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Full Length Research Paper

Different effect of scion types on callusing in bench grafting

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This study was carried out to determine the different effect of scion types on bench grafting. Rootstock 110R and Hafizali and Cardinal cvs. were used as a plant material. Scion types performed burst cutting-burst scion, burst cutting-swollen scion, and burst cutting-unburst scion. 21 days after grafting, all grafted cuttings were measured and recorded. The results indicate that discarded grafted-cuttings ratio (%) was found totally to be 3%. In bud, burst values swollen and unburst scions were in same statistical group (53.72 and 52.92%). Best results of shoot length ratio from burst scion in group 0-5 cm (38.62%) and group 5-10cm (4.00%) was found. Rotting in bottom of cuttings was found to be between 4.67 (burst scion) to 11.44% (unburst scion). Rooting ratio were increased along with development of bud; 1.42, 3.44 and 4.67%, respectively for unburst, swollen and burst scions. Highest total callus fresh weight was obtained from swollen scion (1159.35 mg).

Key words: *Vitis vinifera* L., bench grafting, scion, rootstock, callus.

INTRODUCTION

To establish a new vineyard, it is necessary to have qualified grafted rooted vines. The year 2011 data showed that Turkiye produced 4,233.715 total number of grapevine cuttings (Anonymous, 2011). This is however not enough because sapling producers have low performance (Bahar et al., 2006). Grafting combines two different plant pieces, a scion and a rootstock. The scion is the variety desired for grape production, while the rootstock portion of the vine serves as its root system (Olmstead and Keller, 2007). Viticulture is based on grafting; scion is a cultivar of *Vitis vinifera* L. and the rootstock is *Vitis* sp. or interspecific hybrids (Winkler et al., 1974). In classical Bench (=Omega) grafting, unburst cutting and unburst scion were used (Alley, 1957). Successful grafting depends on the formation of a sound union between rootstock and scion (Coombe and Dry, 1992).

During the grafting process, callus is formed, which are undifferentiated cells that bind the scion and rootstock together. These cells differentiate into specialized cells that form a new xylem (water and nutrient pathway) and phloem (sugar pathway) within the graft union (Olmstead and Keller, 2007). Also, affinity has more importance for grafting (Bahar et al., 2010). In previous studies, it was reported that the burst cutting and burst scion affected bud viability, bud burst, shoot development, rooting in bottom of cutting, callus formation (four sides) and callus rate in grafting positively (Bahar et al., 2007). However, in order to increase the performance in bench grafting; burst, swollen and unburst scions were grafted onto bursted rootstock in this experiment.

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MATERIALS AND METHODS

This study was carried out at Department of Horticulture, Grafting and Callusing Room, Agricultural Faculty, Namik Kemal University, in 2011. In this study, Hafizali and Cardinal (Flame Tokay × Alphonse Lavallée) table grape varieties have been grafted onto rootstock 110R (*V. rupestris* × *V. berlandieri)*.

Experimental methods

Unbursted cuttings from 110R, Hafizali and Cardinal were stored in +4°C, 70 to 80% humidity conditions in cold storage room. 110R, Hafizali and Cardinal canes were taken from cold storage room 1 to 2 weeks before grafting and placed into water for bursting under room conditions. All rootstock's cuttings were bursted in this experiment. Scions were divided in 3 groups; unburst scion, swollen scion and burst scion. Moreover, twenty hours before grafting they

Figure 1. Burst (a), swollen (b), unburst (c) scions and burst cutting (d).

were cut by one bud (Figure 1).

Burst cuttings were 35 to 40 cm, and one bud alive in bottom (the other buds were rust). Omega grafting was performed on scion/ rootstock pairs of approximately the same diameter. Grafts were briefly dipped into melting wax (56 to 60°C) and settled for callusing over 21 days at 28 to 30°C, 100% humidity in callusing room. Cuttings were put into box which contained water and charcoal. Water was changed every second day and temperatures were recorded 21 days consecutively (Korkutal and Dogan, 2010) (Table 1).

Statistical analysis

The experiment was established a randomized block design including 3 replicates of 3 scion types (1) burst cutting-burst scion, (2) burst cutting-swollen scion, and (3) burst cutting-unburst scion in 2 grape varieties (Hafizali and Cardinal); and each replicates had 25 grafted cuttings (totaling 450). TARIST was used to analyze data. Statistical differences with P-values <0.05 were considered significant using LSD test.

The following parameters examined to determine the effects includes: Discarded grafted-cuttings ratio (%), bud burst ratio (%), shoot lengths ratio (0 to 5 cm and 5 to 10 cm) (%), rotting in bottom of cuttings (%), rooting ratio (%), grade of callus formation (%) [No callus, one sided callus, two sided callus, three sided callus, four sided callus], grade of callus formation from cutting (%) [No callus, one sided callus, two sided callus, three sided callus, four sided callus], grade of callus formation from scion (%) [No callus, one sided callus, two sided callus, three sided callus, four sided callus], callus fresh weight from cutting (mg), callus fresh weight from scion (mg) and total callus fresh weight (mg).

RESULTS AND DISCUSSION

The scion types had an effect on every parameters studied. The data show that different scion types did not significantly affect the discarded cuttings ratio (Table 2), but interaction between scion types and cultivars significantly affected this criterion. In Hafizali (8.11%) cultivar, unburst scions gave more discarded grafted-cuttings ratio than the others. Korkutal and Yildirim (2011) reported that the burst cutting – unburst scion have lowest value in discarded cutting ratio. This may be because of the cytokinin applications.

Differences between bud burst ratios were found statistically important. Swollen (53.72%) and unburst (52.92%) scion types were in the same statistical group. Burst scion had the lowest ratio (40.62%) of bud burst (Figure 2). Swollen scion had positive effect on grafting than the unburst and burst scion. This result is similar to Bahar et al. (2007) findings, they found burst scion / burst cutting combination had 100% value and at the same time unburst scion / burst cutting had 100%. This variation may be related to the differences of cultivar / rootstock combination. These result had also been supported by the previous study conducted by Korkutal and Yildirim (2011). More also, there were no significant differences in shoot lengths. But shoot lengths were separated in two different group; first one between 0 to 5 cm, second 5 to 10 cm (Figure 3). The findings reveal that the shoot lengths between 0-5 cm, burst scion (38.62%) could grow better than the unburst scion (34.47%). In Merlot / 5BB grafting combination, Bahar et al. (2007) found similar results; the burst scion have 73.13%, and unburst scion have 59.38% shoot lengths ratio. In addition to this finding in 5 to 10 cm group, shoot lengths were higher than the swollen scion (4.00%).

Overall findings reveal that the rotting in bottom of grafted-cuttings have lowest ratio in burst scion (4.67%). Burst scion made positive effect against rotting (Table 3). This result is also supported by the findings of Bahar et al. (2007); burst cutting and burst scion was 5.50% value for rotting in their experiment. Also, Moretti (1988) reported that the soaking of cuttings in water decreased the rotting. The results also reveal that differences between rooting ratio for all examined scion types were found to be not significant (Table 4). The highest rooting ratios taken for burst scion (4.67%). But rooting in cuttings after callusing room condition was not important. Our findings were however different from the results of Korkutal and Dogan (2010) who found neither rooting nor rotting in their study.

While the grade of callus formation from cutting was giving highest value from burst scion and four sided (80.81%), this result is similar to Korkutal and Dogan

Table 1. Temperature and humidity mean values in 21 days.

Date	*1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	April															May					
	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10
Temperature (°C)	31.5	32.7	30.5	28.7	32.5	31.5	27.6	27.8	27.8	29.6	29.1	28.2	27.0	27.4	27.6	27.4	27.4	27.9	26.7	26.4	27.6
Humidity average (%)	51.0	54.0	54.0	61.0	66.0	69.0	80.0	61.5	74.3	74.0	79.0	80.0	83.5	84.6	83.0	77.3	64.0	52.6	72.0	70.3	74.0

*Day

Table 2. Discarded cutting ratios (%).

Cultivar	Burst scion*	Swollen scion*	Unburst scion*	Main effect of cvs.*
Hafizali	1.33^{b}	2.67^{ab}	8.11^{a}	4.04
Cardinal	2.67^{ab}	2.77^{ab}	0.00^{b}	1.81
Main effect of scion types	2.00	2.72	4.05	-

LSD <0.05: 0.162. * Scion type

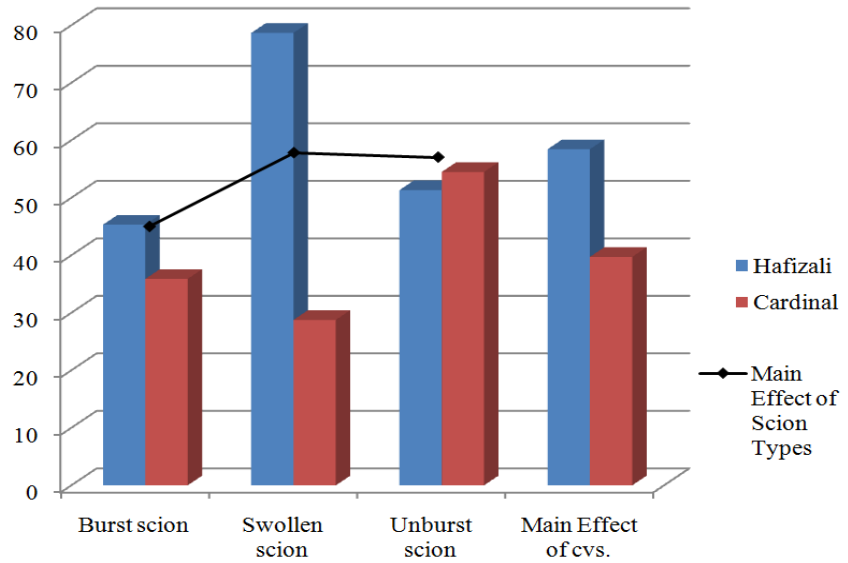

Figure 2. Bud burst ratio (%).

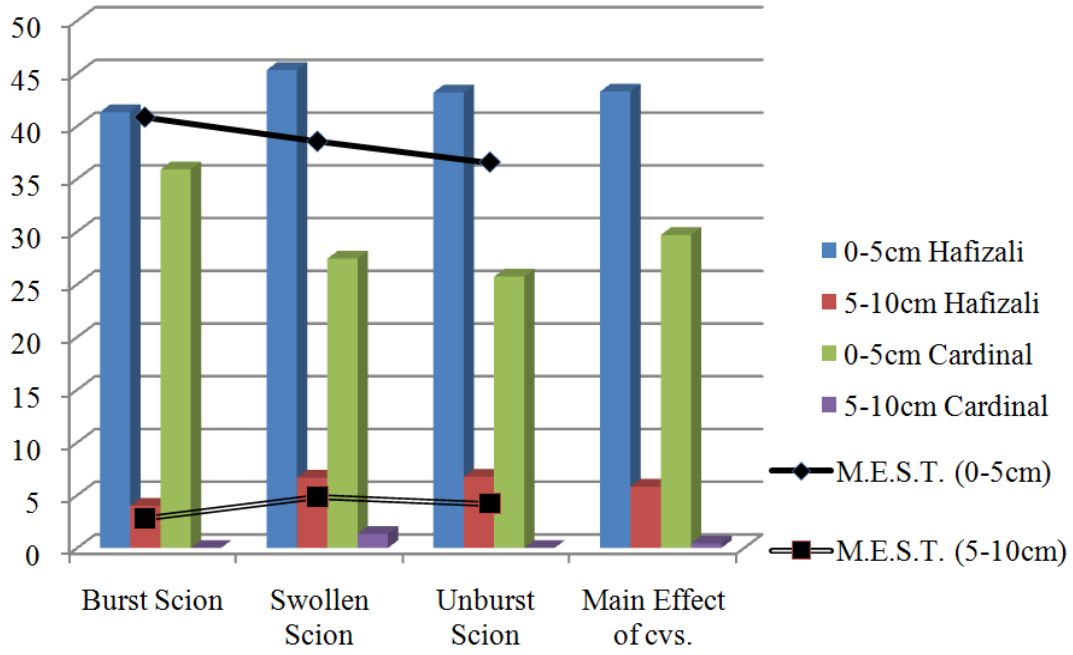

Figure 3. Shoot lengths (%).

Table 3. Rotting in bottom of grafted-cuttings (%).

Cultivar	Burst scion*	Swollen scion*	Unburst scion*	Main effect of cvs. *
Hafizali	4.00	2.67	10.77	5.81[b]
Cardinal	5.33	19.15	12.11	12.20[a]
Main effect of scion types	4.67	10.91	11.44	-

Main effect of cvs. LSD <0.05: 0.115. *Scion type

Table 4. Rooting ratio (%).

Cultivar	Burst scion*	Swollen scion*	Unburst scion*	Main effect of cvs.*
Hafizali	4.00	1.33	1.33	2.22
Cardinal	5.33	5.55	1.51	4.13
Main effect of scion types	4.67	3.44	1.42	-

*Scion types

(2010) burst (sprout uncut) scion 92%. The lowest grade of callus formation from burst scion and no callus is 2.00% (Figure 4a). The grade of callus formation from scion gave the highest value from burst scion and four sided in opposite to this swollen scion and no callus (3.39%) gave the lowest value (Figure 4b). In some of researches conducted on this subject, it was reported that burst cutting and/or scion was effected positively (Korkutal and Dogan, 2010; Bahar et al., 2007). Also, Moretti (1988) reported that the soaking of cuttings in water increased the success rate in grafting. The highest callusing grade from four sided callus formation to unburst scion was 53.55%, followed by the burst scion (51.62%) and swollen scion (51.57%). The lowest callusing grade from no callus formation to burst scion (4.00%) (Figure 5). Callus formations is presented in Figure 6.

The highest total callus fresh weight (mg) was obtained from swollen scion (1159.35 mg), while the lowest was obtained from unburst scion (915.06 mg) (Figure 7). These results highlight that the callus weight originated from scion was 10 to 15% and from cutting was 84 to 89%. In this research, swollen and burst scion gave better results than unburst scion. Scion collected in

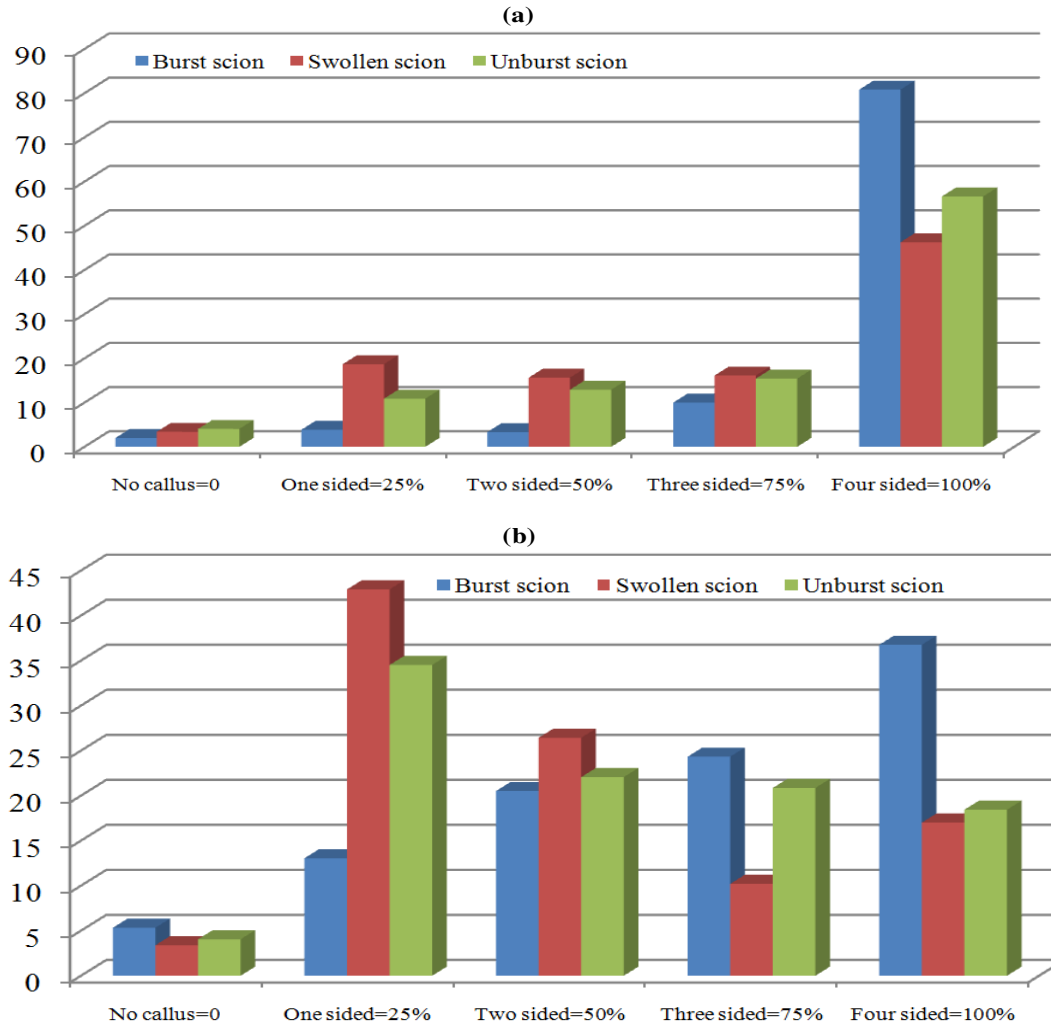

Figure 4. Grade of callus formation from cutting (a) and scion (b) (%).

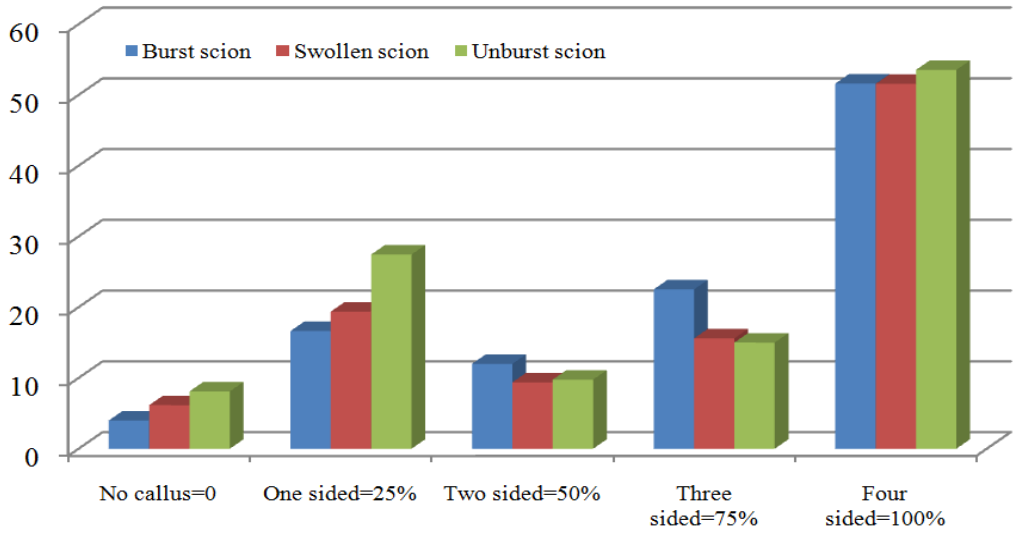

Figure 5. Grade of callus formation (%).

Figure 6. Grades of callus formation.

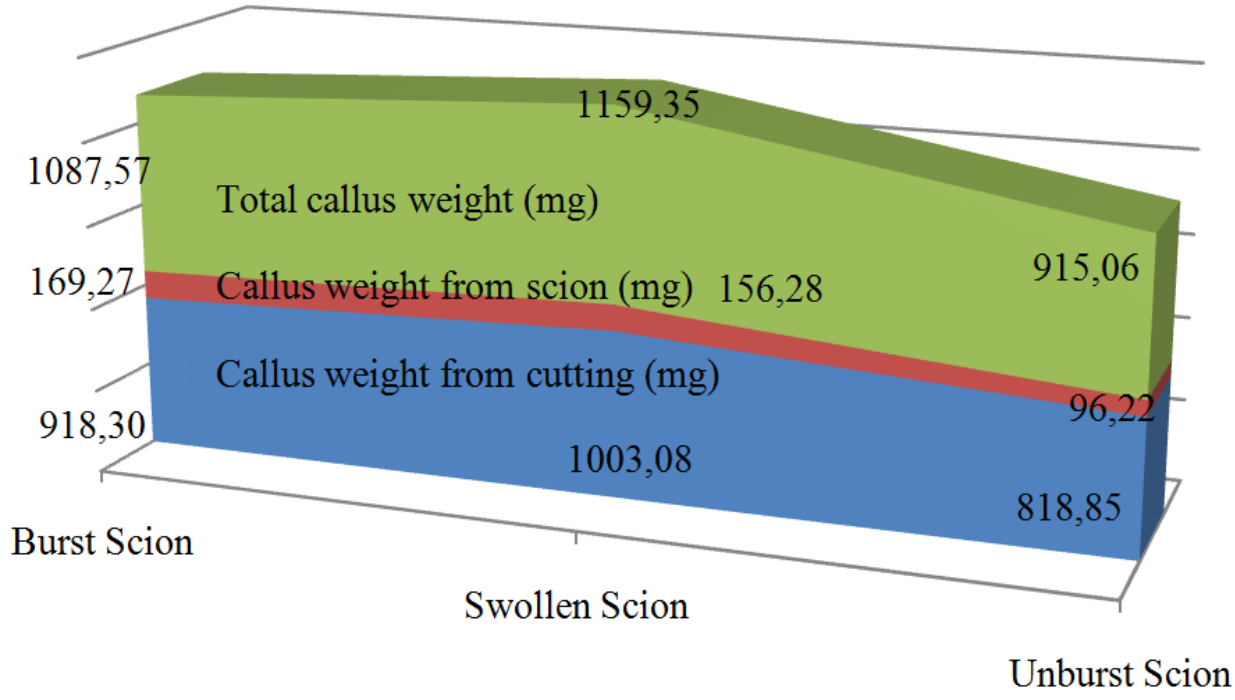

Figure 7. Callus fresh weights (mg).

spring (usually end of the February) as dormant wood cuttings. At this point, most of the carbohydrates are stored as starch (Olmstead and Keller, 2007). Swollen and burst scion's bud start to grow by being powered by energy derived from stored carbohydrate (Carbonneau et al., 2007; Creasy and Creasy, 2009). Therefore, swollen or burst scion can also be successfully used in bench grafting.

Conclusion

Traditionally, unbursted scions are grafted into unbursted cuttings. However, the results of this study show that;

(1) The callus formatted from bursted cutting is generally more than the callus formatted from the scion.
(2) In bursted cuttings, the cambium was activated before

accelerated callus formation, which rapidly covered the grafting point.
(3) The callus formation from the swollen scion was more than the others and had a positive effect on grafting union and in determination of bud health condition.

As a result, along with the traditional method because of their positive effect bursted, cuttings and swollen scions can be successfully used in bench grafting and in production of grafted-rooted vine.

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