ANATOMICALLY INVESTIGATIONS OF GRAFT UNION IN SOME COMPATIBLE AND INCOMPATIBLE PEARS GRAFTS

INVESTIGAȚII ANATOMICE ASUPRA PUNCTULUI DE ALTOIRE LA UNELE COMBINAȚII COMPATIBILE ŞI INCOMPATIBILE DE PĂR ALTOITE PE GUTUI

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Abstract: *Light microscopy was used to study the graft union formation of five compatible (Curé) and incompatible (Triumf, Trivale, Contesa de Paris, Williams) three years old pear cultivars grafted on quince (Cydonia oblonga). Observations of graft unions showed necrotic points at the xylem in the cutting zone of the incompatible combinations graft union. The cambium connection between rootstock and scion in compatible graft combination after three years was completed. On the other hand, in incompatible combinations was observed that most part of the callus did not differentiate and cambium occurred partly. In addition, vascular differentiation did was not completely and necrotic layers increased during the periods after grafting. The visual observations were observed in the graft union zone between different cultivar. The poor performance of Trivale and Contesa de Paris cultivars may be caused by partial blockage at the graft union, or reduction in movement of water and nutrient materials, or both. Ultimately, malfunctioning of the graft union adversely affect assimilate translocation.*

Rezumat: *S-au efectuat observații microscopice asupra secțiunilor realizate prin punctul de altoire a cinci soiuri de păr aflate în anul al treilea de vegetație (Triumf, Trivale, Contesa de Paris, Williams şi Curé) cu grade de compatibilitate diferite cu gutuiul (Cydonia oblonga). Observațiile efectuate au arătat prezența unor puncte necrotice la nivelul xilemului în cazul combinațiilor incompatibile. Conexiunile cambiale dintre altoi şi portaltoii în cazul soiului Curé s-au realizat complet, pe când în cazul combinațiilor incompatibile cea mai mare parte a calusului nu s-a diferențiat în țesut cambial. De asemenea, s-a constatat faptul că diferențierea țesutului vascular a fost perturbată observându-se raze necrotice care se accentuează în timp la combinațiile incompatibile. S-au constatat diferențe privind procesul de regenerare a simbionților la diferite soiuri. Simptomele cele mai accentuate s-au observat în cazul soiurilor Trivale şi Contesa de Paris, la care anomaliile pot cauza reducerea circulației sevei prin punctul de altoire, generând în scurt timp simptome certe de incompatibilitate.*

Plant grafting is a widely used means of plant propagation and growth control that is of considerable importance in the adaptation of interesting cultivars

in appropriate areas. The grafted partners can belong to the same species or genus, but usually components that are more genetically divergent are used. In these cases the stock and scion do not always constitute a successful graft and show their disagreement in the form.

The development of graft union is a process of forming a functional unit through the interaction of organs, tissues or cells from the same or different plants (Shanfa, 2000). A number of detailed studies have been made about graft union formation with woody and herbaceous plants (Hartman et al. 1997).

The anatomical changes that occur during graft union formation are in the approximate order of occurrence, following grafting in many plants. These include the death of layers of cells at the graft interface, cohesion of scion and rootstock, generation of callus and establishment of vascular continuity and a new stem centre (Miller, Barnett 1993). According to Moore (1984), the development of a compatible graft includes three events: cohesion of rootstock and scion, proliferation of callus cells at the graft interface, and vascular differentiation across the graft interface.

The mechanism, in which incompatibility is expressed, is not clear and several hypotheses have been advanced in an attempt to explain incompatibility. In many cases incompatibility is manifested by the breaking of the trees at the point of the union particularly when they have been growing for some years (apricot on Prunus grafts, pear on quince grafts).

The objective of this study was to investigate the structural development of graft union formation in some Pyrus combinations at early stages of incompatibility.

MATERIAL AND METHODS

The trial was performed at the Faculty of Horticulture in the experimental field from S.D.E. „V. Adamachi"-Iasi.

Research material was represented by *Pyrus* genous varieties, which are not compatible with *Cydonia oblonga*. The determinations were made on trees in the third growing season .

The trial was set up on a lot in the spring of 2004 when rootstocks of *Cydonia oblonga* were planted at 90×20 cm. In August these rootstock were budded the incompatible varieties Triumf, Trivale, Williams and Comptesse de Paris. Curé pear variety was used as witness because it has a good compatibility with quince. Morfo-anatomical studies were made concerning the rootstock-scion combinations with different compatibility degrees.

For histo-anatomical observations vegetal material was fixed in ethylic alcohol 70% for proprieties and form of the cell walls conservation. With semi-automatic microtome, sections were made through vegetal material, which were conserved in Javel water 40 minutes for excluding the cell content. Preparations were washed with acetic water, and colored first with methylene blue for 10 minutes, washed with

distilled water, colored once again with red ruthenium, washed with alcohol 90^0 for moving away the coloring matter and fixed in Canada balsam.

The observations were made with Motic microscope using 10 ocular and 4 objective and captures were made using the Motic camera.

RESULTS AND DISCUSSIONS

First period after grafting is characterized by intensification of metabolic processes and by growing and specialization of tissues. Quick knitting and vascularisation at the graft point indicate the compatibility of the two partners. If they are incompatible, between the two surfaces a stratum of cambium and felogenous, and later a suber appears, which later cicatrizes, isolating the two grafting partners.

Between these two extreme cases there are numerous situations where, initially the knitting takes place, but, in time the grafted tree presents low compatibility symptoms like: presence of parenchyma tissues at the graft point, the deformation of vascular tissues, the interruption of the wood and bark, and forming of the wood bridges.

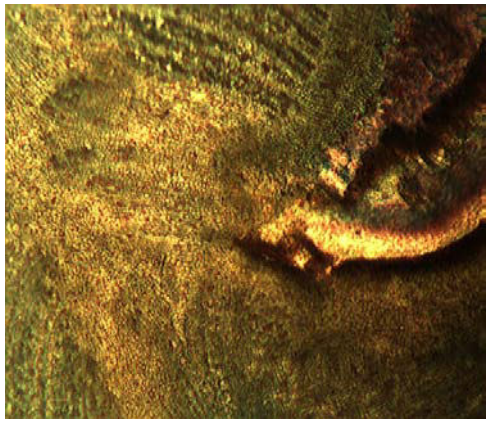

Fig. 1. Comtesse de Paris - necrotic point

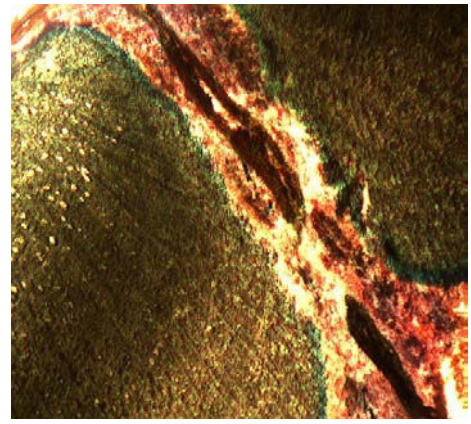

Fig.2. Comtesse de Paris – presence of *non-differentiated parenchyma at union line*

The observations made at the Comptesse de Paris variety (fig.1 and 2) the lignified tissues of the scion and rootstock were separated in many places by a parenchyma tissue. Between rootstock and scion a parenchymatic compact stratum was formed and bark stratum of the two partners were separated by a dark color tissues. The vascular tissue differentiation was destroyed, and we observed necrotic rays which may cause the reducing the circulation of the sap through the graft point and generate in the short time certain symptoms of incompatibility.

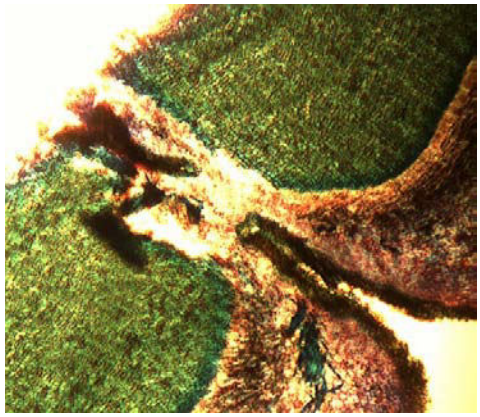

Fig. 3. Trivale - bark stratum penetrating the vascular tissues

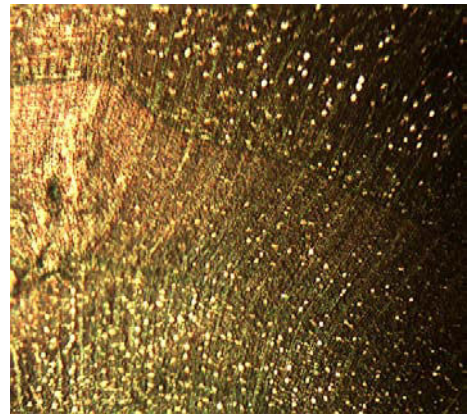

Fig. 4. Trivale – deformation of the vascular tissues

Regarding Trivale variety (fig. 3 and 4) we observed the inclusion of cortical tissues between the cambial tissues. The bark stratum comes to the cambial tissues of the scion and rootstock.

The cambium generated a little tissue which reconstituted the conducting vessels continuity, so that water and mineral substances could arrive into the scion and start his growth. The bark arrived in cambial zone, and was cought between scion`s and rootstock`s xylem and because of that, the knitting become fragile.

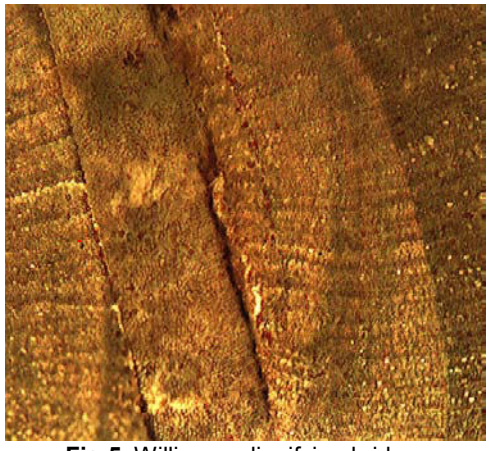

Fig.5. Williams – lignifying bridges

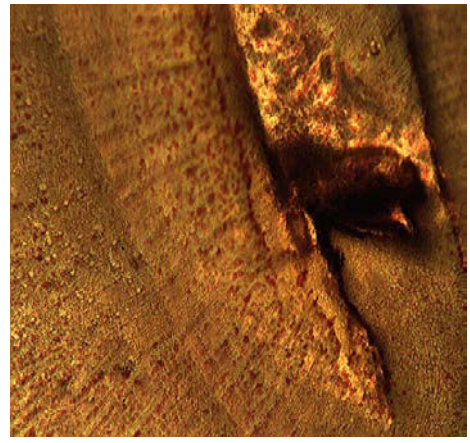

Fig.6. Williams – necrotic point

Graft incompatibility was pit into evidence at the Williams variety (fig. 5, 6) by presence of some necrotic points in grafted area which determined interruption of sap circulation between rootstock and scion. Between the two surfaces a cambium and felogenous and later, a suberus stratum formed. The

damaged surfaces were healed and the two partners were isolated which proved that knitting and vascularization didn't take place.

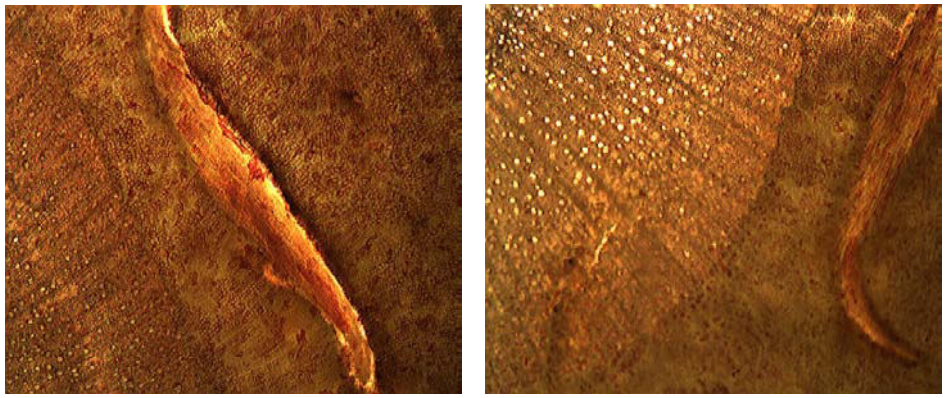

Fig.7. Triumf – wood vessels discontinuity

Sections made at Triumf variety at the graft point (fig. 7 and 8), made in evidence the presence of some necrotic points which determined the interruption of vessels continuity, lignified tissues of the scion and rootstock being separated in many places by the dark suber tissues.

Because a direct contact between cambial tissues of the two partners was not established, the absence of supply with sap, conducted to necrosis of both scion and rootstock tissues.

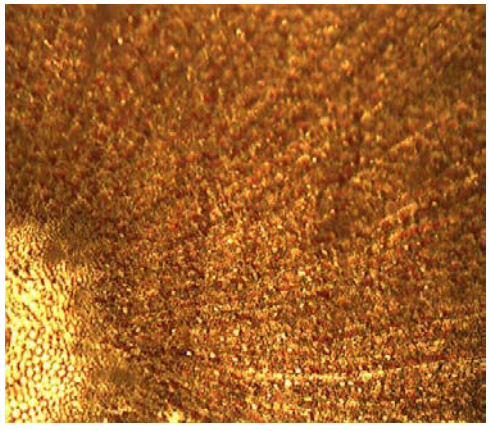

Fig.9. Curé-*central cylinder and vessels*

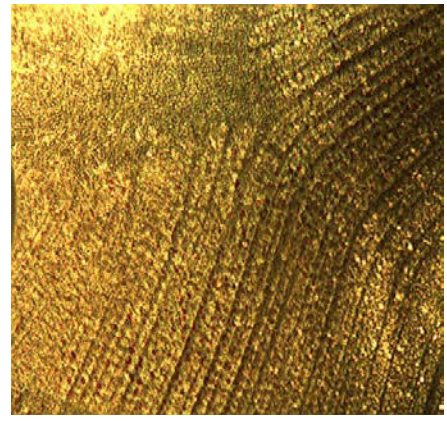

Fig.10. Curé- *distortions of the vessels*

Regarding the Curé variety, whose grafting succeed, we observed a continuity of the rootstock and scion cambial tissue. By the meristematic tissue activity result the new conductible tissues (xylem and floem), assuring both

supply with water and mineral substances of the scion and the transport of assimilates to the rootstock.

However, in this case we can observe some deviations of the wood conducting vessels, which may generate difficulties in sap circulation through the graft point and the installation in future of some incompatibility symptoms.

On the other way these deviations, resulted after partners union, may have a normal functionality, which lead to a satisfying development of planting material obtained.

CONCLUSIONS

After the morfo-anatomical observations made at pear varieties grafted on quince, we identified:

1. Incompatibility phenomenon was evident at the varieties: Comptesse de Paris by the presence of the undifferentiated parenchyma on the graft union area and Trivale variety by the invaginated bark stratum.

2. In the case of Williams *and* Triumf varieties, the phenomenon of incompatibility was less visible, of these varieties meeting discontinuity of the wood vessels and bark and forming of the ligneous bridges.

3. Regarding the witness variety, Curé, although we observed some deviations of the conductible tissues, grafting is considered a success because of continuity of the cambial tissues between rootstock and scion.

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