

**UNIVERSITY OF CRAIOVA
FACULTY OF HORTICULTURE**

DOCTORATE THESIS ABSTRACT

**RESEARCHES CONCERNING SOME GRAFT/ROOTSTOCK BIO-
SYSTEMS FOR THE PLUM CULTIVATED IN THE CENTRAL
ZONE OF OLTENIA**

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THE IMPORTANCE

Plum is part of the Rosales order, Rosaceae family, Prunoideae sub-family, Prunus L. gender, which includes a lot of species and varieties, most of them originated from the north hemisphere temperate zone.

Due to the low-keyed requirements according to the climate and soil factors, this species has met a large spread in the sub-Carpathian hills, filling land almost improper for other agricultural cultures and becoming the main source of being for people from that area.

Plums are really appreciated under both natural (fresh or dry form) and prefabricated forms (jam, marmalade, compote, jelly, liqueurs, plum brandy). Compared to the rest of the kernelled fruits, plums are more appropriate to be refrigerated, especially in sugar syrup.

Plum can be easily multiplied with drajons and engrafted on the most common graft – apricot, fact that had contributed to the his spread and maintenance in culture. This species it is characterized by a quick growth, early entrance in fruit (3-4 years from planting), large productions and yearly maintenance.

Due to the large number of varieties with different periods of fruits maturation, the consuming season is extended over a long period (the beginning of June – the end of September).

It is a rustic species which has results even with the minimal agrotechnics conditions and this is the reason why it had spread so much in the populations' gardens.

THE SCOPE AND THE AIMED OBJECTIVES

The conducted researches has aimed to observe de the bio-system bearing for some graft/rootstocks for the plum cultivated in the central zone of Oltenia, in order to reconsider and promote this culture in the conditions of high productivity and superior fruits quality, for its streamline.

In order to achieve this purpose, we established the following objectives:

- to determine the growth strength for the plum graft/rootstocks bio-systems, in the central zone of Oltenia's ecological conditions, in order to establish a productive and efficient cultivation system
- to evaluate the radicular system for the graft/rootstock mixture taking into consideration the bio-system elements and the edafic factor
- the bearing in the fructification process and to establish the production quality for the central zone of Oltenia graft/rootstocks combinations

THE BIOLOGICAL MATERIAL AND METHODS USED

THE BIOLOGICAL MATERIAL

The researches were carried out during the 2006-2008 years, on a plantation established in 1995, when the plants had 12-14 years old.

The biological material used for this paper is composed of 19 plum varieties, from which 9 varieties – Ialomita, Centenar, Flora, Carpatin, Valcean, Tita, Pescarus, Dambovita and Stanley – engrafted on four rootstocks – Otesani 8, Pixy, Miroval and Rosior văratic, and 10 varieties – Diana, Silvia, Pitestean, Minerva, Tuleu gras, Renclod Althan, Alina, Valor, Record and Anna Spath – engrafted on three rootstocks – Otesani 8, Pixy, Miroval.

THE RESEARCH METHODS

The methods used for this research during the three studying years had the following objectives:

1. In order to establish the culture assortment based on the graft/rootstock bio-system growth strength, in the central zone of Oltenia's ecological conditions – has been noticed the following observations:
 - a) biometrics measurements
 - b) growth and fructification's plant stage development
 - c) record of the rootstocks drajons capacity
2. In order to evaluate the radicular system for the graft/rootstock combination, according to the bio-system elements and the edafic factor – it has been studied the radicular system using the following methods:
 - a) the profile method (Oscamp - Dragavtev)
 - b) the skeleton method (Hels - Kolesnikov)
3. In order to observe the varieties conduction in the fructification process and the production quality for the graft/rootstock combinations in the central zone of Oltenia – has been determined:
 - the annual production of fruits
 - the fruits quality
 - the fruits characteristics
4. In order to establish the plum varieties and rootstocks assortments for the cultivation in the central zone of Oltenia – it has been taken into consideration the recording, the calculation and the correlation of the climate data with the growth and fructification processes (temperature, precipitations, the air relative humidity, the period of sun brightness etc.)

THE ANALYSIS AND INTERPRETING METHODS

Across this paper were used different methods of mathematical statistics analysis for the results. The main statistics parameters (arithmetical media, the standard deviation, variation, correlations, regressions etc.) was determined using the computer programs MS EXCEL and CSS.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS CONCERNING THE PLUM VARIETIES CONDUCTION IN THE CENTRAL ZONE OF OLTENIA

The study performed on several plum varieties conduction in the central zone of Oltenia has pointed the agro biological and economical value reported to the existing environment conditions. Based on the determinations effectuated on the different types of manner of presentation, it was created the premise of choosing some varieties with optimum conductions and their promotion in an valuable assortment for the future.

- the climate condition in the area are in general favorable to the plum cultivation (10,8 C annual average temperature; 558 mm average sum of annual precipitations; rare temperatures and precipitations during the blossom which affects the fructifications; the air relative humidity between 66 and 80%, 2275 hours annually the sun brightness duration);

- the edafical conditions are favorable, as the soil is brown reddish, easily pseudogleizat, baticaric, with poor acid reaction (pH=5,-6,6), medium humus contains, medium supplied with total nitrogen and good enough with phosphorus and potassium.

a) concerning the growth and fructifications stage of development

- the start to vegetation, marked by the beginning of burgeon distending, takes place when the sum of the degree active temperatures (temperatures > 5C) records values between 50 and 117 C, this values being influenced by the cold season duration;
- the plum varieties blossom in the central zone of Oltenia took place during the April month, when the recorded active temperatures was between 129-189 C, differences of blossoms being noticed both among the varieties and among the same variety, based on the graft/rootstock bio-system. The varieties which have the fastest blossom beginning are Diana, Silvia, Valcean, Ialomita, Centenar, Renclod Althan and Valor, while the ones with the latest blossom are Stanley, Dambovita, Anna Spath, Alina, Tuleu gras etc.;
- for the fruits maturations the sum of the active temperatures recorded varies between 1239 °C and 2732 °C, based on the year and the graft/rootstock. The varieties maturation order is: Diana, Ialomita, Minerva, Pitestean, Carpatin, Vâlcean, Silvia, Centenar, Renclod Althan, Tita, Flora, Alina, Pescarus, Dambovita, Tuleu gras, Stanley, Valor, Record and Anna Spath;
- the end of the vegetation period, marked by the leaves falling takes place when there are recorded active temperatures of 1575-3125 °C;
- the number of active temperatures days recorded during the vegetation period, for the three studying years (2006-2008) varies between 226 and 253 days.

b) concerning the plants growth

In the climatic and edafic conditions from the central zone of Oltenia where the study took place, it could be observed:

- the largest trunk section area can be found at the Valcean/Miroval bio-system (330 cm²), while the Pitestean/Otesani 8 bio-system has the smallest values (59 cm²);
- the trees crown diameter, obtained as average between the tress crown diameter value from a road and the trees crown diameter values between roads, has oscillated between 448 cm for Alina/Miroval bio-system and 229 cm for Pitestean/Otesani 8 bio-system
- the trees high recorded the maximum value at Renclod Althan/Miroval (501 cm), the lest value was observed at the Pitestean/Otesani 8 bio-system (281 cm)
- the crown volume has oscillated between 9 m³ at the Pitestean/Otesani 8 bio-system san 61 m³ al Alina/Miroval bio-system
- the highest land filling degree was noticed at Alina/Miroval bio-system (98, 4%), while the Pitestea/Otesani 8 bio-system presented the lowest ground filling degree (25,7%), thus it is highly recommended that the plantation distance ought to be different based on the bio-system
- the physiological fruits falling, for the 19 studied varieties, during the 3 studying years (2006-2008), varies among the varieties between 22,7% (Tita) and 76,1% (Diana), and among the associations graft/rootstock

between 34,9-50,2% for the varieties engrafted on Otesani 8 rootstock, 34,4-48,3% for the varieties engrafted on Pixy rootstock, 32,1-49,9% for the varieties engrafted on Miroval rootstock and 33,1-48,0% for the varieties engrafted on Roşior văratic rootstock.

c) concerning the drajons capacity

- the medium drajons capacity of the plum rootstock in the central zone of Oltenia conditions, varied between 10,4 drajons/tree (2008) and 15,6 drajons/tree (2007), among the rootstocks, the lowest drajons capacity was encountered at the Miroval rootstock (7,3 drajons/tree), and the highest at the Roşior văratic rootstock (16,6 drajons/tree);
- among the studied varieties, the highest number of drajons were found at the Renclod Althan variety (25,43 drajons/tree), and the opposite to the Diana variety (3,73 drajons/tree)

d) concerning the radicular system

The radicular system analyses using the profile method show that:

- at 1 m distance from the trunk, the total number of roots founded varied between 48 roots (Carpatin/Otesani 8) and 208 roots (Record/Miroval);
- at 2 m distance from the trunk, the three thickness categories roots sum was between 15 roots (Carpatin/Otesani 8) and 126 roots (Record/Miroval);
- the highest roots weight is on the soil depth of 0-60 cm (85%);
- the most roots with less than 3 mm diameter was observed at the Record/Miroval bio-system (314 roots); the ones with the thickness between 3 and 5 mm at the Stanley/summery Rosior bio-system (16 roots), and the ones with more than 5 mm diameter at the Carpatin/Pixy, Valcean/Miroval, Stanley/Miroval and Anna Spath/Pixy bio-systems (12 roots).

The radicular system analysis based on the skeleton method has pointed out that:

- the most developed radicular system was the Centenar/Roşior văratic bio-system, presenting the highest number of discovered roots (2283 roots);
- the 0-4 mm diameter roots was the most numerous at the Centenar/Roşior văratic (2180 roots) and the fewest at the Centenar/Otesani 8 (1056 roots);
- from the 4-10 mm thickness category, the most roots could be observed at the Stanley/Roşior văratic bio-system (93 roots), and the fewest at the Stanley/Otesani 8 bio-system (51 roots);
- the 10-30 mm in diameter roots category was found the most frequently at the Centenar/Miroval bio-system (27 roots) and the fewest at the Stanley/Otesani 8 bio-system (8 roots);
- the roots from the more of 30 mm category was founded more rarely, the limits were between 5 roots at the Stanley/Miroval bio-system and 0 roots at the Centenar/Miroval, Stanley/Pixy and Stanley/Roşior văratic bio-systems;
- generally, the most numerous roots from the first thickness category (0-4 mm) were disposed at the 1-2 m distance from the trunk, while at the rest of the categories, most of the roots were disposed at 0-1 m distance from the trunk.

- the highest radicular system weight was established at the Stanley/Miroval bio-system and was a little more over 4,5 kg;
- the highest weighting of roots (more than 94%) is from the 0-4 mm thickness category and most of the roots are 2 m distance from trunk disposed.
- based on the rootstock and the soil depth, the most numerous root were on the 20-40 cm depth spacing, except for the Pixy rootstock, where most of the roots can be found on the 0-20 cm line depth.
- concerning the distance from the trunk, the most numerous roots, taking into consideration their length, is at the 0-1 m distance for the Otesani 8 and Pixy rootstock, respectively at the 1-2 m trunk distance for the Miroval and Roșior văratic rootstocks, due to the fact that the 2 rootstocks (Miroval and Roșior văratic) present more voluminous crowns as a consequence to the strengthness of these rootstock.

e) concerning the fruits production

- in the central zone of Oltenia, on the brown reddish soil, plum varieties meet good fructifying conditions. The average fruits production recorded for the 19 varieties studied in the 2006-2008 period was 17,29 t/ha.
- the average fruit production was very different both from a variety to another (from 7,50 t/ha – Vâlcean to 30,57 t/ha – Renclod Althan) and among the same variety, based on the rootstock (from 3,07 t/ha – for the Minerva/Otesani 8 association, to 21,47 t/ha for the Minerva/Roșior văratic association).
- The Renclod Althan (30,57 t/ha), Pescarus (26,02 t/ha), Silvia (24,87 t/ha), Anna Spath (20,02 t/ha), Ialomita (19,14 t/ha), Tita (18,32 t/ha), Alina (18,01 t/ha), Record (17,7 t/ha) etc. varieties was proven to be very productive, superior to the Tuleu gras (14,10 t/ha), the standard variety for this zone.
- Among the rootstocks, the largest productions are obtained by engrafted the varieties with the Miroval species, followed by the Roșior văratic, Pixy and Otesani 8, at the same plantation distance. In the case of less strength varieties (Pixy, Otesani 8) must be used 4,0X2,0 m plantations distances, case in which the fruit productions are superior to the Miroval and Roșior văratic rootstocks.

f) concerning the fruits characteristics

- the studied plum varieties present fruits with morphological and chemical characteristics, with genetic determination, an even with major influence from the environment conditions;
- the varieties with fruits designed to be commercialized were loaded respecting the European Union standards FFV-29/1988, in the next groups:
- very big fruits (over 60 g) – Vâlcean, Record
- big fruits (40-60 g) – Renclod Althan, Silvia, Anna Spath, Diana, Dambovita, Flora, Carpatin, Tita
- medium fruits (20-40 g) – Centenar, Pescarus, Valor, Pitestean, Stanley, Minerva, Ialomita, Tuleu gras.
- The plum varieties are different by the chemical composition of fruits (contain of dry soluble substance and sugar)
- The dry soluble substance oscillated between 12,66% (Ialomita) and 23,10% (Stanley). The highest content of dry soluble substance was

discovered at several semi-undue and undue mature varieties like: Stanley (23,10%), Valor (22,68%), Record (20,36%), Anna Spath (20,33%), Renclod Althan (19,26%), Alina (18,40%). The sugar content (at all the 19 studied varieties) oscillated between 10,50% (Ialomita) and 19,17% (Stanley), the lowest values were recorded at the varieties with early maturation (Diana – 10,84%, Minerva – 12,66%, Flora – 12,75%, Valcean – 12,88%), while the highest values could be observed at the varieties with latish maturation (Valor – 18,83%, Record – 16,90%, Anna Spath – 16,87%, Renclod Althan – 15,98%).

- For the central zone of Oltenia are dignified the following varieties which can be included in the cultivate assortment:
- one assortment of varieties with mass consuming destination composed of varieties: Silvia, Anna Spath, Tita, Alina, Carpatin, Stanley, Centenar, Tuleu gras;
- one assortment of varieties for mixed destination (industrial and mass) composed of the varieties: Anna Spath and Stanley, and the varieties known in the area (Agen 707, Andreea etc).

RECOMMENDATIONS CONCERNING THE PLUM VARIETY PROPOSED FOR THE CENTRAL ZONE OF OLTENIA

For the intensive plum cultivation in the central zone of Oltenia it is recommended to use the Miroval rootstock for the 5,0X4,0 m distance for cultivation variety and Otesani 8 for the 4,0X2,0 m distance for cultivation.

According to the destination of the variety assortment it is recommended:

a) varieties with fresh fruits for consuming purpose

The ecological, technical and social conditions from the central zone of Oltenia are favorable for cultivation of some plum varieties which correspond with the national and international standards concerning the productivity and quality.

For the cultivation in intensive system, in the advantageous orchard exploitations and in the family's gardens it is recommended the next varieties, in the following proportions:

- Centenar	10%
- Carpatin	10%
- Silvia	10%
- Tita	10%
- Tuleu gras	10%
- Stanley	25%
- Anna Spath	25%

That specific assortment can be characterized by:

- the varieties present a high and constant echelon, big fruits (over 40 g, in the superior technological conditions), accepted on the international market, except for the Tuleu gras variety which substitute the size of the fruits with the special gustatory qualities.

b) varieties with mixed destination fruits

For the fruits processing industry it was considered suitable, recommending for the assortment, the following varieties: Anna Spath and Stanley, together with the varieties known in the area (Agen 707, Andreea etc.)

These varieties, beside of the fresh consuming, can be used for dehydrated or for industrialization in various forms. For alcohol processing (alcohol) are suitable especially those varieties which have a high content of dry soluble substance and sugar.