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AN ANATOMIC ANALYSIS OF THE EXTENT OF COMPATIBILITY IN THE PISTACHIO SEEDLINGS BUDDED IN DIFFERENT PERIODS

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Abstract

This research aims to make an anatomic analysis of the extent of compatibility in the budded parts of the cross sections taken from *P. vera* seedlings which are T-budded in the spring and autumn budding periods. It is derived that, in all patterned after the budding period, compatibility in the buddings that are done in the spring budding period is much quicker and healthier when compared to the buddings in the autumn budding period.

Key Words : Pistachio, budding, anatomical observation

1. Introduction

Compared to the other growing techniques, budding in pistachio raising leads to more successful results and gains importance due to its suitability to pistachio- specific raising techniques (1). However, compared to the other fruit species, the process of budding in this species implies greater care and attention concerning the time and the technique of the budding (1,2).

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In the studies produced by many researchers about pistachio budding, the best time for budding and the methods for the most successful budding are mentioned (3, 4, 5, 6, 7). Although varying with the place and the year, in the regions where pistachio raising is practiced, the most appropriate time for pistachio budding in general is reported as the spring budding period beginning from the mid of May till the end of June. Whereas, during the autumn budding period, which lasts till the end of August and mid of September, it is quite hard to remove the bark from the stock, the process of budding gets much more difficult and the success of budding fails. In addition, due to its considerable success and its ease in practise, the use of budding is suggested (1, 2, 3, 4, 5, 6, 7). In our country, T-budding is widely practised in pistachio raising, leading to successful results (1, 2, 8, 9, 10).

Besides the appropriate time and technique for budding, some other factors like the careful practice of the budding concerning its technique, maintenance tasks also have important roles in the success of budding. In addition, the cambial relations between the stock and the scion emerge as an important stage in the success of budding and in obtaining a healthy budded sampling (11, 12, 13, 14, 15).

In our study, considering the *P. vera* seedlings that are budded in different periods, the anatomic structure in the budded parts is analysed and the impacts of those different budding periods on the cambial activity, which affects the success of budding, are explored.

2. Material and Methods

The research is carried out in Gaziantep, a province with a highly considerable status regarding pistachio raising, in the conditions provided by Pistachio Research Institute.

As the stock, *Pistacia vera* L. seedlings are employed due to their stock characteristics and their importance for producing more lateral roots compared to other species. Budding scions are taken from the Siirt cultivar, which has lower susceptibility to periodicity and higher fruit quality.

P. vera seedlings, which were produced by planting seeds in the 20x50 cm. black plastic bags using 1/3 thiny sand + 1/3 burned barn fertilizer + 1/3 sieved sand, are budded when they reached to the optimum thickness needed for budding. The process of budding was practised in the spring (at the beginning of June) and in the autumn (at the end of August) budding periods and T-budding was employed as the budding technique (1, 2).

On the 7^{th}, 14^{th}, 21^{th} and 28^{th} days after the process of budding, a sample of 15 seedlings was randomly selected from each budding period and the seedling, which was cut in a way leaving 3 cm. below and above the budded parts, was fixed in FAA solution (15). The cross sections with 50 μ thickness that were obtained by a hand microtone were stained by safranin and fast green double technique, and the extent of compatibility of the tissues was analyzed.

3. Results and Discussion

When an analysis of the sections which are taken from the bud joint points of *Pistacia vera* L. seedlings that are budded in spring budding period is made, it is observed that there occurs an increase in parenchymatic cells in the budded part during the first two weeks (7^{th} and 14^{th} days) following the budding and that the new callus cells are just beginning to appear whereas the formation of callus bond in the budded part is not complete (Figure 1, 2).

It is known that budding has four stages for a budded part to heal. These are; the combination of the budding elements from the cambial regions, the formation of the callus bond by the mutual appearance of the parenchymatic cells, to provide the cambial continuity and to make new phloem and xylem tissues appear from the new cambial tissue (11).

In our study, the initial ones of those main stages were observed to occur during the first two weeks following the spring budding.

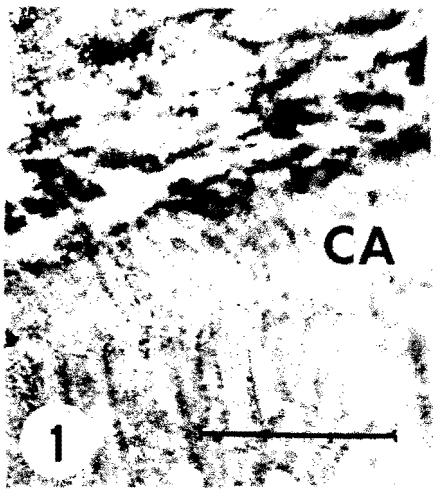

Figure 1. The newly formed callus cells in the budded part in the cross sections taken 7 days after the budding from the budded part of *P. vera* seedlings T-budded in the spring budding period.
Bar: 200μm (CA – Callus)

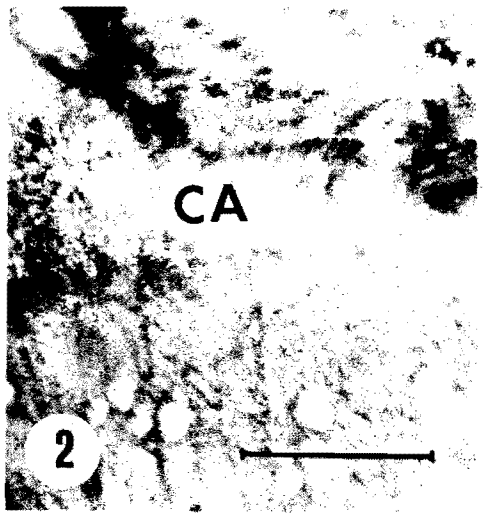

Figure 2. The newly formed callus cells in the budded part in the cross sections taken 14 days after the budding from the budded part of *P. vera* seedlings T-budded in the spring budding period.
Bar: 200μm (CA – Callus)

In the cross sections taken in the third week (21st day) after the budding, it was found that in the majority of the bud joint points, the cambial relation between the stock and scion had been established (Figure 3A). The intensity of the cambial relation between the stock and scion was not the same in all joint surfaces. Especially in the edge regions where the stock and scion tissues join, a more active growth of the callus tissue was observed.

In the surface where the mid surface of budded part joins with the stock, the establishment of the cambial relation took much more time compared to that one in the edge regions. Besides these, it was realized that new xylem elements had already formed (Figure 3B).

Figure 3. In the cross sections taken 21 days after the budding from the budded parts of *P. vera* L. seedlings T-budded in the spring budding period A) curvilinearly established cambial continuity in the budded part B) callus cells and differentiated new xylem elements
Bar : 200μm (NC - New Cambium, CA - Callus, Ca - Cambium, Xy - Xylem)

In the cross sections taken in the fourth week (28th day) after the budding, it was found that in all surfaces of the budding elements, the cambial relation had been established (Figure 4).

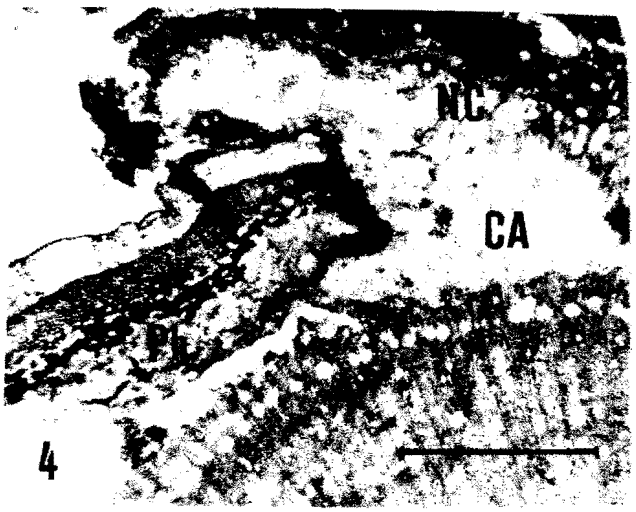

Figure 4. In the cross sections taken 28 days after the budding from the budded parts of *P. vera* L. seedlings T-budded in the spring budding period, cambial and vascular relation established on the callus bond in the budded part

Bar : 200 μm (CA - Callus, NC - New Cambium, Ph - Phloem)

In the cross sections that were taken from the budded parts of P. vera L. seedlings budded in autumn budding period, the callus formation between the stock and budded surfaces could be observed only in the sections taken in the second week (14^{th} day) (Figure 5). In the sections taken in first week (7^{th} day) after the budding, any cellular activity was not reported.

Figure 5. In the cross sections taken 14 days after the budding from the budded part of *P. vera* L. seedlings T-budded in the autumn budding period, the newly formed callus cells.
Bar : 200μm (CA - Callus, Ca - Cambium, Xy - Xylem, Ph -Phloem)

In the seedlings budded in the autumn budding period, the formation of the callus stratum between the stock and budded surfaces could be observed in the sections taken in the third (21st day) and fourth (28th day) weeks (Figures 6 A and B, Figure 7).

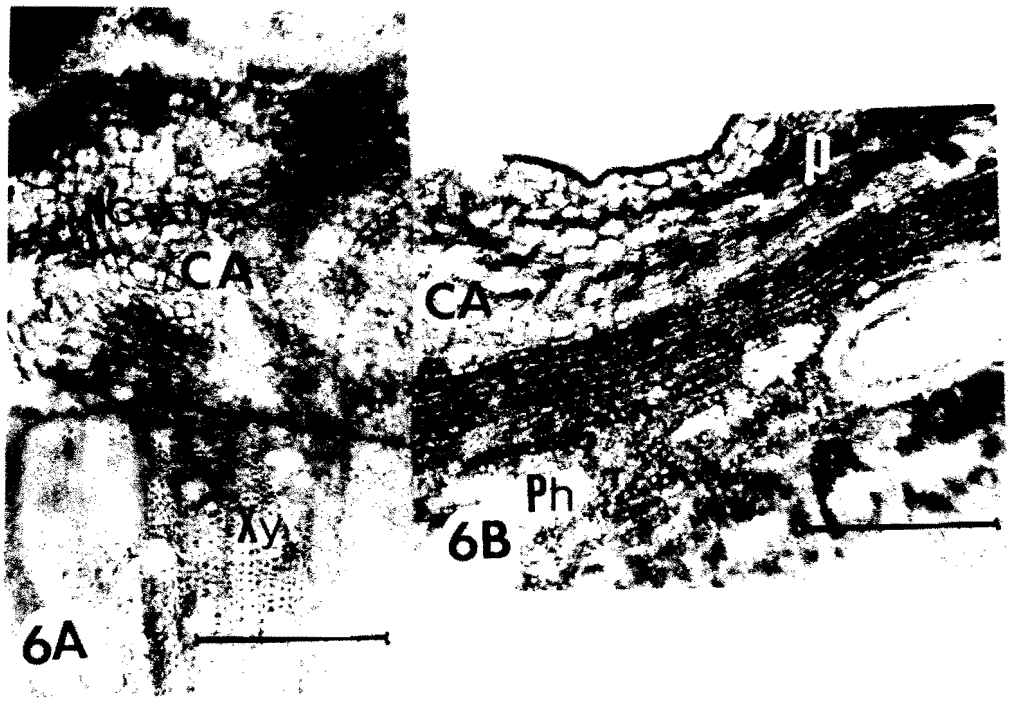

Figure 6. In the sections taken 21 days after the budding from the budded parts of *P. vera* L. seedlings T-budded in the autumn budding period, A) callus tissue formed by budding elements B) the newly formed phellogen (P) strata.

Bar : 200µm (CA - Callus, NC - New Cambium, Xy - Xylem, Ph - Phloem, P - Phellogen)

Figure 7. Cambial relation established in the budded part in the sections taken 28 days after the budding from the budded parts of *P. vera* L. seedlings T-budded in the autumn budding period,
Bar : 200 μm (CA - Callus, Ca - Cambium, Xy - Xylem, Ph - Phloem)

It was found out that the cambial relation among the budding elements was established earlier in the seedlings that are budded in the spring budding period. Concerning the budding in both periods, new xylem differentiation was much more seen in the stock of the budded parts. While the callus bond between the stock and budded part was linear through the section, it was curvilinear at the points of congruency of the stock and budded part. It is seen that our findings above are similar with those of Balta et al. (15).

When the budding periods were compared, it was reported that, in the seedlings budded in the spring period the cambial bond among the budding elements had been established earlier than the one in the autumn

budding period and the activity in the cambium strata occurs in a wider surface as well.

Likewise in their studies about pistachio, Ibrahim and Nahlawi (3, 4), Needs and Alexander (5), Nahlawi et al. (6), Mamedov (7) and Kuru et al. (8) mention that the budding in the spring budding period leads to more successful results, the success of budding is achieved quicker and growth of the branch begins earlier when compared to those in the autumn budding period.

Especially in the spring period, the compatibility in the budded part is completed in a cellular level in the first three weeks. A similar case is reported by Balta et al. (15, 16) who mention that in the sections taken 25 days after the budding, in the majority of the bud joint points, cambial relations between the stock and the scion had been established. Besides, Kuru et al. (8) and Ozbek (17) mentioned that the success of the budding can also be understood by naked eye considering certain criteria like checking the wrinkle and the colour of the bark in the budded part approximately 20 days after the budding.

Also, in our study, it was found out that anatomically, the compatibility in the budded part had been established in the first three weeks after the budding. Furthermore, another finding indicates that when compared to autumn period, compatibility in spring budding period occurs much quicker. This condition can be explained by the cell division that provides the cambial activity –which consists of the main stages for the compatibility of budding elements- and the effect of the heat on the formation of activities.

Whereas the temperature is more appropriate for cell activation in the spring periods including June, in the autumn periods including August and September, due to the high temperature, cell activity gets slower in the regions where pistachio raising is practised. This approach is consistent with

the findings of researchers who report the difficulty in removing the bark from the stock and in the budding process, and the low success rate of budding in the buddings during August and September when the temperature is quite high (8, 17, 18).

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