### **RESEARCH ARTICLE**

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# The Study of Adaptation of the New Peach Cultivars in the Agricultural Region of Vlora

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#### Abstract

Drupaceous fruits are placed in the first place in the species structure of Albania's farms. To anticipate problems in the development of arboriculture and market production, scientific institutions have started a research to find possible solutions for the development of this sector. This is the reason why through collaboration between, CTT Vlore & IAM Bari was made possible to bring from Italy during the years 2000-2001, 96 cultivars of peaches, plums, cherries, apricots, nectarines, almonds. These cultivars dominate the production markets of the Mediterranean countries. In this project were included 21 peach cultivars 10 years old, rootstocks, planting material of basic category, clear of viruses and other pathogens. As the main rootstocks were selected GF 677 and MRS 2/5.

To study the behavior, adaptability and productivity of the peach cultivars, in the warm coastal areas, specialists from the Agriculture University of Tirana and Center for Technology Transfer in Vlora carried out a number of tests and evaluations during a three year period.

At the end of the study it resulted that the cultivars with a very early maturation better adapted in the coastal areas were: 'Cardinal', 'May Crest', and 'Spring Crest'. The cultivars with early maturation and consolidated productivity were: "Red Haven", "Bolero", "Dixired", "Early Crest", "Iris Rosso". Cultivars with an average maturation period were: "Red Haven Bianca", "Red Top", "Regina Bianca", "Sun Crest". The most suitable cultivars with a delayed maturation period are considered: "Big Moon", "Domiziana", "Haile", "Laure", "Maria Delizia", "Rome Star", "Pontina" and "Red Cal". The only cultivar with a very delayed maturation is "Padana".

Keywords: cultivar, structure, collection, vegetative rootstock, regionalization.

#### 1. Introduction

Albania as a Mediterranean country offers excellent climate and soil conditions for the cultivation of different fruit tree species. According to foreign and Albanian researches, in this country are recorded more than 3225 different plant species while are widely cultivated 20 primary species and 15 secondary fruit tree species. In the national inventory of the fruit trees, the peach plant holds a very important place [8], [18].

The interest of the farmers for the peach species has increased in the last 15 years, thus making this plant a much demanded fruit in the Albanian horticulture and national markets. This general tendency follows the same trends as in the neighbor countries such as Italy or Greece [15], [12].

The developments in Albanian horticulture are focused on the work of scientific institutions,

diffusion of studies concerning the behavior of new cultivars, the ratio between traditional cultivars and their correct regionalization. It's also important to evaluate the data collected by researchers in countries that have similar climate conditions with Albania [17], [7], [2].

To resolve these problems during the years 2000-2001, were officially introduced from Italian certified orchards the best cultivars of peach, nectarine, apricot, cherries, almond, plum, grapevine and olive. This genetic material was planted in the Experimental Base of Shamogjin in the town of Vlora. In the new structure were also introduced some vegetative rootstocks such as GF677, GF 305, MRS - 2/5, Missour, Montclar etc [5], [14].

#### 2. Material and Methods

To test the suitability and diffusion of the new plant material, 21of the best cultivars of peaches and

nectarines in the main markets of the Mediterranean were selected. The mediator was the Mediterranean Institute of Bari that has been directing for 4 years a project of certification of the fruit species in our country. The collection of plant material was introduced through a formal agreement and financing partner institutions such as Italian Cooperation, CTT Vlore and IAM Bari, IMB Durrës and UB-Tiranë [2].

Before planting the new cultivars, was carried out the cleaning and unification of the soil through plowing the soil circa 31-37cm. After evaluating the nutritions, the organic matter, pH etc, of the soil, were created the profiles and taken samples for an analysis of the mechanical and nutritional indices in the depth of 0-20 cm, 21-40 cm and 41-60 cm [4].

These analysis of the laboratory of ISSoil\Tirana showed that the soil has an average mechanic composition and has an average content of organic matter. On the other hand is poor in  $N_2$ , but has average levels of  $K_2$  and  $P_2O_5$  and secondary mineral elements. The content of active lime is 3.85%, while the pH in the soil fluids is 7.1 ppm.

The minimal and maximal temperatures during the month of January reach +2.7 °C &+12°C, while the minimal and maximal temperatures for the month of July are +21.9°C and +36°C. During the year rains circa 826.5 mm in total. During the summer it rains circa 4.5-6%, making it a necessity to fulfill the water balance with constant irrigation [5].

### 2.1 Monitored indices

The experiment for the evaluation of the adaptability of the new peach cultivars is carried out in three consecutive years during the time frame 2009-2011 in accordance with the methodology created by specialists of the University of Agriculture in Tirana. The plants are 9 year old and have been producing for 4 years. The cultivars are planted in rectangular plots and the planting distance is 4x4 m. The form of the crown is that of a cup and there are 657 plants planted for unit/area. The rootstock used is GF 305 which has been used previously with excellent results in Albanian orchards. [9]

The main indices under study were:

- The average growth of the diameter of the trunk 20 cm above the grafting point

The average length of the growth of the scions
The period of the beginning and ending of the

flowering

- The period of maturation of the fruits
- The average weight of the fruits

- Evaluation of the big diameter/D and the small diameter/d of the fruit

- Correlation between the diameters D and d over the weight of the fruit

- Productivity kg/plant;

- The content of sugar, dry matter, vitamin C, and acidity [11].

### **3. Results and Discussion**

For the analysis of the indices provided in the methodology, three plants were marked. The data was provided in the determined deadline and was registered in the field notebook. Below we are analyzing some of the main results of this three year experiment.

### The annual growth of the trunks diameter/AST

To evaluate the annual growth of the trunks diameter/AST, the measurements are carried out twice a year (before the beginning of the vegetation and after the leaves have fallen) 20 cm above the grafting point. The calculation of the growth is considered a ratio of the average of both measurements and is expressed in mm. The standard for the annual growth of the trunk predicts three levels:

- Cultivars with a small annual growth of the trunk/AST: 7-10mm

- Cultivars with an average annual growth of the trunk/AST: 10,1-14 mm

- Cultivars with a strong annual growth of the trunk/AST: >14,1mm

The reference cultivar is "Red Haven", whose average growth is 10.1-14mm/year. The cultivars under and above this level are considered with a strong or small annual growth. [14],[1]

Based on this reference, the cultivars under study are classified as follows:

- Cultivars with a strong annual growth of the trunk: "Haille"/14.9 mm.

- Cultivars with an average growth of the trunk: "Iris Rosso"/13.6 mm, "May Crest"/11.1 mm, "Maria Delizia"/10.5 mm, "Padana"/12.4mm, "Red Haven"/12.1mm, "Red Cal/13.6mm, "Sun Crest"/10.9 mm, "Regina Bianca"/13.6

- Cultivars with a small annual growth: "Big Moon"/9.6mm, "Bolero"/9.8mm, "Cardinal"/7.5mm, "Dixie Red"/7.2mm, "Early Crest"/7.8 mm, "Laure"/9.5 mm, "Pontina"/9.2 mm, "Red Haven Bianca"/9.1 mm, "Red Top"/9.4 mm, "Rome Star"/8.7 mm, "Spring Crest"/9.6 mm , "Domiziana" /9.85 [13].



Figure 1. The average annual growth of the trunk's diameter, 2009-2011 in mm

The evaluation of the vegetative growth was carried by measuring 50 scions/cultivar and calculating the average linear length. Three levels of growth were predicted:

-Cultivar with a small vegetative growth, in this case the average length of the scions is <40cm.

-Cultivar with an average vegetative growth, in this case the average length of the scions is 41.1-60 cm

-Cultivars with a strong vegetative growth, in this case the average length of the scions is >60.1 cm

To verify this index was measured the length of 150 scions/cultivar. These samples were taken by the three selected plants, during the three consecutive years. The average linear length is the ratio of the total length /number of the scions and is measured in cm. The results obtained prove that, there is a linear

correlation between the volume growth and the average linear length of every cultivar under the condition that the pruning applied is the same. [1],[15]

According to this test the peach cultivars under study are classified as follows:

- Cultivars with a strong vegetative growth: "Red Cal", "Domiziana", "Sun Crest"
- Cultivars with an average vegetative growth:
  "Dixie Red", "Early Crest", "Red Haven",
  "Cardinal", "Bolero", "Big Moon", "Haille",
  "Red Haven Bianca", "May Crest", "Maria Delizia", "Red Top", "Regina Bianca",
  "Rome Star", "Spring Crest".
- Cultivars with a small vegetative growth: "Laure", "Padana", "Iris Rosso", "Pontina". [11].



Figure 2. The average annual growth of the scions, in cm and %

### Evaluation of the flowering period of the peach cultivars/2009-2011

The period of the beginning of the flowering period is considered when have bloomed 7-10% of the flowers while the period of the ending of the flowering period is considered when have bloomed 80-85% of the flowers in the marked branches. The reference cultivar for the evaluation of the flowering period is the cultivar "Red Haven" that in warm agricultural regions flowers in 11-15 March. [3], [12]

According to the period of flowering the regional comparison is the follows:

- Cultivars with a very early flowering/early flowering period, that flower between 01- 10/03 are: "Cardinal", "May Crest", "Spin Crest", "Bolero", "Dixie Red", "Early Crest", "Iris Rosso"

- Cultivars with an average flowering period, that flower between 11-20/03: are "Red Haven", "Red Haven Bianca", "Red Top", "Regina Bianca", "Sun Crest"

- Cultivars with a late flowering period, that flower between 21-31/03 are: "Big Moon", "Domiziana", "Halle", "Laure", "Maria Delizia", "Pontina", "Red Cal", "Rome Star", "Padana". [13]



Figure 3. Evaluation of the flowering period of the peach cultivars, 2009-2011

### Evaluation of the maturation period of the peach cultivars, 2009-2011

The period of maturation of the cultivars has few changes through the years, these changes are

mainly caused by climate changes. The reference cultivar for the evaluation of the maturation period is the cultivar "Red Haven" which has an average maturation period, and usually matures between 01-15 July. [17], [10].



Figure 4. Evaluation of the period of maturation of the peach cultivars, 2009-2011

Based on the maturation period the cultivars are categorized as with very early maturation period or early maturation period, if the cultivar matures before the cultivar "Red Haven", with average maturation period if mature during the same time frame and with delayed or very delayed maturation period if the cultivar under sutdy matures after the standard cultivar. [7], [8]

The maturation period the cultivars under study are the following:

- Cultivars with a very early maturation period, that mature between 15/05-15/06 are: "Cardinal", "May Crest", "Spring Crest"
- Cultivars with an early maturation period, that mature between 16/06-15/07 are: "Red Haven", "Bolero", "Dixie Red", "Early Crest", "Iris Rosso"
- Cultivars with average maturation, 16/07-15/08, "Red Haven Bianca", "Red Top", "Regina Bianca", "Sun Crest"
- Cultivars with a delayed maturation period, that mature between 16/08-10/09 are, "Big Moon", "Domiziana", "Halle", "Laure", "Maria Delizia", "Pontina", "Red Cal", "Rome Star"
- The only cultivar with a very delayed maturation, period that matures after 11/09 is "Padana"

The fact that the maturation period of the cultivars under study does not have deviations during the three years, proves the stability of the basic characteristics and suitability of these cultivars for the climate and soil conditions of our country. [13]

Evaluation of the average productivity of the cultivars /2009-2011.

The measurement of the productivity was carried out during the period of harvesting, directly in the orchards, and in accordance with the period of maturation for every cultivar. For this purpose were used different materials such as: analytical scales, calibrator, notebooks, pencils, workers, crates etc. The evaluation of the productivity kg/plant is carried out through the comparison with the cultivar "Red Haven" which is considered a cultivar with high productivity that offers 41-50kg/plant. [10]

The analysis of the productivity indices during the three years and the average productivity are estimated as follows:

- Are considered cultivars with a very high productivity or over 50 kg/plant the cultivars: "Big Moon", "Regina", "Bianca", "Red Cal"

- Are considered with a high productivity or 41-50 kg/plant the cultivars: "Bolero", "Dixie Red", "Domiziana", "May Crest", "Padana", "Pontina", "Red Haven", "Red Top", "Spring Crest", "Sun Crest", "Rome Star".



Figure 5. Productivity for every cultivar, 2009 – 2011 in kg/plant

- Are considered with an average productivity or 31-40 kg/plant the cultivars: "Cardinal", "Early Crest", "Halle", "Iris Rosso", "Laure", "Maria Delizia", "Red Haven Bianca"
- Are considered cultivars with low productivity or 21-30 kg/plant. Practically there aren't evidenced any cultivars that offer a productivity that low. [13], [15]

Evaluation of the average weight of the fruit

The regressive analysis of the influence of the fruit diameters on the average weight of the fruit, proves that: for the Fisher index of 36.84 the value of the diameters influences directly the weight of the fruit. To determine the average weight of the fruit, were casually selected 100 fruits, which were weighed with an analytical scale and the data was transferred on a computer. On this sample were carried out calibric measurements and were determined the values of both diameters D and d. [16]

The varietal standard for the weight of the peach provides 4 levels of measurement, more specifically: the fruits could have a small weight or less than130 gr, an average weight or circa 131-160 gr, a big weight or cica 161-190 and a very big weight which is more than 191 gr. [14], [1]

Based on this analysis, the cultivars under study are divided as follows:

- There aren't any cultivars with a weight of 161-190 gr.

- The cultivars with an average weight or circa 131-160 gr are: "Red Haven Bianca" that weights146.9 gr, "Big Moon" that weights 144.9 gr, "Cardinal" that weights 140.8gr, "Regina Bianca" that weights 139.5 gr, "Bolero" that weights 139.2gr, "Iris Rosso" that weights 135.5 gr, "Early Crest" that weights 135.2 gr, "Red Cal" that weights 130.9gr, "Dxiered" that weights 130.5 gr
- The cultivars with a small weight or that weight less than 30 gr are: "Domiziana" that weights 129.8gr, "Haile" that weights 120.7 gr, "Laure" that weights 128.3 gr, "May Crest" that weights 122.2 gr, "Maria Delizia" that weights 125.9 gr, "Padana" that weights 108,8gr, "Pontina" that weights 125.2gr, "Red Haven" that weights 123.2gr, "Red Top" that weights 126.9gr, "Rome Star" that weights 108.7gr, "Spring Crest" that weights 119.1gr, "Sun Crest" that weights 124.1gr. [13].



Figure 6. The average weight of the fruits, 2009-2011

# Evaluation of the influence of the diameters **D** and **d** on the weight of the fruit

To evaluate the influence of the diameters D and d on the fruit weight was applied the formula Y=76.13+8D-0.584d. For this purpose were casually

selected 30 fruits/cultivar, and were carefully measured both diameters D and d. For the values of the two diameters were found the means/ averages and was created a table, while the impact is indicated in the table below.

Indices	Coefficient	T Stat	P-value
Free Variation	76.13566015	12.12787973	4.25398E-10
D (cm)	8.000129466	0.926668221	0.366357884
d-cm	-0.583898028	-0.06635423	0.947827262

According to the formula above, if the D value would increase with 1 cm and all the other factors would remain constant, the weight of the fruit would increase by 8gr. The opposite happens with the d value, this means that if d increases 1 cm and all the other factors remain constant the weight of the fruit would decrease by 0.584gr.

Table 2.	Statistical	analysis c	of the influen	ce of the d	liameters (	$(\mathbf{D} \text{ and } \mathbf{d})$	on the average	weight of t	he fruit
Lable 2.	Statistical	anarysis c	n the minuen		manneters (		on the average	weight of t	ne nun.

No	Statistics of the regression			
1.	R	0.896488199		
2.	$R^2$	0.803619109		
3.	Standard Error	4.823120358		
4.	Observations	21		
5.	Fisher Value	36.84		

- R=0.896 shows a strong positive connection between the influence of the diameters and the weight of the fruits
- $R^2 = 0.80$ , means that 80% of the fruit weight is justified with the length of the diameters
- The Fisher Value= 36.84 is bigger than critic Fisher Value, this means that the length of the diameters of the fruit influences its weight.

According to the measurements carried out for the diameters D and d of the fruits was observed that:

- The cultivars with the diameter of the fruit D1>d2 are: "Big Moon", "Bolero",

"Cardinal", "Domiziana", "Early Crest", "Haile", "Iris Rosso", "Laura", "Maria Delizia", "Red Haven Bianca", "Red Cal", "Red Top", "Red Top", "Regina Bianca", "Rome Star", "Spring Crest"

- The cultivars with the fruit diameter D1<d2: "Dixie Red", "May Crest", "Sun Crest"
- The cultivars with the diameter of the fruit D1=d2: "Padina", "Pontina", "Red Haven". [13].



Figure 7. The fruit diameters according to the cultivars, 2009-2011

## Analysis of the main chemical components of the fruit

To determine the main chemical components of the fruit was carried out a laboratory analysis of the samples of 30 fruits/cultivar. The samples were picked during the harvesting. The main components analyzed were: the percentage of sugar, acidity, vitamin C and dry matter.[16]

### The content of Vitamin C in the fruit

To evaluate the content of Vitamin C in 1ml sample are used 3 levels of evaluation: low content of Vitamin C, average level of vitamin C and high level of vitamin C. According to the analysis the content of vitamin C varies based on the cultivar, this characteristic is connected to the period of maturation and is determined by the quality of the variety. According to the results obtained from the three year laboratory analysis of the content of Vitamin C of the cultivars was determine that:

- There aren't any cultivars with a low level of the vitamin c or less than 6.5 mlgr/l vitamin C
- Cultivars with an average level of vitamin C of circa 6.6-8.5 mlgr/l are: "Bolero", "Domiziana", "Haille"
- Cultivars with a high levels of vitamin C of more than 8.51mlgr/l are: "Big Moon", "Cardinal", "Iris Rosso", "Laure", "Red Haven", "Sun Crest", "Red Cal", "Maria Delizia", "Red Top" etc. [18].



Figure 8. The content of vitamin C in the peach cultivars, 2009-2011 in mlgr/l.

### Evaluation of the content of acidity and dry matter.

To evaluate the content of sugar, acidity and dry matter in the fruit the measurements are conducted on a sample of 30 fruits/cultivar. This evaluation was conducted in accordance with the standard methodologies which take into consideration three levels of evaluation: low content, high content and average content. [9]

The sugar content of the cultivars under study is the following:

- Cultivars with high sugar content or less than 12% are: "Padana", "Big Moon", "Regina B", "Laure", "Red Haven"
- Cultivars with an average content of sugar or circa 10.1-12% are: "Red Cal", "Dixie Red", "Maria Delizia", "Haile", "Domiziana", "Cardinal", "Bolero", "Pontina", "May Crest", "Red Haven Bianca", "Red Top", "Rome Star"
- Cultivars with low sugar content or circa 8.5-10% are: "Spring Crest", "Sun Crest", "Early Crest", "Iris Rosso". [7], [8]

For the evaluation of the acidity content in the fruit are considered three levels of evaluation: low or circa 5-8gr/l, average or circa 8.1-10 gr/l and high or more than 10.1gr/l. This analysis proves that the peach cultivars are classified as below:

- Cultivars with high acidity content are: "Big Moon", "Early Crest", "Haile", "Laura", "Padana", "Red Cal", "Red Top" etc.
- Cultivars with low acidity content are: "Iris Rosso", "May Crest", "Dixie Red" etc

The content of the dry matter in the fruit varies for each cultivar. The content of dry matter is determined by the period of maturation where the main rule is: The cultivars with very early/early maturation period have lower percentages of dry matter and the opposite happens with cultivars with an average/delayed maturation period where the percentage of dry matter in the fruit increases but within some average levels.[4], [5]

Are considered cultivars with low content of dry matter, when the dry matter levels are between 5-10%, with an average content of dry matter those when the dry matter levels are between 10.1-15% and with a high content of the dry matter, in case its levels are

over 5.1%. Based on the results of the tests the peach cultivars can be classified as follows:

- The cultivars with low levels of dry matter are: "Cardinal", "Dixie Red", "Early Crest", "May Crest", "Red Haven Bianca", "Pontina", "Spring Crest", "Red Haven", "Domiziana".
- The cultivars with an average content of dry matter are: "Bolero", "Dixie Red", "Iris

Rosso", "Padana", "Red Top", "sun Crest", "Bolero", "Haile", "Laura", "Maria Delizia", "Red Cal", "Rome Star".

The cultivars with high content of dry matter are: "Haile", "Maria Delizia", "Pontina", "Red Haven", "Red Cal", "Regina Bianca", "Regina Bianca", "Rome Star". [1], [6].



Figure 9. Average content of the sugar, acidity and dry matter in the fruits.

From the three year analysis on adaptability, growth indices and productivity, the 21 peach cultivars can be classified as follows:

- Cultivar with a very high productivity or over 50 kg/plant are: "Big Moon", "Regina Bianca", "Red Cal"
- Cultivars with a high productivity or 41-50 kg/plant are: "Bolero", "Dixie Red", "Domiziana", "May Crest", "Padana", "Pontina", "Red Haven", "Red Top", "Spring Crest", "Sun Crest", "Rome Star"
- Cultivars with average productivity or 31-40kg/plant are: "Cardinal", "Early Crest", "Halle", "Iris Rosso", "Laure", "Marie Delicia", "Red Haven Bianca"

### 4. Conclusions

As main conclusions of the study we can highlight:

- The new peach cultivars under study are very adaptable in the Mediterranean conditions of our country

- The rootstock used GF 305, insures a great soil adaptability and a good adaptability with the scion with few exceptions
- The most adaptable cultivars for diffusion in the warm climate conditions of our country are: "Big Moon", "Regina Bianca", "Dixie Red", "May Crest", "Red Top", "Red Haven", "Spring Crest", "Cardinal", "Red Haven Bianca", Regina Bianca"
- As not very adaptable cultivars are considered: "Iris Rosso", "Pontina", "Sun crest", "Rome Star", etc

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