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DETERMINATION OF GRAFTING UNION SUCCESS IN 0900 ZIRAAT AND STARKS GOLD CHERRY CULTIVARS ON GISELA 5 AND SL 64 ROOT STOCKS

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Abstract

This research was conducted to determine the compatibility of graft combinations in 0900 Ziraat and Starks Gold Cherry scions and Gisela 5 and SL 64 L clone stocks. Sometimes intensive necrotic layers and insufficient cambial continuity was detected at the 6 months old graft sections at both combination. At the cross and longitudinal sections of 12 months graft of all combinations, development of cambial continuity and new healthy vascular system formed successfully. In addition differences in tissue development quality were observed depending on combinations. However, to find out the reasons of late incompatibility of some combinations, more research on biochemical differences and further field observations of the combinations would be useful.

Introduction

Grafting is the operation of connecting two pieces of living plant tissue together to grow and develop as one plant. The basis of unity between two parts of plant depends on mutual responsibility.

The first step for successful grafting depends on a delicate work performed by an experienced person since the most important step in grafting is to match the cambium layers of stock and scion. Next step depends on hormonal and biochemical interaction between graft components, stock and scion, and on climatic conditions. During the graft union, the first step is the formation of callus. For a successful callus formation, very tight contact of graft components is crucial since strength of graft union is highly related with the contact of stock and scion. It was reported that cell division resulted from accumulation of dictyosomes along the cell walls and callus formation has started 6 hours after grafting, arising from living cells behind brown line of dead and crushed cell which plays important role in grafting union. These cells have been produced by living cambium, phloem, and young xylem parenchyma and sometimes by cortex cells. Callus should be formed well enough by both graft components. After grafting, the space between the two components of the graft has been filled by callus, providing limited passage of water and nutrients between the stock and scion. Callus formation takes 2-3 weeks and then new cambium tissue has been developed from the callus. It was known that vascular system has been connected in 6-8 weeks (Soule, 1971; Moore, 1981; 1982; 1983).

Unsuccessful grafting depends on callus formation during the graft union and the failure of either cambial differentiation or incomplete steps during this period. These incomplete steps would result from a technically incorrect graft, time of year, incompatibility between stock and scion and environmental factors such as temperature and moisture. In case of utilizing different stock and scion species, graft incompatibility is much more noticeable and arise clearly due to anatomical, physiological and biochemical differentiation and their interaction. In general, anatomically graft incompatibility is result of union of cambium tissues of stock with scion to establish callus formation. Unsuccessful graft would be determined by anatomical or histological examination at this stage, since cambium develops within 6 to 8 weeks. However, this kind of evaluation would give information only about anatomical incompatibility, but results will not be used to obtain information regarding physiological and biochemical effects in future. The present report describes the grafting union success in 0900 ziraat and starks gold cherry cultivars on Gisela 5 and SL 64 roots stocks.

Materials and Methods

This study was carried out in the Egirdir Horticultural Research Institute. 0900 Ziraat and Starks Gold Cherry varieties were grafted by using T budding method on 1 year old Gisella 5 (148/2) (*Prunus cerasus* x *Prunus canescens* cross) and SL64 (*Prunus mahalep* clone*)* stocks.

Longitudinal and cross sections of 30-40 µm diameter were taken in 6 and 12 months by using SM 2000R microtome for anatomical and histological examination. For macro observation, 12 month-old cross-section samples were taken by using saw since stocks were too thick. Cut surfaces were painted by using 1% potassium iodide solution, after that cut surfaces were sandpapered and starch accumulation was observed between stock and scion.

Samples, dyed with IKI and sealed with glycerin, were investigated separately. After this step, the photographs were taken by means of a computerized camera that zooms in 20-25 times.

Results

Six months after grafting of 0900 Ziraat variety (scion) grafted on Gisela 5 stock, necrotic plate was observed at the side combination of stocks with scion on the cross-section of grafting. Also cambial continuity was observed between the stock and the scion cambium differentiation in the barely formed callus tissue (Fig. 1).

Similarly, six months after grafting in 0900 Ziraat/Gisela 5 stock combinations, local necrotic plates were observed at the side graft union of another cross-section taken from grafting zone. In addition, cambial continuity occurred between the stock and the scion. On the other hand, it was detected that new vascular system was generally very weak in the 6 month-old cross sections (Fig. 2).

Six months after grafting in S.Gold cherry/Gisela 5 stock combinations, intensive callus tissue originated from cortex and new cambium differentiated from this callus on the side union of cross sections taken from grafting zone. However, it was observed that vascular connection did not yet complete at this union point (Fig. 3). In this sample, parenchymatic tissue occurrence related to incompatibly was not observed. Unsuccessful cambium continuity may result from differences in the cortex thickness of the stock and the scion.

Six months after grafting in SL-64/0900 Ziraat combination, it was observed that cambial differentiation was completed satisfactorily and cambial continuity was still carrying on in the cross section of grafting (Fig. 4).

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 1. Cross section of 6 months old Gisela 5/0900 Ziraat graft combinations (20x).
Fig. 2. General appearance of side graft union of 6 months old Gisela 5/0900 Ziraat graft combinations (20x).
Fig. 3. Appearance of tissues on side graft union of 6 months old Gisela5/S.Gold graft combinations (20x).
Fig. 4. General appearance of side graft union of 6 months old SL-64/0900 Ziraat graft combinations (20x).
Fig. 5. General appearance of graft zone of 6 months old SL-64/S.Gold graft combinations (20x).
Fig. 6. General appearance of graft zone and necrotic plates of 6 months old SL-64/S.Gold graft combinations (20x).
Fig. 7. Aappearance of longitudinal sections of bottom side of graft union of 12 months old G.5/0900 Ziraat graft combinations (25x).
Fig. 8. Appearance of cross sections of graft union of 12 months old G.5 / 0900 Ziraat graft combinations (25x).

Fig. 9

Fig. 10

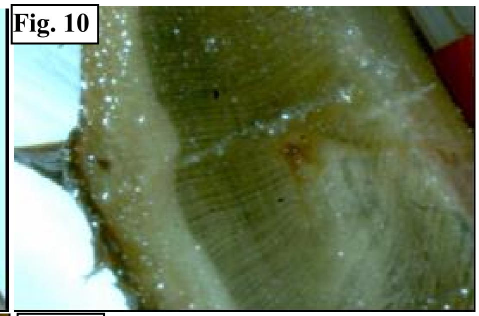



Fig. 11

Fig. 12

Fig. 13

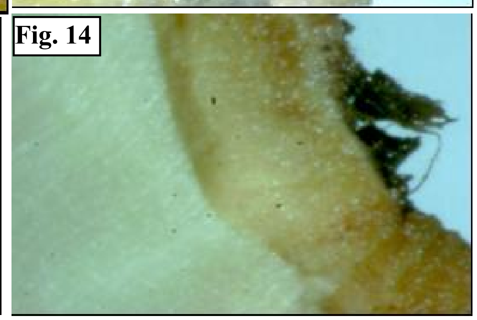
Fig. 14


Fig. 10. Appearance of vascular tissues on cross sections of graft union of 12 months old G.5 / S. Gold graft combinations (25x).
Fig. 11. General appearance of vascular tissues of bottom side of graft union of 12 months old SL 64/ 0900 Ziraat graft combinations (25x).
Fig. 12. General appearance of tissues on cross sections of graft union of 12 months old SL 64/ 0900 Ziraat graft combinations (25x).
Fig. 13. Appearance of vascular tissues of graft union of 12 months old SL 64/ S.Gold graft combinations (25x).
Fig. 14. The appearance of tissues on cross sections of graft union of 12 months old SL 64/ S.Gold graft combinations (25x).

Six months after grafting in S.Gold cherry variety grafted on the SL-64 stock, it was observed that new cambium and vascular tissues belonging to the scion developed from necrotic plates localized the scion, and cambium of stock and the scion showed continuity by making high curve along with the sides of graft components (Fig. 5).

Six months after grafting in SL-64/S.Gold graft combinations, vascular tissues relative to the stocks and the scion, callus having parenchymatic tissue, necrotic plates, and cambial unity were detected in another cross-section of grafting (Fig. 6).

Twelve months after grafting in Gisela 5/0900 Ziraat graft combination, it was observed that vascular tissues showed continuous and healthy growth related with the stock and the scion at the longitudinal and cross section samples taken from the bottom zone of the grafting (Figs. 7,8).

Twelve months after grafting in the Gisela 5/S.Gold graft combination, the healthy growing tissues relating to the vascular system was observed at the longitudinal and cross sections taken from the bottom zone of grafting (Figs. 9,10).

Twelve months after grafting in SL 64/0900 Ziraat graft combinations; some intensive necrotic plates were observed at the longitudinal and cross section samples, taken from the bottom zone of the grafting, and also the cambial continuity and growing points related to the vascular tissue especially at the longitudinal section samples. On the other hand, clear cambial continuity from the interior of the callus tissue growth just above the necrotic plates was not detected (Figs. 11,12).

Twelve months after grafting in the SL-64/S.Gold graft combinations, it was observed that the development of vascular system was regular and healthy at the longitudinal and cross section samples from the bottom zone of the grafting (Figs. 13,14).

DISCUSSION

There are four important stages in graft union. The first stage is to make tight contact between rootstock and scion, matching cambium tissues, and then the occurrence of callus just after the grafting (Errea *et al*., 1994). Callus tissues were produced at both side of the graft components and they combined to make connection between rootstock and scion (Mosse, 1962; Moore, 1984). Callus cells should be formed at both graft components. While callus tissues at rootstock are formed from young xylem cells, at scion they are formed from undamaged bark cambium, young phloem ray cells, and sometimes from cortex (Simons, 1987; Kankaya *et al*., 1999). The callus formation is produced by live cells, located behind the dead cells during grafting process, as a response to injury (Polat, 1990). In order to establish callus bridge, callus cells should make connection between graft unions by cracking the dead cell groups, which have brown colors due to the oxidation of phenolic components and injured during graft process.

The second stage for successful grafting is cambial differentiation in callus tissue which is formed from scion. Previous studies in different plant species indicated that cambial differentiation formed 2-3 weeks after grafting (Ashurov, 1977; Hartmann & Kester, 1983; Errea *et al*., 1994). In this study 6 months graft samples were investigated and cambial differentiation were found at graft samples. The other two important stages in grafts are to obtain continuous cambium formation and to establish vascular system. While callus formation and cambium differentiation plays important roles, cambium continuity and vascular system formation have been more important for graft union. In this study, graft samples, which were taken 6 and 12 month after grafting, were investigated. During these investigations, cambial differentiation, cambial continuity and the formation of new vascular tissues were investigated to explain the effect of anatomical and histological formation on cambium union. At the 6 months graft samples of some combinations, intensive necrotic layers and insufficient cambial continuity in the graft section was noticeable. These results may be attributed to the differences between the scion and the stock thickness, tannin density and damaged tissue problems (Ünal, 1992; Kankaya *et al*., 1999). Because of the problems mentioned above, 12 months graft samples were examined more carefully at the connection sides of the graft union.

Development of cambial continuity and new vascular system formed healthy and successfully at the cross and longitudinal sections of 12 months graft samples of all combinations. However, differences in the quality of tissue development depending on combinations were observed. As a result, negative development that would be problem at the further graft union stages was not observed anatomically.

The results and observations in this research agree with those of Ünal & Tanrısever (1986); Tekintaş (1988); Kankaya *et al*., (1999); Errea *et al*., (1994). However, biochemical differences of the combinations should be examined and further field observations of the combinations should be done, because late incompatibility was seen in some graft combinations.

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