

ASPECTS REGARDING GRAFTING INCOMPATIBILITY ON SOME CULTIVARS OF PLUM

ASPECTE PRIVIND INCOMPATIBILITATEA LA ALTOIRE LA UNELE SOIURI DE PRUN

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Abstract. *The mechanism of the incompatibility to grafting is considered to be a result of the mutual influence between scion and rootstock. In order to emphasize the early incompatibility phenomenon, both different biochemical and physiological processes have been studied on the level of the grafting area, as well as different compounds and mineral substances that are transported through the joining area. We performed biochemical analyses regarding the accumulation of nitrogen, soluble glucides and content of gross protein in the grafted combinations. The results showed differences regarding the transport of nitrogen and soluble glucides on the level of the grafting area. Thus, the compatibility between the scion and the rootstock is essential for the production and the use of the carbohydrates and nitrogen reserves which reflects the strength of the plant and the economic efficiency.*

Key words: graft, incompatibility, nitrogen total, soluble sugars

Rezumat. *Mecanismul incompatibilității altoirii este considerat un rezultat al influenței reciproce dintre altoi și portaltoi. Pentru evidențierea fenomenului de incompatibilitate timpurie au fost studiate atât diferite procese biochimice și fiziologice de la nivelul zonei de altoire, cât și diferiți compuși și substanțe minerele ce sunt transportate prin zona de uniune. S-au efectuat analize biochimice privind acumularea azotului, a glucidelor solubile și a conținutului de proteină brută la combinațiile altoite. Rezultatele au scos în evidență diferențe privind transportul azotului și a glucidelor solubile la nivelul zonei de altoire. Astfel, compatibilitatea dintre altoi și portaltoi sunt esențiale pentru producerea și utilizarea rezervelor de carbohidrați și azot fapt ce reflectă vigoarea plantei și randamentul economic.*

Cuvinte cheie: altoire, incompatibilitate, azot total, glucide solubile

INTRODUCTION

One of the biggest obstacles in producing trees is represented by the incompatibility of grafting. That could be the result of the genetic, physiological or anatomical aspects (Hartmann et al, 1997). The time necessary for the apparition of the symptoms of incompatibility is usually very long, so that in some cases years could pass by without the tree manifesting any visible symptom. Moreover, the anatomical symptoms manifested in early stages of the trees are not always

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clearly associated with the phenomenon of incompatibility (Andrews and Marguez, 1993). The reserves of carbohydrates play an important role in the metabolism, development, increase of resistance to freezing, defence and prevention of the mortality of the woody plants. The capacity of mobilization at the level of the deposit organs depends, among other factors, of the mechanisms to deposit (Wolswinkel, 1985) and the launch of carbohydrates, the metabolism of storing in the area of depositing (Daie, 1985). In case of using the combination of grafted peach tree on plum grafting carrier, the availability of the carbon in the roots and the assimilation of nitrogen by the graft present a very important role in the incompatibility of the grafting (Yano et al., 2002). The studies done by Moing and Gaudillere (1992), underline the importance of the content of carbohydrates and nitrogen for maintaining the vigour of the tree. Even though it is clear that the phenomenon of incompatibility is determined by the genetic differences of the two partners, the intimate mechanism by which takes place the phenomenon of rejection has not been clarified till date. A few hypotheses have been presented, explaining the causes of the appearance of this phenomenon, but none of them is not fully proved and supported by relevant experimental proves. Thus, the elaboration of some sure methods of early identification of the incompatible combinations is a modality to eliminate the economic loss in the tree practice.

MATERIAL AND METHOD

The experiment was located in the experimental field of the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" of Iasi from S.D.E. [Didactical Experimental Station] "V. Adamachi". The biologic material used is represented by four types of plum (Stanley, Centenary, Tuleu timpuriu, Gras ameliorat) grafted on graft carriers *Prunus cerasifera* and P. F. Renclocl green.

Studies were done during the vegetation period of 2010, the planted material being in the second year of vegetation. In order to realize the biochemical analyses, the tests were harvested at 2 cm above the grafting point, in the area of the grafting point, from 2 cm under the grafting point. Biochemical studies were done regarding the contents of the soluble carbohydrates (by means of Schoorl method), total nitrogen and brute protein (by means of the Kjeldahl procedure) at the level of the grafting area.

RESULTS AND DISCUSSIONS

The incompatibility is due to the lack of differentiation at the level of the grafting point of the tissues of callus in phloem and xylem tissues, aspects presented in the studies done by Moore (1983). These phenomena can provoke lack of combination between graft carriers and graft, which leads to the lack of graft lignifications with the graft carrier.

The distribution of the carbohydrates in the young plus trees implies the production of carbohydrates in the photosynthetic organs, the following translocation by phloem at the level of the organs of growth and deposit. In case of young plum trees, the content of carbohydrates is influenced by the graft carrier used, but this thing depends on the type of carbohydrates and the vegetation season (Gaudillere et al., 1992).

Providing minerals from the root to the trunk interacts with the assimilation and repartition of the carbon, which can influence the proportion of biomass between root and trunk. The proportion root/trunk is modified by environment factors, such as water and the availability of the minerals (McDonald et al., 1986). In order to establish the influence of the phenomenon of incompatibility on re-establishing the vascular continuity between the two grafted partners, it was determined the content of soluble carbohydrates and total nitrogen at the level of the grafting point. The reserves of carbohydrates play an important role in the metabolism, development, increase of resistance to freezing, defence, postpone and prevention of the mortality of the woody plants.

The results of the studies done with varieties of plum show a bigger accumulation of carbohydrates at the level of the grafting point, both in the variety grafted on *Prunus cerasifera* and in the variety grafted on *P.F. Renclod green*. On comparing the results obtained in the two varieties, it is underlined the degree of remaking the continuity of the vessels according to the compatibility between the partners and the age of the trees. In the case of the compatible variety, the resemblance from the anatomic point of view is underlined by the close values of content of soluble carbohydrates obtained at the level of the grafting point and graft carrier (table 1).

This is underlined by the close values of the content of carbohydrates at the level of the grafting point and graft carrier, both in the variety grafted on the graft carrier *P.F. Renclod green* and in the variety Stanley/*Prunus cerasifera*, combination known as being compatible.

The influence of the phenomenon of incompatibility determined in the incompatible combinations the accumulation of some larger quantity of soluble carbohydrates at the level of the grafting point comparing with the compatible variety. The largest average content of soluble carbohydrates at the level of the grafting area was underlined in the variety Tuleu timpuriu (39.04 mg/g s.u), followed by the variety Gras ameliorat (38.13 mg/g s.u). The lowest average value of the content of soluble carbohydrates at the level of the grafting area was noticed in the variety Stanley, being of 36.11 mg/g s.u.

In the incompatible varieties grafted on *Prunus cerasifera*, in the graft, the average content of soluble carbohydrates was bigger than in the graft carrier, but lower than in the grafting area. This fact suggests that, in the area of combining the two partners, there are some barriers in the anatomic structure, which hinders the transportation of the photo-assimilated towards the graft carrier.

Since in both varieties it was noticed retention of the content of soluble carbohydrates at the level of the grafting point, we can consider that the transport of the soluble carbohydrates towards the root is perturbed not only by incompatibility, but also by the grafting, which determines the retention of soluble carbohydrates at the level of the joint area.

The results regarding the content in total nitrogen underline a higher quantity of total nitrogen at the variety grafted on the graft carrier *P.F. Renclod green* comparing with the results obtained in the varieties grafted on the graft

carrier *Prunus cerasifera*. The highest quantity of total nitrogen was accumulated at the level of the grafting point and in the graft carrier. At the level of the graft, the maximum content was 0.63g/100g s.u. at the variety grafted on the graft carrier a *P.F. Renclod green*, respectively 0.42 g/100g s.u. at the variety grafted on *Prunus cerasifera* (table 2). In the graft, at the variety grafted on *Prunus cerasifera*, the content of total nitrogen had lower values comparing with the variety grafted on *P.F. Renclod green*, the values being between 0.57 g/100g s.u. at the variety Centenary and 0.58 g/100g s.u. at the variety Gras ameliorat.

As for the variety grafted on *P.F. Renclod green*, the highest value was underlined in the varieties Stanley with 0.58 g/100g s.u., and the lowest value by the variety Tuleu timpuriu with 0.37 g/100g s.u.

The values obtained in the trees in the second year of vegetation underlines, in the case of the compatible variety grafted on *P.F. Renclod green*, some content of total nitrogen in the graft close to the one in the graft carrier (table 2), however lower than in the grafting point.

Table 1

Sugar content average values on Stanley,Centenar, Gras ameliorat, Tuleu Timpuriu plum cultivars

Scion/rootstock	2 cm above union (mg/g DW)	on the union (mg/g DW)	2 cm below union (mg/g DW)
Centenar/<i>Prunus cerasifera</i>	30,46	37,56	28,34
Tuleu timpuriu/<i>Prunus cerasifera</i>	32,48	39,04	29,34
Gras ameliorat/<i>Prunus cerasifera</i>	31,79	38,13	28,97
Stanley/<i>Prunus cerasifera</i>	34,66	36,11	35,46
Centenar/<i>P.F. Renclod verde</i>	25,67	29,11	30,11
Tuleu timpuriu/<i>P.F. Renclod verde</i>	24,67	25,33	25,56
Gras ameliorat/<i>P.F. Renclod verde</i>	27,17	27,26	27,81
Stanley/<i>P.F. Renclod verde</i>	26,13	27,66	28,47

DW – dry weight

Table 2

Nitrogen content average values on Stanley,Centenar, Gras ameliorat, Tuleu Timpuriu plum cultivars

Scion/rootstock	2 cm above union (g/100 g DW)	on the union (g/100 g DW)	2 cm below union (g/100 g DW)
Centenar/<i>Prunus cerasifera</i>	0,38	0,41	0,39
Tuleu timpuriu/<i>Prunus cerasifera</i>	0,37	0,43	0,44
Gras ameliorat/<i>Prunus cerasifera</i>	0,39	0,41	0,40
Stanley/<i>Prunus cerasifera</i>	0,58	0,65	0,67
Centenar/<i>P.F. Renclod verde</i>	0,57	0,63	0,66
Tuleu timpuriu/<i>P.F. Renclod verde</i>	0,58	0,64	0,69
Gras ameliorat/<i>P.F. Renclod verde</i>	0,59	0,65	0,68
Stanley/<i>P.F. Renclod verde</i>	0,37	0,41	0,42

DW – dry weight

In the case of the variety grafted on *Prunus cerasifera*, the difference between the content of total nitrogen in the graft, graft carrier and grafting point is much higher, which underlines a remake not exactly appropriate of the timber vessels.

Determining the content of brute protein underlines a higher quantity of protein in the varieties grafted on *P.F. Renclod green* compared with the ones grafted on the graft carrier *Prunus cerasifera* (table 3). At the level of the graft, it was noticed a lower content of brute protein than in the point of graft and graft carrier. At the level of the grafting area, the maximum content of brute protein at the varieties grafted on *Prunus cerasifera*, was 4.06g/100g.s.u. variety Stanley. In the case of the variety grafted on *P.F. Renclod green*, the maximum value of the content of brute protein in the first year of vegetation was 4.06g/100g s.u.

Table 3

Crude protein content average values on Stanley,Centenar, Gras ameliorat, Tuleu Timpuriu plum cultivars

Scion/rootstock	2 cm above union (g/100 g DW)	on the union (g/100 g DW)	2 cm below union (g/100 g DW)
Centenar/<i>Prunus cerasifera</i>	2,38	2,56	2,44
Tuleu timpuriu/<i>Prunus cerasifera</i>	2,31	2,69	2,75
Gras ameliorat/<i>Prunus cerasifera</i>	2,44	2,56	2,50
Stanley/<i>Prunus cerasifera</i>	3,63	4,06	4,19
Centenar/ <i>P.F.Renclod verde</i>	3,56	3,94	4,13
Tuleu timpuriu/ <i>P.F.Renclod verde</i>	3,63	4,00	4,31
Gras ameliorat/ <i>P.F.Renclod verde</i>	3,69	4,06	4,25
Stanley/ <i>P.F.Renclod verde</i>	2,31	2,56	2,63

DW – dry weight

CONCLUSIONS

1. The biochemical studies done in the varieties of plum grafted on the two graft carriers, underline the influence of the phenomenon of incompatibility on remaking the vascular continuity among the grafted partners.

2. The differences regarding the contents of soluble carbohydrates between the two varieties suggest the existence of some structural anomalies at the level of the conductive tissues in the case of the incompatible variety. These anomalies determine the retention both of soluble carbohydrates and proteins, which are synthesized in the aerial part of the trees.

3. The influence of the phenomenon of incompatibility was also underlined in the case of the circulation of nitrogen in the content of total nitrogen higher at the level of grafting point, which underlines the fact that, at the level of the xylem vessels, there are some modifications of structure.

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