Scion, Mahaleb, budding, *Prunus mahaleb* L., bud shoot diameter

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

All commercial sweet cherry trees are either budded or grafted. The part of the tree above the graft/bud union is known as the scion and the part below the graft/bud union is known as the rootstock[1]. Cherry belongs to the genus Prunus of Rosaceae, or rose family. The genus Prunus includes stone fruits such as almond, apricot, plum, peach and nectarine. There are many cherry species, but only a few have been domesticated[2]. The parent trees, from which the seeds for seedling production are obtained differ in the growth strength, resistance to frost, the period of the fruit ripening and other properties. An alternative for the production of trees on seedlings are the rootstocks obtained due to vegetative multiplication, which gives genetically equal material after budding or grafting[3]. Vegetative rootstocks compared with generative ones, ensures on orchards uniformity in terms of vigor and fruit bearing and a better adaptation to different the soil types[4]. Time of season will largely determine what type of propagation techniques you will need to use to create new plants. All forms of top working and repair grafting are done only when the plants are dormant in late winter to early spring. Budding can be done in the dormant season with a dormant chip bud but is most often done during the growing season using either T-budding or chip budding[5]. Graft incompatibility is a complex, anatomical, physiological and biochemical process that is not fully understood. Compatible graft is typically comprised of tree major events; cohesion of the rootstock and scion: proliferation of callus cells at the graft interface and vascular differentiation across the graft interface[6]. There are several external symptoms to detect graft incompatibility including graft union uniformity, lack of lignifications, yellowing of foliage, decline in vegetative growth and vigor and anatomical abnormalities[7,8]. Graft incompatibility in fruit trees is one of the greatest obstacles in rootstock breeding[9]. Furthermore, compatibility of different sweet cherry cultivars grafted on *P. mahaleb* is unpredictable[10]. The basic rootstocks used under cherries in Iran are the seedling of Mahaleb cherry (*Prunus mahaleb* L.) and sweet cherry (*Prunus avium* L.). The seeds for their production are obtained from valid places. This research was done with aim of determine the most suitable scion source, the best grafting height and the most suitable budding methods on Mahaleb rootstock.

MATERIALS AND METHODS

Plant material: The study conducted during the growing season of 2013 at private Nursery in Isfahan, Iran. The native cultivar of sweet cherries (white and black) was used as scion and Mahaleb seedling were used as rootstock.

Methods: The treatments consisted of three budding methods (T-budding, T with wood budding and chip budding) at three different height (10-12, 20-25 and 30-35 cm) above ground. The experiment was laid out in a split plot randomized complete block design with three replication. The percentages of bud take successes were recorded after two months of the budding operations, whereas the different growth parameters (number of leave, number of lateral shoot, bud sprouting rate, bud shoot diameter and bud shoot length) were recorded from early April till end of the season.

Bud shoot diameter: This growth parameter was recorded by vernier caliper from early April till end of the season. Samples were collected randomly from each plot. The results were calculated as an average of three replicates of each treatment.

Bud shoot length: Bud shoot length was recorded by ruler from early April till end of the season. Samples were collected randomly from each plot. The results were calculated as an average of three replicates of each treatment.

Number of leave and lateral shoot: Number of leave and lateral shoot were determined on random samples of 10 plants per plot. The results were calculated as an average of three replicates of each treatment.

Statistical analysis: Data was evaluated by analysis of variance with SAS (SAS Institute Inc., Cary, NC, USA) and the means were compared using Duncan's multiple range t-test at $p \leq 0.05$.

RESULTS AND DISCUSSION

Budding take and sprouting: Table 1 shows the earliest budding take was belonged to treatment at low height 10-12 cm above ground in both sweet cherry scions with three budding methods. However, the highest mean percent of bud take were obtained from Black sweet cherry scion with T-budding with wood performed at 10-12 cm above ground and this treatment was sprouted faster than other treatments on spring. Because increasing the callus tissue was earlier in T-budding with wood, so the empty space between rootstock and scion filled faster and vessel connection was confirmed earlier[1]. Also percent of budding take depends on good temperature and relative humidity and rate of sap movement

Table 1: Effect of scion, budding method and budding height on treatments

Treatments	Budding take (%)	Sprouting (%)	Shoot diameter (mm)	Shoot length (mm)	No. of leave	No. of lateral shoot
White-T-budding (30-35 cm)	17^{a}	241^{c}	1/4^{bc}	135^{a}	72^{b}	0/00^{e}
White-T-budding with wood (30-35 cm)	17^{a}	241^{c}	1/2^{efg}	125^{c}	72^{b}	0/1^{cde}
White-chip budding (30-35 cm)	17^{a}	241^{c}	1/4^{bc}	126^{c}	74^{b}	0/00^{e}
White-T-budding (20-25 cm)	17^{a}	241^{c}	1/3de	125^{c}	74^{b}	1/3de
White-T-budding with wood (20-25 cm)	16/5^{bc}	241^{c}	1/2^{fgh}	121^{ed}	72^{b}	1/2^{fgh}
White-chip budding (20-25 cm)	16/67^{ab}	241^{c}	1/1^{hij}	121^{ed}	72^{b}	1/1^{hij}
White-T-budding (10-12 cm)	16^{c}	240^{d}	1/1^{j}	121^{ed}	75^{b}	1/1^{j}
White-T-budding with wood (10-12 cm)	16^{c}	240^{d}	1/2^{efg}	121^{ed}	74^{b}	1/2^{efg}
White-chip budding (10-12 cm)	16^{c}	240^{d}	1/16^{hi}	110^{e}	67^{b}	1/16^{hi}
Black-T-budding (30-35 cm)	17^{a}	243^{a}	1/4^{ab}	124^{ed}	67^{b}	1/4^{ab}
Black-T-budding with wood (30-35 cm)	17^{a}	243^{a}	1/2^{efg}	124^{c}	193^{a}	1/2^{efg}
Black-chip budding (30-35 cm)	17^{a}	243^{a}	1/3^{e}	118^{d}	55^{b}	1/3^{e}
Black-T-budding (20-25 cm)	16/67^{ab}	242^{b}	1^{j}	105^{e}	56^{b}	1^{j}
Black-T-budding with wood (20-25 cm)	16/33^{bc}	243^{a}	1/1^{ij}	124^{cd}	55^{b}	1/1^{ij}
Black-chip budding (20-25 cm)	17^{a}	242^{b}	1/5^{a}	127^{c}	72^{b}	1/5^{a}
Black-T-budding (10-12 cm)	16^{c}	242^{b}	1/2^{ef}	144^{a}	60^{b}	1/2^{ef}
Black-T-budding with wood (10-12 cm)	17/22^{a}	243/61^{a}	1/3^{ed}	147^{a}	65^{b}	1/3^{cd}
Black-chip budding (10-12 cm)	16^{c}	242^{b}	1/13^{hij}	110^{e}	55^{b}	1/13^{hij}

Values with different superscript letters differ significantly at $p \leq 0.05$

in rootstock and scion at time budding; if all situations are suitable, due to earlier healing of budding union and callus formation, percent of budding take increase[5]. On the other hand, anatomic study showed that in T-budding cambium connection was often poor and caused bud rosette and delayed scion growth[2].

Shoot length: Table 1 shows the highest shoot length was obtained from black sweet cherry scion with T-budding with wood performed at 10-20 cm above ground. Because budding take and sprouting was done earlier in T-budding with wood than other treatments, as increasing the callus tissue was earlier in this treatment[2,8]. Match the cambium layers is so important in budding, since the first connection between rootstock and scion was done through their cambium connection[9]. So earlier healing and formation cambium layer in T with wood budding is due to exist a wood layer with scion in this method[4].

Diameter shoot: Table 1 shows highest mean shoot diameter was obtained in both scions with chip budding at 20-25 cm above ground. Because the most powerful budding take and faster absorption of water and nutrition in chip budding was done better and earlier than T-budding. Based on results of Marini *et al.*[2], who examined taking of almond scion (Neplus ultra) on Nemagard rootstock, method budding didn't significant effect on diameter shoot of budding, however mean diameter shoot in chip budding was more than diameter shoot in T-budding, so results of this research were agreed with those obtained by Marini[2].

Number of leave: Results showed that the most number of leave was belonged to black sweet cherry scion at high height with T-budding with wood treatment. Because of earlier budding take at T-budding with wood method, beginning growth and sprouting was occurred faster too and followed that producing leave was increased[1].

Number of lateral shoot: Results showed that, the most number of lateral shoot was belonged to black sweet cherry at medium height with chip budding, that probably sytokinin hormone caused it. Cytokinins are synthesized at roots and by xylems transferred to shoots. Baryla[11] at his study showed, which examined effect chip budding on Mahaleb and sweet cherry rootstock, that quality features of young cherry trees were dependet on stock used type and cherry trees obtained on Mahaleb cherry were thicker, higher and better branched than on sweet cherry. The Results of this study were agreed with his results.

CONCLUSION

Highest mean percent of bud take and sprouting rate were obtained from black sweet cherry scion with T-budding with wood performed at 10-12 cm above ground. The highest mean shoot diameter were obtained in both scions with chip budding at 20-25 cm above ground and the highest shoot length were obtained from black sweet cherry scion with T-budding with wood performed at 10-12 cm above ground. The most number of leave were obtained with T-budding with wood performed at 30-35 cm above ground. The most of

lateral shoot were obtained with black sweet cherry scion with T-budding with wood performed at 20-25 cm above ground. T-budding with wood method was significantly more successful than two other methods. Also budding at 10-12 and 20-25 cm above ground had been best results and scion of black sweet cherry was be most suitable as scion for Mahaleb rootstock.

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