SUMMARY

Cuvinte cheie: grafting incompatibility, scion, rootstock, pear, plum, apricot.

Grafting is a vegetative propagation method through which the stock and the scion accept each other and live together as a new physiological entity with its own features and traits. After grafting, the joining of the scion with the stock is based on the regeneration capacity of the tissues of the plant and on the characteristic of the new tissues formed as a result of the injury to grow together if they are put in tight contact even if they come from different individuals. Nevertheless, there are cases in which the stock and the scion reject each other even if they belong to the same species. In the specialized literature, this phenomenon is called *incompatibility to grafting*.

The incompatibility to grafting is one of the most important issues that the fruit-growing practice must deal with. In horticultural terms, the incompatibility phenomenon is not limited only to the physical inability of the plants to form durable junctions in the grafting point, but it also refers to the capacity of the grafted plant to develop normally, to fructify and to go through all the ontogenetic development stages with a longevity characteristic to the respective species.

Due to the fact that the fruit production is in a permanent interdependency determined by the reduced compatibility of some scion-stock combinations, the choice of the varieties and of the stocks must be done judiciously. The compatibility between the scion and the stock is determined by the anatomical, physiological and biochemical resemblance which also determines the engraftment, the growth and the development of the trees from the nursery and the plantations.

Presently, one of the main objectives of the horticultural research is the creation of new varieties and stocks with high affinity to grafting.

It is known that the stock is the one that influences the exchange of the substances between the two partners, the quantitative content of minerals from the leaves of the scion and the different reactions of the trees to the hydric conditions of the soil. The compatibility is an important

characteristic due to the fact that the more compatible is the stock with a large number of varieties, the more valuable it is.

During the last years, the issue related to incompatibility has determined a significant increase of the number of studies regarding the manifestation of the anatomical, physiological and biochemical processes involved in the tissue regeneration processes of the trees grafted *in vivo* and *in vitro*.

Nevertheless, up to the present, the performed studies have not been able yet to predict the reactions of both partners shortly after grafting.

In order to establish the processes that stay at the basis of the incompatibility to grafting phenomenon, we have taken into account the anatomical-morphological, physiological and biochemical characterization of the intergrowth process and the further development of the grafted trees.

Thus, we have established the following objectives:

- assessment of the engrafting percentage, the further growth and development of the pear tree varieties (Curé, Untoasă Bosc, Contesa de Paris,Williams), the plum tree varieties (Stanley, Centenar, Tuleu timpuriu, Gras Ameliorat) and the apricot tree varieties (N.J.A.42, Tudor, Umberto, Goldrich) grafted on compatible stocks and on stocks with a low compatibility;
- determining the anatomical-morphological modifications of the scion-stock combinations with different compatibility degrees that would allow the efficient correlation of the physiological and biochemical processes that take place on the level of the grafting area, with the cell differentiation processes and forming of new tissues;
- monitoring some biochemical indicators such as the content of soluble glucides, the content of total nitrogen, the peroxidasic activity involved in the tissue regeneration processes of the grafted trees.

The doctoral thesis has 231 pages that comprise 42 tables, 50 figures and colour photos, the conclusions and the bibliography with 287 titles.

Chapter I presents the importance related to the production of the fruit-growing planting material on national and world level, the present trends and tendencies in the area of pear tree, plum tree and apricot tree stocks, as well as the biological foundations for grafting the fruit-growing varieties.

Chapter II describes the production technology of the planting material for the studied varieties.

Chapter III presents a synthesis of the present stage of the researches on national and world level regarding the incompatibility to grafting, beginning with the year 1934 and up to the present. This chapter also presents the assessment methods related to incompatibility, its manifestation forms and the anatomical-morphological, physiological and biochemical modifications that occur between the grafted partners.

Chapter IV presents the eco-geographical conditions of the researches, that is: the geographical location of „V. Adamachi" Didactic Station, the organizational framework, the relief, the soil and the hydrographical network of the area.

The temperate-continental climate with excessive aspects and optimal thermal potential (the average multi-annual temperature during 2001-2010 is 10,4^{o}C; the multi-annual average of the precipitations is 583,97 mm/year) provides favourable conditions for most of the fruit growing species.

The territory of the farm belongs to the forest steppe area and the location on the Plateau of Moldova and the placement between the steppe from the dried everglades and the forests from the high Western and Southern units, gives it more the layer quality than that of phytopedoclimatic area.

Chapter V presents the studied biological material and the used research methods. It presents the chemical analyses, the biometric determinations and the made observations.

Within the performed experiments, the biological material is represented by the species *Pyrus sativa, Prunus domestica* and *Armeniaca vulgaris*. Each species is represented by four varieties grafted on two stocks, one compatible and one incompatible.

Regarding the pear tree, the varieties Curé, Untoasă Bosc, Contesa de Paris and Williams are used to be grafted on *Pyrus sativa* (Harbuzeşti) and *Cydonia oblonga* BN 70 (quince tree).

For the plum tree, the four varieties are represented by Stanley, Centenar, Tuleu timpuriu and Gras Ameliorat that are grafted on the stocks *Prunus domestica* (P.F. Renclod green) and *Prunus cerasifera* (mirobolam tree).

Regarding the apricot tree, the grafting of the varieties N.J.A. 42, Tudor, Umberto and Goldrich is done on the stocks *Armeniaca vulgaris* (apricot tree) and *Prunus cerasifera* (mirobolam tree).

For achieving the proposed objectives and for obtaining some conclusive scientific results regarding the incompatibility to grafting in the case of some pear tree, plum tree and apricot tree varieties, on certain stocks, anatomical, physiological, biochemical and biometrical analyses have been carried out. The performed studies and the observations in order to establish the compatibility

between the studied varieties and the used stocks were carried out during October 2007 – September 2010.

The researches have been carried out both in the nursery, where biometric measurements are done in order to emphasize the influence of the incompatibility between the scion and the stock and in the lab, where anatomical-morphological, physiological and biochemical analyses are performed.

The biometrical analyses aim at the engraftment percentage, the height of the trees and the size of the trees on the level of the grafted area.

For the anatomical-morphological analyses, we have used 5 cm stem segments taken from the grafted area during the vegetation period that are preserved in 70^{o} ethanol. Further, we have made cross-sections through the grafting area using the microtome CUT 6062 Slee Mainz that are coloured with methylene blue and ruthenium red. The microscopic preparations are analyzed following the callus forming stage, the new vascular elements, the orientation of the xylem vessels, their number and size, the presence or the absence of the necrotic areas and the undifferentiated parenchymal cells.

The physiological analyses aim at determining the total quantity of assimilating pigments from the leaves and the dried substance from the leaves and the grafted area during the vegetation period for the analyzed varieties and stocks.

The biochemical analyses consisted in the determination of the contents in soluble carbohydrates, of total nitrogen content and of the gross protein at the level of the grafted area, as well as in the determination of the activity of the peroxidase in the leaves.

Chapter VI presents the results obtained following the research conducted with a view to attaining the proposed objectives.

The biometrical analyses performed on the three studied varieties revealed the existence of incompatibility between some varieties and stock. These combinations revealed a small percentage of bonding during the grafting procedure, the reduction of vegetation growth, significant differences of the ratio between the diameter of the scion and the diameter of the stock, differences concerning the diameter of the scion and stock.

The anatomic and morphological observations made with regard to the transversal cuts through the grafted area revealed the presence of callus and undifferentiated parenchyma at the incompatible combinations, as well as at the compatible ones, filling in the empty spaces which remained between the scion and the stock. As concerns the compatible combinations, the meristematic cells generated new conducting tissues: liberian fascicules towards the outside and wood fascicles towards the inside.

Following the differentiation of the meristematic tissue, we obtained new conducting tissues (woody and liberian), thus assuring the supply of water and mineral substances to the scion, as well as the optimum transportation of the photoassimilates to the stock. Nevertheless, just like in the case of the compatible variants, the newly formed conducting vessels presented some distortions in the area of the grafting point, which may determine the slowing down of the sap flow for this variant as well.

In the case of the associations with reduced compatibility, the callus did not differentiate itself in the cambium and vascular tissue, which led to the appearance of extended areas of undifferentiated callus cells at the level of the grafted area. We thus noticed a weak bond between the stock and the scion: the woody tissues of the scion and stock were separated in several places by parenchyma, and the bark layers of the scion and stock were separated by dark brown suberized tissues. The differentiation of the vascular tissue was affected and we noticed the presence of necrotic beams which influenced the reduction of the sap flow through the grafted area. The analysis concerning the diameter of the vessels of the two grafted partners revealed higher sizes of the scion in comparison with the values obtained for the stock.

As concerns the photosynthetic pigment content of the studied stocks, we noticed higher values for *Cydonia oblonga* and *Prunus cerasifera* in comparison with the value obtained for the *Pyrus sativa*, P. F. Renclod green and *Armeniaca vulgaris* stocks.

The green pigment content was influenced by the stock and registered bigger values for the combinations of pear grafted on quince, plum tree and apricot tree grafted on wax cherry tree. The a/b chlorophyll, chlorophyll b/carotenoids, chlorophyll/carotenoid pigments suggest that, at a physiological level, the studied varieties do not present any modifications determined by the reduced compatibility between the grafted partners.

As concerns the incompatible combinations, we noticed the accumulation of bigger quantities of soluble carbohydrate in the scion and at the level of the grafting point as a result of the slowing down of the sap flow through the union point between the scion and the stock. Nevertheless, we also observed the retention of carbohydrates at the level of the grafting point, which suggests the fact that the recovery of vascular continuity is not perfect. These results show that the distribution of sugars around the grafted area in the grafted trees that are in their first year of vegetation is not influenced only be the incompatibility between the partners, but also by the grafting process.

The determination of the total nitrogen content at the level of the grafted area presented a general tendency of growth at the level of the stock and grafted area. The obtained values outline the

existence of some difficulties concerning the circulation of nitrogen at the level of the grafted area, which indicates the presence of some deficiencies in the structure of the vessels recovered after the grafting.

As concerns the activity of the peroxidase in the leaves for the studied varieties, we obtained differences with regard to its level of activity at the scion/stock combinations which registered structural modifications at the level of the grafted area. Thus, the in the case of the varieties of pear trees grafted on quince, as well as in the case of the plum tree and apricot tree varieties grafted on wax cherry tree, we noticed a more intense enzymatic activity, which reflects the increase of the level of oxidative stress at the level of the combinations with reduced affinity.

The last part of the thesis comprises the conclusions and recommendations that announce the use of the results of anatomic and morphological, physiological and biochemical research in scientific projects aimed at assessing the degree of scion-stock compatibility of the new varieties obtained in order to start growing them.